Serious games combined with wearables in battling pediatric obesity

The medical professionals' perspective

Masterthesis Health Sciences

M. Scholten

Dr. Ir. A.A.M Spil

Dr. J.G. van Manen

UNIVERSITY OF TWENTE.

Masterthesis

Surname	Scholten
Given name	Mireille
Email	m.scholten-3@student.utwente.nl

Master program	Health Sciences
Track	Health Services and Management / Innovation in Public Health
Faculty	Science and Technology (TNW)
Date	12-07-2018

First supervisor	Dr. Ir. A.A.M Spil
Faculty	Behavioral, Management and Social Sciences
Department	Industrial Engineering and Business Information Systems
Email	a.a.m.spil@utwente.nl

Second supervisor	Dr. J.G. van Manen
Faculty	Behavioral, Management and Social Sciences
Department	Health Technology and Services Research
Email	j.g.vanmanen@utwente.nl

Acknowledgements

During the process of writing this thesis and executing the accompanying research, I've received aid and support from several people, and I would like to take this opportunity to express my gratitude to them. First of all, I would like to thank my supervisors Dr. Ir. A.A.M. Spil and Dr. J.G. van Manen for their enthusiastic feedback, help and motivation. I would also like to thank Dr. B.J. Thio, dhr. J. Geerdink and the physical therapists and pediatrician for their willingness to give me insight in their professions. Finally, I would like to thank my friends, Roland and my parents for the brainstorm sessions, advice, proofreading and their support during this journey.

1. Abstract

Introduction. The number of people with obesity or overweight in the modern world is increasing, with the number of children aged 5-19 categorized as obese or overweight exceeding 340 million individuals worldwide. Obesity is paired with psychological, physical and environmental issues that might well persist into adulthood. Treatment of obesity is aimed at changing the lifestyle to increase physical activity and increase the consumption of healthy foods. Through the years, these lifestyle changes have been aided by a range of technologies. Currently, wearables and serious games seem to be the next innovation. Serious games are used to track the progress of a participant and provides feedback in a playful learning environment. As research shows that consumers and children experience an overall positive attitude towards serious games and wearables, this research aims to assess the opinion of the medical professional, the physical therapist, tasked with treating children with obesity.

Methods. A questionnaire has been set-up based on a literature review exploring the impact of obesity and current developments in the area of serious games and wearables. The questionnaire included questions with an open character to get insight in the current situation, the respondent's stance on wearables and serious games and introduced a hypothetical game called Healthy Buddy. The gathered data was complemented with information gathered from a casual conversation with 2 graduates (MSc) in the fields of Psychology and Health & Society, and an interview with a pediatrician.

Results. A total of 8 physical therapists answered the questionnaire. All of them were enthusiastic about the possibility of implementing serious games combined with a wearable into their treatment sessions. They felt that the combination of serious games and wearables would provide the child with visual cues of its progress and ensure the physical therapist has control over and insight in the lifestyle of the child. However, they felt that the game should be adjusted to the individual goals of the child, should offer variation, challenges and engage peers. Furthermore, the influence of parents, the possibility of the child sabotaging the process, the game being only a hype for a short period of time and an increase of screen time were mentioned as factors that require further consideration.

Conclusion. Physical therapists specialized in children were enthusiastic about implementing serious games combined with wearables in their treatment sessions. They felt the technology makes it possible for children to see their progress while therapists (and parents) are able to have insight and control on progress and are able to provide feedback. They felt the technology produced a trendy solution based on the wishes of modern society.

Table of contents

2. Introduction

Obesity and overweight have been and currently are a prevalent problem in the modern world. According to the WHO, worldwide obesity has nearly tripled since 1975. In 2016 more than 1,9 billion adults were overweight, with 650 million of this group being categorized as obese. Also, over 340 million children aged 5-19 were considered overweight or obese in that same year. (World Health Organization, 2017)

Obesity is defined by the World Health Organization as: *"abnormal or excessive fat accumulation that may impair health"* [1], and by the Centers for Disease Control and Prevention as *"Weight that is higher than what is considered as a healthy weight for a given height"*[2]

Obesity is caused by a disbalance between consumed calories and expended calories (World Health Organization, 2017). This disbalance is the result of, on one side, an increase in the consumption of energy-dense foods with a high fat and glucose level, and on the other side a decrease in physical activity due to sedentary forms of work, increased availability of transportation methods and increasing urbanization. (National Institute of Diabetes and Digestive and Kidney Diseases, 2012)

It has become visible over time that obese children have a very high probability of becoming obese adults later on in life, which can be paired with several psychological, physical and environmental issues which will be explained later on (Kar, Dube, & Kar, 2014). Therefore, it is important to tackle obesity at a young age.

Many interventions have been developed for people with obesity or overweight based on several principles that should improve the physical activity, limit the daily calorie intake or provide information. Kar et al. mentions different types of interventions that influence different aspects of a child's life (Kar, Dube, & Kar, 2014). These types include for example;

- Provide children and parents with information about obesity and a healthy lifestyle.
- Include prominent people and local champions to promote a healthy lifestyle.
- Organize community and family involvement to promote a more active lifestyle and ensuring the intervention is more family-centered instead of child-centered.
- Increase the importance of physical activity in schools.
- Ban unhealthy food from school canteens.

[1] http://www.who.int/mediacentre/factsheets/fs311/en/
[2] https://www.cdc.gov/obesity/adult/defining.html

- Restrict screen time and encourage physical activity.
- Decrease the tax on fruits and vegetables.

However, recent developments showed that the youth can be influenced via the digital world. The recent rage of Pokémon Go and its effects on physical activity have been researched by Althoff et al. They found that after the release of Pokémon Go, millions of people have increased their physical activity, spent more time outside and had more social contact with others. The research showed that the research population, independently of prior activity level, age, weight status and gender increased their activity during the research period. Results suggest that the game even reaches sedentary, obese and older users, which are often seen as populations for which other interventions have been ineffective in promoting an increase in physical activity. (Althoff, White, & Horvitz, 2016)

The fact that Pokémon Go seemed effective in reaching populations that are normally unaffected by “normal” interventions, might pave the way for new subtypes of interventions, like gamification. Gamification is defined by Deterding et al. as *“the use of game design elements in non-game context”* (Deterding, Khaled, Dixon, & Nacke, 2011). Spil et al. mentions that there is an opportunity in combining gamification with wearables. Currently, there are many health improvement applications available for smartphones, however, they are not yet totally fitted for combined use with wearables. (Spil, Thiebes, & Sunyaev, 2017) The adoption of wearables like smartwatches is trending, but mostly in populations of people that already live a healthy lifestyle and use the wearable to quantify and control their progress. There is however a far broader opportunity for implementation, like for patients with chronic illnesses, who could use the wearable to collect data over a longer period of time to monitor their disease. Wearables could provide positive impact on progress of patients by providing instant feedback, being practical and “wearable”, and being able to collect and process information while being away from home. (Deterding, Khaled, Dixon, & Nacke, 2011)

2.1 Research question

Currently, researchers from the University of Twente together with the Saxion, Medisch Spectrum Twente (MST) and Zorggroep Twente (ZGT) are researching possibilities for implementation of innovative technologies in medical practice to improve patient health care (University of Twente - Pioneers in Health Care, sd). One of these researches aims to study the effects of wearables in combination with serious games to battle obesity in children. Pediatricians from both the MST and the ZGT experience an increase in the number of children with obesity they see during their consults. Gamification, the use of serious games, gets more and more traction as being the next generation of interventions attempting to change the behavior of people. Therefore, the MST and ZGT want to develop a serious game combined with the use of a wearable together with the UT and the Saxion, which will help children with obesity to be more active during their treatment.

According to available scientific literature, both the influence of serious games and the influence of wearables have been studied and proved to have a positive impact on changing the lifestyle of users. However, the combination of both technologies and their application on children lacks extensive scientific foundation. As the opinion of the children already has been researched by Schulz et al. (Schulz, Spil, & de Vries, 2017), this research will explore the opinion of the medical professional on this subject to assess whether or not it is feasible to put effort into further scientific research.

Therefore, the following research question has been formulated:

What are the expectations and requirements of medical professionals, specifically physical therapists specialized in children involved in the treatment of pediatric obesity on the use of a serious game in combination with wearables to stimulate a healthier lifestyle?

To answer this research question, subquestions have been formulated. First, it should be established what the current state on obesity and the use of serious games and wearables is, and why a change in this state is necessary. The corresponding subquestions form a theoretical framework and are formulated as follows:

- *What are the health risks of obesity in children and how can serious games and wearables help in improving the physical health of these children?*
- *What is the current state of implementing gamification and wearables in lives of people with obesity?*

Based on the information gathered in the theoretical framework the opinion of the medical professionals can be gathered. The corresponding subquestions are formulated as follows:

- *What expectations do medical professionals, specifically physical therapists specialized in children, have of the effect of the use of a serious game in combination with wearables to increase activity and improve overall health of children with obesity?*
- *What requirements do medical professionals, specifically physical therapists specialized in children, pose before they are willing to actively implement the use of a serious game in combination with wearables for the children with obesity they are treating?*
- *What limitations to the project do medical professionals, specifically physical therapists specialized in children, expect that might have an impact and should be considered during the development of the game?*
- *Does scientific literature agree with the posed points of concern by the medical professionals and which solutions are offered?*

Gathered information from the theoretical framework and the opinions of the medical professionals provide guidelines for the design of a serious game combined with a wearable to implement in the treatment of children with obesity. Therefore, in the final chapter of this thesis, the next question will be answered:

- *How should the combination of a serious game and a wearable be designed to aid children with obesity in the adoption of a healthy lifestyle?*

3. Methods

The thesis exists of two different parts, namely a literature review part and a part where information has been obtained via the medical professionals themselves. Of the total of seven sub-questions, the first two will be answered through a literature review, the last four questions through qualitative data collection via an interview and questionnaires. This chapter first describes the used methods for the literature review, followed by the method section for information gathering through medical professionals via questionnaire and interview.

3.1 Part 1 – Literature review

In the first section of this paper, an explorative literature review has been executed to obtain an understanding of the impact of obesity on children and the current developments in the area of gamification and wearables. To execute the literature research in a thorough way, a combination of the Grounded Theory as presented by Wolfswinkel et al. and the “10 simple rules for writing a literature review” by Pautasso have been used. The choice to use steps from both methods ensured that the literature review could be easily executed following (parts of) a scientific accepted structure, while not going into the depth of a very extended literature review.

3.1.1. Grounded Theory as presented by Wolfswinkel

The Grounded Theory consists of 5 steps that ensure most influential literature has been found and that the review is transparent (Wolfswinkel, Furtmueller, & Wilderom, 2013). These steps include:

- Step 1) Setting the definitions for the literature research.
- Step 2) Searching for suitable literature.
- Step 3) Refining and selecting the samples.
- Step 4) Analyzing and summarizing the samples and structuring of the content.

3.1.2.Ten Rules for writing a Literature Review as presented by Pautasso

The rules according to Pautasso (Pautasso, 2013), hereafter abbreviated to “Ten Rules” included:

- Rule 1) Define a topic and audience.
- Rule 2) Search and research the literature.
- Rule 3) Take notes while reading.
- Rule 4) Choose the type of review you wish to write.
- Rule 5) Keep the review focused, but make it broad of interest.
- Rule 6) Be critical and consistent.
- Rule 7) Find a logical structure.
- Rule 8) Make use of feedback.
- Rule 9) Include your own relevant research, but be objective.
- Rule 10) Be Up-to-date, but do not forget older studies.

3.1.3. Executing the literature review

As the Grounded Theory has a more structured first step in the process of reviewing the literature, namely, setting the definitions for the literature research, this step has been used to prepare for the review. Since gamification and wearables are modern technology, articles from 2005 up to 2018 were included in the review. As this research is mostly focused on children, the scope of the literature search is set to obesity in children and wearables suitable for children.

The fields of research determined for this thesis are the following;

1. Obesity in children, specifically health risks and physical and mental implications.
2. Using modern technologies to measure, contain and improve the health status, specifically gamification and the use of wearables.
3. Presumptions and experiences from the pediatric or at least medical field concerning the use of wearables, preferably also in combination with gamification focused on health improvement in the case of obesity or overweight.

The databases used for this thesis are Web of Science, Google Scholar, NCBI and Scopus. In these databases, the search terms used were the following: obesity AND children, overweight AND children, childhood AND obesity, weight loss AND children, wearables, gamification and gam*, technology, pediatricians, health improvement. The choice was made to not include the

term “diabetes” next to “obesity”, since figures show that a lot of people with diabetes have not yet been diagnosed. As mentioned in the introduction, 340 million children aged 5 to 17 worldwide are obese according to the World Health Organization (World Health Organization, 2017). The National Institute of Health mentions that in the United States 208.000 people younger than 20 years have diagnosed diabetes (National Institutes of Health, 2017). This number, however, includes both the auto-immune induced Diabetes type 1 as well as the hereditary and/or overweight related Diabetes type 2. This indicates that only a small percentage of children with obesity are diagnosed with the disease, and considering the hereditary possibility of type 2, a percentage of the cases has Diabetes without being overweight. Using the term “obesity” in this search creates more potential of finding relevant literature than the use of the term “diabetes”.

Following the structure of the Grounded Theory, the next step was to collect as many articles as possible through the selected databases, while filtering for duplicates and non-applicable papers. To filter for duplicates and non-applicable papers, all papers have been scanned for information in the title, abstracts and parts of the text. In the process of searching for literature, both the search terms and inclusion and exclusion criteria were adjusted if necessary, and the search process was repeated until there were no relevant articles found that were not collected before. This step was complemented with Rule 2 and 3 from the Ten Rules, in which literature should be gathered and notes should be taken of the information in the articles.

Transferring from the Grounded Theory to the Ten Rules included having to choose the type of review. Based on Pautasso’s structure, the choice was made to go for, what he categorizes as, a full review with an integrative and narrative character, ensuring all collected articles could be used in describing the impact of obesity and the developments concerning gamification and wearables. The final steps of the Ten Rules have also been followed to finish the literature review, introducing the context and summarizing main points, using reviewers to provide feedback and searching for the newest articles on the subjects.

3.2. Part 2 – Questionnaire

In the second part of this thesis, information on the opinions and preferences of the medical professionals have been gathered through an interview and questionnaires with a semi-structured character. As the information required is of a qualitative character, no extensive data analysis was applied. Based on the information provided in the literature review, information has been gathered concerning the important aspects of using wearables and serious games in battling pediatric obesity. Answers from the questionnaire were seen as key information, complemented with an interview with a pediatrician to test the statements that were a result of the questionnaires.

3.2.1. Study population

For the questionnaire, a purposive sample has been taken of medical professionals working closely with children with obesity. Initially, this research focused on the pediatricians. During an exploratory talk with an active pediatrician, it was discovered that the pediatricians primarily focus on occurring active health problems and referred children with obesity and no physical health problems to physical therapists specialized in children. Therefore, the study population shifted from pediatricians to physical therapists specialized in children. As the initial active pediatrician was connected to a network of 8 physical therapists specialized in children who were working closely together on introducing new technologies to the care for children with obesity or problems with physical activity, the respondents were exclusively from this network. Inclusion criteria used were therefore: the physical therapist should be specialized in children, currently working with children and be active in the regional area of Twente.

3.2.2. Data saturation and homogenous groups

To assess whether the filled in questionnaires of 8 physical therapists specialized in children provides enough information to draw conclusions and whether these conclusions can be linked to the opinions of all physical therapists in the Netherlands, research has been done into data saturation and homogenous groups. Data saturation is the principle that, as a certain amount of data has been collected, further collection will provide no new insights (Saunders, et al., 2017). According to Guest et al. data saturation occurs within the first twelve interviews, and most important themes can be gathered within the first six interviews (Guest, Bunce, & Johnson, 2006). Data saturation is reached when there is enough information that replicating the study is possible, the ability to obtain additional new information has been attained and further analysis and coding of the responses is no longer sensible (Fusch & Ness, 2015).

Furthermore, it should be assessed whether the research population consists of a homogenous group. Homogeneity is defined by Rabiee as a situation in which all participants share similar characteristics, including age range, gender, and in this case, occupation (Rabiee, 2004). As all of the physical therapists specialized on children are female, working in the same region and have the same main occupation, this group can be seen as homogenous and their opinion may be generalized as an overall opinion.

3.2.3. Data collection

The respondents were personally asked to participate and invited to fill in the questionnaire during one of their regular group meetings in the MST hospital. The questionnaire has been made available on paper and online via Google Forms and all possible respondents were provided with a link. The questionnaire was available from the end of April to the end of May. To obtain the true opinion of the physical therapists, the questionnaire has an open character, with a minimal amount of closed questions. The results of the questionnaire were posed during an interview session to a pediatrician from a different hospital in the Twente region, who was not involved in the process earlier. Furthermore, during the period the questionnaire was available online, a casual conversation has been held about the topic with a graduate (MSc) psychologist and a graduate (MSc) Health and Society, which provided more insight on the psychological background of the possibilities of implementing serious games and wearables.

3.2.4. Questionnaire

The questionnaire used was not based on an existing questionnaire, but used the retrieved literature in this thesis as a basis. The questionnaire was formatted into 5 different sectors. In the first sector, the current baseline situation as experienced by the physical therapist has been questioned, aiming to get an understanding of the current situation and what the physical therapist experienced as lacking in that specific situation. The second sector questions whether the physical therapist is familiar with wearables and what their opinions are on wearables and their use in a setting with pediatric obesity. The third sector questions whether the physical therapist is familiar with serious games and what their opinions are on using the serious game in a setting with pediatric obesity, this sector also providing an indication of the opinion of the physical therapist on the serious game. The fourth sector aims to combine both the wearable and the serious game and questions the opinions of the physical therapists on this combination.

The fifth and final sector aims to compare a hypothetical setting with the combination of a wearable and a serious game against the current situation as found in the first sector of the questionnaire. This sector introduces the hypothetical, non-existing, game Healthy Buddy, HB,

which is an interactive game based on the popular Tamagotchi. The child is responsible for feeding and interacting with a digital pet. As the child is physically active, as registered by the wearable pedometer, he will collect coins. The child also has the opportunity to rate his food pattern and collect coins in that manner. These coins can then be used to “buy” food and toys for his pet. It also allows him to play games with his digital pet, or with other children and their digital pets. For the physical therapists, a control screen is implemented, in which they can check whether the child has been physically active and where they have the opportunity to reward bonus coins. In the questionnaire, the physical therapists are asked to rate this hypothetical game against their current situation.

A matrix explaining the link between literature and the full questionnaire is posted below. In the first column, the statement according to found literature has been stated. This is transferred into a question for the questionnaire in the second column. The third column describes the information this question aimed at gathering. The fourth column states the sources used for the literature statements as used in the rest of this thesis. In the table, the physical therapists are abbreviated to “PT’s”. The full questionnaire is included in *Appendix B.*

Statement according to literature	Question as posed in the questionnaire	Information attempted to gather from the posed question	Literature source
SECTOR 1			
Parents have an important role on the diet of children. Furthermore, obesity is caused by an increase in the consumption of energy-dense foods and a more sedentary lifestyle with more screen time for children.	What is the most important factor in pediatric obesity? What does the currently used treatment method lack?	Do PT's experience the three factors named in literature (parents, increased food consumption and more screen time) as well in their treatment sessions? What improvement do PT's need in their current situation?	(Clark, Goyder, Bissell, Blank, & Peters, 2007) (National Institute of Diabetes and Digestive and Kidney Diseases, 2012) (Kar, Dube, & Kar, 2014)
The right way to treat children with obesity is by changing the lifestyle, increasing physical activity and consumption of healthy meals with plenty of fruits	What is according to the PT's the right way to treat children with obesity?	What is the current "best practice" in treating pediatric obesity according to professionals working closely with these children?	(National Institute of Diabetes and Digestive and Kidney Diseases, 2012).
SECTOR 2			
The adoption of wearables is trending, but mostly in populations that already live a healthy lifestyle.	Do you use a wearable of do you know people using a wearable? Would this technology be suitable for treatment use in pediatric obesity?	Are PT's familiar with wearables, and if so, do they find them suitable for use in their treatment plans of pediatric obesity?	(Deterding, Khaled, Dixon, & Nacke, 2011) (Piwek, Ellis, Andrews, & Joinson, 2016)

Using wearables confronts people with their own activity levels.	What would be the pros and cons of using this technology?	What do PT's see as the pros and cons of this technology based on their own experiences?	(Hartman, et al., 2016)
SECTOR 3			
Serious games have the opportunity to intrinsically motivate initiation and continued performance of a certain behavior, is widely accessible and are applicable in daily life.	Do you use serious games? Would these games be suitable for use in treatment of pediatric obesity?	Are PT's familiar with wearables, and if so, do they find them suitable for use in their treatment plans of pediatric obesity?	(Johnson, et al., 2016)
Using Dance Dance Revolution triggered a positive change in physical activity in children, however, this positive change died down after a couple of weeks as children were no longer interested and motivated.	What would be the pros and cons of using this technology?	What do PT's see as the pros and cons of serious games based on their own experiences?	(Paez, Maloney, Kelsey, Wiesen, & Rosenberg, 2009)
SECTOR 4			
There is a positive attitude towards wearables and gamified health apps, and the combination can contribute to a more healthy lifestyle for the user.	If a serious game would be combined with a wearable, would this be suitable for use in the treatment of pediatric obesity?	What is the opinion of the PT's on the combination of a serious game and a wearable and do they find it suitable for use in their treatment plans of pediatric obesity	(Schulz, Spil, & de Vries, 2017) (Spil, Thiebes, & Sunyaev, 2017)

Gamified mobile health apps that use wearables lack the opportunity to influence behavioral triggers, are only popular for a short time as the user exhibits increasing amounts of failure and frustration.	What would be the conditions under which the PT's would consider implementing the combination serious game and wearable in their treatment plans?	What conditions do the PT's set as factors that need to be investigated further and solved before they would consider implementing the combination of a serious game and a wearable?	(Lister, West, Cannon, Sax, & Brodegard, 2014)

SECTOR 5

Finally, as mentioned above, in sector 5, the hypothetical game "Healthy Buddy" was introduced. Physical therapists were asked to rate "Healthy Buddy" against the current situation, to assess whether or not, in their opinion, the game would have an added value in the treatment plans of children with obesity. The statements that needed to be assessed, included statements about dietary behavior, physical activity, coaching and support, the risk of "Healthy Buddy" becoming a nine days' wonder and whether the game would be an added value.

3.2.5. Data analysis

As the collected data has a qualitative character, the results will be gathered and presented in a textual form. When necessary for a more quantitative understanding of the data, Microsoft Excel has been used to present data in a table. Where open questions have been applied, a coding system categorizing the mentioned subjects has been used to be able to analyze the answers.
To get an understanding of the opinion of the physical therapists on the fifth sector of the questionnaire, in which the current situation is compared against the hypothetical game "Healthy Buddy", a five point Likert scale has been used. This scale ranged from strongly agree – agree – neutral – disagree – strongly disagree.

4. Theoretical Framework

4.1. The (health) risks of obesity

The next chapters will provide an answer to the first two research questions. First, the health risks of obesity will be set out, both in physical and mental areas. This will be followed by chapters exploring the implementation of technological solutions in the battle against obesity, transferring into the use of wearables, gamification and the combination of both.

4.1.1.The risks and impact of obesity

To assess the impact of obesity on the health of children, first an assessment of the impact of obesity on adults has to be made. Obesity in adults can have severe effects on both mental and physical health. Segula mentions several psychosocial problems, for example that obese women are less likely to complete their education, have a lesser chance of getting married and have a higher level of poverty (Segula, 2014). Also, psychiatric disorders have been linked to obesity in adults. A study by Rosik following patients before and after bariatric surgery concluded that psychiatric disorders like OCD, phobias, hypochondriasis and somatization were reduced significantly after the surgery (Rosik, 2005). Being obese increases the risk of a lot of health problems. This list includes Type 2 Diabetes, high blood pressure, certain types of cancer, kidney and liver diseases, high blood pressure, heart disease and strokes, sleep apnea, osteoarthritis and problems during pregnancy (National Institute of Diabetes and Digestive and Kidney Diseases, 2015). While these problems on itself already have impact on the health of obese persons, there is also the case of obesity preventing the execution of medical procedures, either caused by the physical weight or by the risk of complications and infections afterwards. MRI scanners, for example, have a weight limit of around 200kg. Restricted access to care as a result of immobility caused by their bodyweight is also a problem in heavily obese persons. (Segula, 2014)

As an increase in the number of adults with obesity can be observed over the years, there is also an increase in the number of children battling with nutrition related chronic diseases like diabetes. This is, as mentioned above, caused by the energy disbalance between consumed and expended calories caused by adopted lifestyle and dietary intake preferences. (Sahoo, et al., 2015) Davison et al. describe their ecological model that suggests that the risk factors for childhood obesity include dietary intake, physical activity and sedentary behavior. These factors however are moderated by factors like age and gender, parenting style and parental lifestyles, peer lifestyles, school policies and demographics. (Davison & Birch, 2001) Furthermore, genetic heritage plays a factor in the development of obesity in children. Eating while watching TV or

eating out is associated with a higher intake of fat. Also, the restriction of junk food is associated with, paradoxically, an increased desire for unhealthy food. (Sahoo, et al., 2015)

A special point of attention of obesity in children can be dedicated to the role of parents. Research by Clark et al. mention that the influence of parents on children's diets is the strongest in early childhood. Parents that have a bad dietary awareness and insufficient knowledge about nutrition are less likely to make healthy food choices for their children. Also, parents can use control of portion sizes, are able to encourage or pressure their children to eat and can use food as a reward or bribe. In their research, they found that children who were pressured to eat healthy by their parents chose healthy snacks from a selection of treats as soon as they noticed that their parents were monitoring, while picking unhealthy snacks when they deemed themselves unmonitored. Also, girls who experienced parental restriction in eating snacks, were more likely to snack immediately after a meal, even though they reported not feeling hungry. After the snacking, they indicated feeling bad about the snacking. They found, just as indicated by Sahoo et al and mentioned above, that restriction of food by the parents predicted an inability to regulate snack intake in later stages of childhood. (Clark, Goyder, Bissell, Blank, & Peters, 2007) This indicates that the role of parents should not be underestimated in the process of trying to limit obesity in children.

4.1.2. Health risks of obesity in children

Lobstein et al. mention in their research the health risks for obese children. This list includes many health problems that are also prevalent for overweight adults, like sleep apnea, liver and kidney disease, endocrine diseases like Diabetes Type 2 and cardiovascular problems like hypertension. However, the list also includes further health problems. These problems are for example menstrual problems and Polycystic Ovary Syndrome (PCOS) which goes accompanied by hirsutism (increased hair growth) and fertility problems that are only discovered later on. (Lobstein, Baur, & Uauy, 2004)

Children with obesity have an increased risk of injuries to their bone structure, like an increased risk of fractures, an increased risk of ankle sprains, flat feet and Blount's disease. There are specific syndromes and disorders linked to obesity. Children with Down syndrome, Prader-Willi syndrome and endocrine disorders are more likely to become obese. Furthermore, children with physical disabilities, Diabetes type 1 or diseases that require the use of medicines like epilepsy medicines or anti-depressants are also more likely to become obese. Ethnicity, parental and maternal obesity and smoking during pregnancy are also risk factors for the development of childhood obesity. (Lobstein, Baur, & Uauy, 2004)

Next to physical problems, psychological problems are also linked to overweight in children. For example, in a research executed as early as 1967, young boys described obese body types with terms as lazy, sloppy, mean, ugly, dirty and stupid (Staffieri, 1967). Strauss et al. found in their research that overweight girls seem to have less friends than their non-overweight counterparts (Strauss & Pollack, 2003). Dietz et al describes a study in which children showed clear preference of having friends with a wide variety of handicaps rather than having friends who were overweight (Dietz, 1998). Research executed in 1993 by Gortmaker et al. showed that American women who were obese during adolescence, became lower educated adults with higher rates of poverty and a lower likeliness of getting married compared to their skinnier counterparts (Gortmaker, Must, Perrin, Sobol, & Dietz, 1993). Children with obesity seem to have an increased risk of being depressed, and suicidal ideas seem to be more prevalent in obese children that have been teased by family or peers (Eisenberg, Neumark-Sztainer, & Story, 2003). Eating disorders seem to have a higher prevalence in overweight women. While overweight children do not seem to have a negative self-image or low self-esteem, these feelings do develop in obese adolescents, probably because in children the self-image is based off of parental messages, while in adolescent stage the self-image is built on culture. (Dietz, 1998)

4.1.3. Diagnosis and treatment of obesity

Currently, the Body Mass Index, BMI, is used as a screening tool to assess if a person is overweight or has obesity (NHS, 2016). However, this is not a definitive method of assessment as it has to take into account muscle mass, age, body-type and, in children, expected physical development in the future. Therefore, other methods like waist circumference, blood pressure and glucose- and cholesterol levels are also used to set a diagnosis (NHS, 2016).

The treatment of obesity depends on changing lifestyle and (feeding) habits, with an increase in physical activity and the increased consumption of healthy meals with plenty of fruits and vegetables. If changes in lifestyle do not lead to a loss of weight enough to have an improvement in health, weight loss pills can be prescribed (National Institute of Diabetes and Digestive and Kidney Diseases, 2012). In extreme adult cases, bariatric surgery, where a gastric sleeve, gastric bypass or gastric band is placed, is recommended (National Institute of Diabetes and Digestive and Kidney Diseases, 2016).

4.2. The increasing role of technological developments in the battle against obesity

4.2.1. Technological developments through the years

There are hundreds of types of interventions aimed at children with obesity. However, the last couple of years, these interventions have transformed from a direct, face-to-face character to a more distant but also more cost-effective and more accessible, technology-driven type. For example, research executed by Callender and Thompson found that African American mothers were assumed to be more likely to cohere to healthy lifestyle behaviors if they were to receive tips and information about a healthy lifestyle via text messages to their mobile phones (Callender & Thompson, 2017). Research by Shaw and Bosworth mentions that there are currently many weight loss tools using text messages to motivate users to take part in a healthy diet and exercise pattern (Shaw & Bosworth, 2013). Hurling et al. expands this into interventions using email and online message boards next to text messages (Hurling, et al., 2007).

As the interventions above transitioned from Short Text Messages to internet message boards, other developments took place. As mentioned by Staiano et al., the average amount of daily time spent playing videogames by children and young adults around 2012 was 1 hour and 13 minutes (Staiano, Abraham, & Calvert, 2012). This opened the opportunity for the development of active games like the Nintendo Wii, the Nintendo Kinect and a computer game called Dance Dance Revolution, also dubbed “exergames”, and their inclusion in the process of battling obesity in children. Staiano et al. found that children playing tennis on their Wii console against a partner burned as many calories as children participating in a beginner’s tennis class. Furthermore, they found that children playing on average 45 minutes daily on the Wii for a number of weeks experienced significant weight loss compared to their control group. However, as the experiment continued, the number of children that were willing to play decreased over time. (Staiano, Abraham, & Calvert, 2012)

A study by Paez et al focused on the use of Dance Dance Revolution (DDR). This is a game where a foam mat with 4 sensored arrows on it is used. This foam mat is connected to the console, where a song will be played and arrows in a programmed fashion, related to the music, are displayed. The player should then step on each arrow following the pattern and timing shown on the screen and will be scored for each step. As the player continues to step on the right arrows at the right timing, visual feedback is shown and the player gets a multiplier bonus as a way to increase his top score even further. According to their research, parental support or parental encouragement seems to be an important factor in increasing youth physical activity.

Children who had peers, parents or siblings participating in a game of DDR were more likely to play the game more often. Furthermore, children who did not have other means to play videogames next to DDR were more likely to sway towards playing a game of DDR, which might implicate that the novelty of the game encourages children to participate. However, in this research, the same novelty of DDR weaned off at the end of the 10 week spanning experiment, leading again to less physical activity. (Paez, Maloney, Kelsey, Wiesen, & Rosenberg, 2009) This implicates that a game should have a continuous factor of novelty to be able to keep children interested and motivated in playing the game.

As interventions transition from text messages to internet messaging boards to exergames on gaming consoles, the next development is implementation of weight loss interventions in apps on smartphones. Laing et al. researched the effects of the mobile app My Fitness Pal, which is an app focused on logging physical exercise and counting consumed calories. However, they found in their research that participants rarely used the app after a couple of weeks. (Laing, et al., 2014)

In the introduction, the explosive growth and activity-promoting character of the Pokémon Go app has been mentioned. In this Augmented Reality game, players can roam the city searching for different Pokémon. Within 20 days after its release, the app was downloaded over 75 million times (Freeman, Chau, & Mihrshahi, 2017). The more distance a person walks, the higher the chance of encountering rare Pokémon are, thereby motivating the player to literally walk the extra mile. Research found that people playing Pokémon Go were significantly more active, especially players that used to have a more sedentary lifestyle (Wong, 2017), (Althoff, White, & Horvitz, 2016). Furthermore, players have reported improvement in mental health conditions like anxiety and depression. An article written by Freeman et al. mentions that in the case of Pokémon Go, the app has not been developed as an influencer for healthy behavior, but simply as a fun game that incorporates the worldwide immensely popular phenomenon Pokémon. They state that "*Public health should turn its focus to developing mobile-based interventions within a framework that embraces please, rewards, participation and community".* (Freeman, Chau, & Mihrshahi, 2017). As Pokémon Go seems to currently be a lot less of a hype, it does give an insight on the feasibility of an app solely focused on improving healthy behavior compared to apps with a primary focus of entertainment.

4.2.2. Gamification and wearables

Currently, wearables, specifically smartwatches, seem to be the next innovation. Piwek et al. state that one in six consumers in the US are using wearable technology. An overview of currently popular available wearables can be found in *Appendix A*. However, as mentioned before, the group of consumers wearing this type of technology is already more prone to a healthy lifestyle and frequent physical activity (Piwek, Ellis, Andrews, & Joinson, 2016) (Deterding, Khaled, Dixon, & Nacke, 2011).

Gamification has been defined as “the use of game design elements in non-game contexts” (Deterding, Khaled, Dixon, & Nacke, 2011). Johnson et al. mentions that since the emergence of the concept of gamification, it has been added to both the academic setting and industry. The concept of using gamification for health behavior change is also posed, with for example a game called “Zombies, Run!”, in which the participant can listen to a narration of a storyline in which he tries to outrun zombies while he is physically active. The aim of gamification is to track the progress of a participant and set it against a goal while providing feedback in a motivating and playful environment. It tries to reorganize the daily life of people instead of adding another aspect. (Johnson, et al., 2016) Lister et al. describes gamification as “the use of game-like rewards and incentives, paired with desired behaviors, to increase motivations and sustain habits of individuals over time” (Lister, West, Cannon, Sax, & Brodegard, 2014).

In the article by Johnson et al., it is set out why gamification, serious games, might help in changing the healthy behavior of people. Health gamification is widely accessible by using mobile phones or trackers and it has possibilities in being applicable to everyday life, while not requiring dedicated time. As an increased amount of people is playing games on their mobile phones, this also means that game design elements are also more approachable and appealing for a bigger population, making gamification a more and more feasible and accepted option. Gamified systems have the opportunity to intrinsically motivate initiation and continued performance of a certain behavior and can contribute to well-being by triggering positive emotions, meaning and feelings of accomplishment. (Johnson, et al., 2016)

Schulz et al. mention that people have a positive attitude towards wearables and gamified health apps in general. However, people are more likely to use gamified health apps instead of wearables. She refers to research executed by Wortley, who concluded after research concerning the wearable bracelet Jawbone Up and gamification that it might have the power to create an engaging experience and influence behavioral change. (Schulz, Spil, & de Vries, 2017)

4.2.3. Implementation of serious games and wearables in the battle against obesity

There are several researches available on the use of wearables, and sometimes also gamification, in battling obesity. For example, Hartman et al. used a combination of eHealth apps like MyFitnessPal and wearables next to traditional aspects of weight loss like dietary information to motivate women in the age of 40-75 with an increased risk of breast cancer to lose weight. They found that combining technology with traditional aspects of weight loss led to a higher weight loss in these women. They hypothesized that the population felt more accountable for their efforts when they were confronted on their wearable with their own activity levels throughout the day. (Hartman, et al., 2016) Kurti and Dallery used wearables in combination with a set goal of a number of steps to motivate elderly to increase their daily activity level. They found that setting a monetary reward led to an increase of 182% in the number of steps during the research period, while the number of steps increased with 108% if no monetary reward was offered. (Kurti & Dallery, 2013)

Lister et al took a look at available mobile health and fitness apps that used gamification. They concluded that gamification has become a common sight as they included 132 available apps in their research, and that most of the apps only focused on motivating their users, while missing the opportunity to address capability or influence behavioral triggers. They also refer to earlier research that describes the rapid expansion and adoption of gamification as being a “hype”, a cycle that occurs with new technology, where it is implemented rapidly and immensely popular. After a while, the “newness” weans off and the technology dies down after increasing amounts of failure and frustration from the users. (Lister, West, Cannon, Sax, & Brodegard, 2014) They, however, do mention an aspect that could offer an expansion to the combination of gamification and wearables, which is the possible implementation of 3-D and narrative stories.

Spil et al. took a look at the possibility of combining both gamified health apps and wearables and concludes that consumers experience an overall positive attitude towards the combination of gamified apps and wearables. By improving the information quality and developing a good

design, gamified apps and wearables can highly contribute to a more healthy lifestyle for the user. (Spil, Thiebes, & Sunyaev, 2017)

This opens the door for a small sidestep, as mentioned by Lister et al.; the implementation of gamification with wearables in combination with Virtual Reality to battle obesity in children (Lister, West, Cannon, Sax, & Brodegard, 2014). For example, the use of a virtual reality headset like the Oculus Rift or the Playstation VR, could ensure a lot of new opportunities. According to Guixeres et al., in Virtual Reality, the user is allowed to interact with and become immersed into a computer generated three dimensional environment. The implementation of VR in health care has been successfully, with it being used for the treatment of simple phobias, PTSD and pain reduction. They found in their research that both children and adolescents were open to the idea of combining VR with a physical activity to increase their activity level. (Guixeres, et al., 2013)

Summarizing the previous chapters, it can be said that, throughout the years, several mediums have been the basis for interventions that tried to get the population more active, ranging from mobile phones to game consoles to wearables. Currently, serious gaming in combination with wearables seems to be the new method to try and battle obesity, and it seems to be promising in stimulating and confronting people to take accountability for their level of physical activity. However, as with all of the previous mediums, it has the possibility to only be a hype, and die down as soon as a new opportunity enters the market. And this new opportunity might be in the form of Virtual Reality, which is still in its infancy concerning motivating children to be more active. Wearables might then be used as an extension for Virtual Reality.

In the meantime, wearables and gamification are currently the “status quo”. To ensure a wearable in combination with a serious game is embraced by the participants, a continuous factor of novelty, keeping the participants motivated and preferably also stimulated by parents and peers seem to be the basic requirements to keep these interventions relevant

5. Results

5.1. Analysis of the questionnaires

The questionnaire as posed in *Appendix B* was handed out to a group of child physical therapists during a meeting. Of the 8 therapists present at that meeting, 6 filled in the questionnaire right after the meeting, 2 were reminded later via email. The answers given will be presented below. The open questions and the corresponding codes used are added in *Appendix C*.

5.1.1. General information

As mentioned above, 8 physical therapists specialized in children answered the questionnaire. All of the respondents were employed in the Dutch province of Overijssel and knew each other through a network of child physical therapists and pediatricians discussing options on, and working together to optimize the care provided to the children that were referred to them. All of the respondents were female and their ages spread from 25 to 58 years. Their years of work experience also differed, with answers ranging from 1 to 15 to 32 years. 5 of the respondents reported working with 1 to 10 children with obesity, and three respondents reported working with 10 to 30 children with obesity.

On the question asking the respondents which factor they felt was exercising most impact on the state of weight of the children they were working with, 7 respondents answered the role of parents and family, and one answered the availability of tv-shows and game consoles. When asked what they thought was the best way to battle obesity in children and help them in adjusting to a healthy lifestyle, three important aspects came forward. Six of the respondents opted for an intervention in the lifestyle of both the children and their families, providing them with information about the subject and ensuring the parents and family support their children fully throughout the whole process. One respondent opted for showing the child that physical activity can be fun while also providing visual cues. Two of the respondents answered that a multidisciplinary trajectory with, for example a dietician, psychologist, coach or psychical therapist deemed a very good option. The previous options are complemented by respondents mentioning promoting a healthy lifestyle with healthy food and physical activity.

Furthermore, the respondents were asked what they felt was currently lacking in their methods of working with children with obesity. Three of the respondents stated that they felt they lacked having control on the progress of the children as they had no clear insight in the pattern of food intake and physical activity. Four of the respondents added that they experienced lack of

motivation and involvement from parents and family and/ or the child itself and had found it hard to break through this state. Added to these answers was a lack of options to provide children with a way to enjoy changing their current state to a healthy lifestyle and a lack of financial aid for these families.

5.1.2. Wearables

Out of 8 respondents 7 reported either wearing a wearable themselves or knowing someone in their close proximity wearing a wearable. When asked if they would consider using wearables in coaching children with obesity, all of them answered that they would. Their arguments included the wearable proving the children with a visual overview and stimulant and therefore also (indirectly) improving motivation. The pros of using this technology according to the respondents included: both the child, parents and medical professional can get insight in the progress of the child, the child experiences more visual stimulants and motivation to try and reach his goals, the possibility to compare data with other people (both as a way to gain insight and to try and set up a friendly competition between children), the child being able to use a nice gadget and, lastly, being able to help the child with a minimal financial investment.

The cons of using this technology in the coaching process of children with obesity also provided a great insight. Respondents provided the following answers: the child can lose the wearable or forgets to wear it, children will try to “cheat the system” by finding ways to activate the wearable with a minimal physical effort (for example: shaking the wearable to simulate steps taken or attaching the wearable to their dog while it goes for a walk), the technology sets a strong focus on the wearable itself and stimulates less focus on the body of the child itself, and lastly, a “big brother” effect of the child being able to be traced in everything he does.

5.1.3. Serious games

All except one of the respondents answered positively when asked if they were familiar with serious games, however, no one reported having used a serious game in their therapy sessions. When asked if they would consider using serious games in their therapy sessions, all respondents answered positive as they felt that a technological solution would appeal to modern day children, and the child is able to be active while using a technological solution. A sidenote posed here was the fact that these games work on a hype. As soon as the game has been played for a while, the child might lose motivation to play the game.

When asked for the pros and cons in implementing serious games in the coaching process, the following answers were provided. Pros according to the respondents included an increase of

motivation for the child, a trendy solution based on the wishes of the current society and more physical activity. Cons as mentioned by the respondents included: the child or its parents should have financial and material means or resources to provide the needed elements, this technology is providing the child with the possibility to find out if it can cheat the system, ensuring the child has more screen time while this factor should be minimized in a healthy lifestyle, the possibility of the serious game not being able to interest the child after a certain amount of play-time (hype), and the posed question if a serious game is able to transition the increase in physical activity from the game to daily life or other physical activities.

5.1.4. The combination of serious games and wearables

When asked if they would implement both serious games and wearables if they were made into one program, all respondents answered positively, motivated by the assumption that children would like a solution that fits into their perception and stimulates them to increase their physical activity, and being rewarded for their progress. The conditions for implementing serious games and wearables as stated by the respondents were the following: the goals should be able to be adjusted to the child itself, the program should offer variance and challenges, should be cheap and easy to implement, should be an addition to the current program and not replace it, and should stimulate both children, peers, parents and family to work together.

5.1.5. Setting: Healthy Buddy

The final part of the questionnaire consisted of a posed setting where a combination of a serious game and wearable were combined into “Healthy Buddy”. The respondents were asked to compare the posed setting to the current setting and answer questions about insight into the life of the child, motivating the child, sustainability, physical activity and support. Their answers to the different questions are shown below, with the color gradients indicating the number of respondents choosing a specific answer.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Positive opinion on HB if it were an existing game	2	6	0	0	0
HB provides increased insight in physical activity of the child	3	4	0	0	1
HB provides increased insight in the food pattern of the child	0	2	4	2	0
HB provides increased insight in the mental state of the child	0	2	3	3	0
Current situation and allotted time allows for sufficient coaching	0	1	5	2	0
Current situation allows for sufficient support	1	1	2	4	0
HB would have an added value if implemented in the current situation	2	5	1	0	0
Current situation allows for sufficient motivation to implement a positive behavioral change	0	3	3	2	0
HB allows for sufficient motivation to implement a positive behavioral change	1	4	3	0	0
HB will still be used by the child in a year's time	0	1	3	5	0
Current situation is more than enough to coach children into a healthy lifestyle	0	1	5	2	0
HB allows for a better aid in implementing a healthy lifestyle compared to the current situation	2	5	1	0	0

As can be seen in the table above, all respondents would have a positive stance on the implementation of “Healthy Buddy” and most agree that it would provide them with a better insight in the physical activity of the child. On the question whether HB would provide increased insight in the food pattern and the mental health state of the child, the opinions fluctuate from a positive stance to neutral to a disagreeing stance. Most respondents gave a neutral opinion on the question whether the current situation allows them enough time to provide sufficient coaching, however, the majority stated that the current situation did not provide them with enough opportunity to provide sufficient support. Overall, the respondents agree that the implementation of “Healthy Buddy” would have an added value and allow for a more easy adoption of a healthy lifestyle and sufficient motivation. However, as mentioned in the theoretical framework, most of these settings turn out to be a “hype”, and the opinions of the respondents show that the majority thinks the game will not be used after a year.

5.2. Summarizing the important factors

Based on the answers of the physical therapists specialized in children in the questionnaire, several topics emerged as important factors in using the serious game and wearable in the treatment of children with obesity. Two of these topics were seen as positive. The first factor included the impact of visual stimulation, where the child is provided with a visual representation of its progress and motivational visual cues are provided when necessary. The second positive factor included the possibility of playing with others, ensuring the child has the possibility to play and engage with his peers.

Four of the factors were seen as aspects that could have a negative impact on the process. The first one included parental influence, as parents have an important role in setting the environment for their children to grow up in. The second factor includes the possibility of the child sabotaging the process, by trying to find ways to earn the rewards without having to be physical active. The third factor included loss of motivation/ end of hype, as children are quick to switch to other hypes as soon as they appear more interesting. The final negative factor included an increase of screen time, as including a serious game aimed at motivating children to increase their physical activity, can only be played on device with a screen, which, paradoxically, increases screen time.

A factor that should be investigated further, is the question whether the implementation of a serious game and a wearable helps the child to transition from the game setting to a sustainable healthier lifestyle in real life.

Positive influence:
- The impact of visual motivation.
- The possibility of playing with others.
Negative influence:
- Parental influence.
- The possibility of sabotaging the process.
- Loss of motivation/ end of hype after a certain period of time.
- The increase of screen time.
To investigate:
- Transition from game to real life.

6. Combining the results with scientific research – short additional literature review

In this chapter, a short explorative literature review will be executed to assess whether scientific research has already been performed on the specific important aspects as mentioned by the respondents. Based on the available literature, recommendations can be made on how to attempt to transform the negative influences to positive influences, how the positive influences can be further exploited to stimulate the process and if the transition from game to sustainability in real life is an achievable goal.

6.1 Positive influence

This subchapter includes the topics that were mentioned by the respondents as having an expected positive influence on the process. First the impact of visual motivation will be discussed, then the possibility of playing with others.

6.1.1. The impact of visual motivation

Motivation is defined by Lai as “the attribute that moves us to do or not to do something” (Lai, 2011). It is a combination of a person’s beliefs, perception, values, interests and actions. There are two types of motivation; intrinsic and extrinsic. Intrinsic motivation is motivation driven by personal enjoyment, interest or pleasure, while external motivation is motivation that is driven by external reinforcement. (Lai, 2011) According to Broussard and Garrison (Broussard & Garrison, 2004), motivation is organized around three questions, namely

- *Can I do this task?*

The answer to this question is based on perceived self-efficacy, which is defined by Bandura as “judgments of how well one can execute courses of action required to deal with prospective situations” (Bandura, 1982). As a person has a high level of self-efficacy, this influences his levels of effort, persistence and goal setting. Individuals with a higher level of self-efficacy are more motivated and tend to be more successful in a given task.

- *Do I want to do this task and why?*

The answer to this question lies in the value an individual holds in participating in the activity. If the individual assigns a high value to a certain task, he has a higher motivation to execute this task. Furthermore, the task at hand should be in line with the goals of a person.

- *What do I have to do to succeed in this task?*

This question is based on whether a person is able to perform self-regulation, where they are able to increase their motivation by engaging in setting appropriate and achievable goals, applying the right strategies and monitoring and evaluating the progress they are making.

The questions above provide insight in what motivates children to join the program and adhere to it. If the physical therapists specialized in children are able to coach the child into answering (positively) on the three questions, a step has been made in ensuring the child is in the right "mood". According to the respondents, use of the wearable has a positive effect because it provides the children with a visual cue on their progress of reaching their individual goal. The pediatrician confirmed this statement and added that seeing a goal being reached might provide the children with a feeling of accomplishment and increased motivation to continue. However, seeing a lack of progress can also have a negative effect, in children seeing they are nowhere close to their goal of the day and giving up their attempts to reach their goal. By providing a friendly competition or feedback during these instances, this problem might be eliminated. According to Fishbach et al. feedback provides stimulation to pursue a goal (Fishbach, Eyal, & Finkelstein, 2010).

Therefore, if the children are able to use the wearable as a means to visualize their progress and are able to get feedback from their physical therapist, this can possibly have a positive influence on both the perceived self-efficacy and self-regulation, and indirectly on motivation.

6.1.2. Playing with others

According to the answers from the questionnaire, some of the respondents mentioned that giving the child the opportunity to compare progress with other children or engage in a friendly competition with peers, might have a positive effect on the progress of the child. According to Lemstra et al. social support in weight loss interventions is one of the most important factors in successful behavioral change. Weight loss interventions that allow friends or family to participate were more likely to provide maintained weight loss at a six month follow-up, and social support can improve commitment to the program. (Lemstra, et al., 2016) However, as the graduate in Psychology brought up in the casual conversation, categorizing the process as "weight loss" and thereby labelling the children using it as being overweight, might have negative effects. She proposes a serious game and wearable that is appropriate and usable for both the child and its classmates as to avoid stigmatization. As Pont et al. explains in their research, children that feel as if they are being stigmatized as overweight might experience psychological adverse effects reinforcing unhealthy behavior, possibly resulting in weight gain on short- or long-term (Pont, Puhl, Cook, & Slusser, 2017). The pediatrician agreed, stated that stigmatization is indeed a

problem in children with overweight. By allowing them to participate in a friendly competition with classmates or peers online, and having the possibility to see themselves at the top of a ranking might have a positive influence on their feeling of accomplishment and give them the feeling that they are good at something. If the serious game is only aimed at children with obesity and does not provide means to interact with other children, there is a risk of the child being only focused on the wearable and the game, which might have a negative influence on his social contacts.

Therefore, instead of focusing the game exclusively on children with obesity, it might be recommendable to develop a game that is playable by all children.

6.2. Negative influence

This subchapter includes the topics that were mentioned by the respondents as having an expected negative influence on the process. First, parental influence will be discussed. This will be followed by the possibility of sabotaging the process, loss of motivation/ end of hype and the increase of screen time.

6.2.1. Parental influence

Based on the information provided by the physical therapists, the influence of parents is a major inhibiting factor on the success of weight loss in children. The pediatrician also stated that most parents are only willing to change their (and indirectly their child's) lifestyle once physical problems occur. Parents have influence on and determine the environment on physical and social levels, and indirectly exercise influence on behavior, habits and attitudes of their children (Turconi, 2012). One of the main reasons for the inhibiting factor is the fact that parental perception of the weight status of children might be skewed. White et al. found in their research that nearly 3/4th of their research population underestimated the weight problems their children had (White, et al., 2016). Almoosawi et al. states that accurate parental perception of weight is related to less weight gain over time, while parents with an inaccurate perception of the weight status of their children were less likely to be concerned about their children's weight and therefore were also less likely to engage in encouraging behavior concerning a healthy lifestyle. In their research they found that children with parents that had a skewed perception of weight, experienced a significant unhealthier diet compared to children with parents with an accurate perception of weight. (Almoosawi, et al., 2016) Also, the weight status of the parents had influence, as White et al. found that overweight/obese mothers were exerting less control over the amount of food their children ate, while normal/lean mothers did exert control (White, et al., 2016).

There are several factors that may explain why there is a difference between perceived weight and actual weight as seen by the parents. This includes a lack of understanding of the objective measurements used to assess if a child has overweight. Parents used alternative approaches to assess the gradation of overweight of their child, for example by comparing it to extreme overweight cases as shown in media, comparison to (overweight) peers and feedback provided by family members. (White, et al., 2016) A lack of education on the subject of a healthy lifestyle also adds to a difference between perceived weight and actual weight, as some parents do not recognize childhood overweight as a risk factor for the health of their child (Lin Tzou & Chu, 2012). Furthermore, parental beliefs have influence on the perceived weight, as Baughcum et al. mentions in his research that specifically in low-income areas, mothers believed that chubbiness in their children represented good health and successful parenting (Baughcum, Burklow, Deeks, Powers, & Whitaker, 1998).

A posed solution to the problem of parents not accurately assessing the weight of their children introduces the pediatrician and other medical professionals working closely with children with obesity. Sugiyama et al reported that the medical professional can use his position to influence the perception of the parents. In their research, they found that parents who communicated with healthcare professionals about the weight status of their children, were more likely to evolve into having a more correct perception of the weight of their children. As this process took place, the parents were more convinced of the necessity to change and were more likely to move forward with, and implement lifestyle changes. (Sugiyama, et al., 2016) The role of the medical specialist is also mentioned by Turconi, who states that the medical professional should provide information, encouragement and support parental efforts on promoting lifestyle changes among their children. However, it is also stated that without support from the community, it is likely that the attempts fail. (Turconi, 2012) Robinson et al. stresses that, while it is important for parents to have an accurate perception of the weight of their children, having the label “overweight” may cause non-beneficial coping responses that could lead to weight gain, as children and adolescents that were labeled overweight by family or peers were more likely to gain weight across adolescence. (Robinson & Sutin, 2016)

Therefore, a balance needs to be found in educating and motivating the parents while in the meantime trying not to stigmatize the child into negative coping behaviors.

6.2.2. The possibility of sabotaging the process

As Bill Gates once said: "*I choose a lazy person to do a hard job, because a lazy person will find an easy way to do it."* Children of this age are growing up with modern technology. As research by Plowman noted, all children aged 5 included in their study had encountered computers, mobile phones, game consoles, televisions and also had technological toys like play laptops or robot pets in their possession (Plowman, 2015). Maslakovic reported that in the UK, students were caught using their smartwatches to cheat on their exams (Maslakovic, 2018). The respondents of the questionnaire stated that they expected children to try and cheat the system. An article on the website Fortune.com (Wieczner, 2016) provides examples, with users tying their wearables to pet dogs, power tools, lawn mowers and even hamster wheels to ensure a goal of physical activity is reached. As this is a reasonable concern, there seems to be no current solution except to ensure the child is motivated enough to try and reach his goals the honest way. The pediatrician stated that a specific group of "high functioning" children would be indeed inclined to try and cheat the system. For other children, she would try to envelope the serious game and wearable in a "magic" setting, where she would state that any attempts in cheating would be immediately noticed.

6.2.3. Loss of motivation / end of hype

In the example of Pokémon Go, which has been mentioned earlier, millions of people around the world used the game to walk around their city to catch virtual creatures, thereby "occasionally" increasing their physical activity. Freeman et al. noted that Pokémon Go has not been developed as an influencer for healthy behavior, and that the focus of public health should turned to mobile-based interventions that embrace please, rewards, participation and community (Freeman, Chau, & Mihrshahi, 2017). However, as fast as the Pokémon Go hype came to life, its popularity also decreased again within a short period of time (Althoff, White, & Horvitz, 2016). Both the child physical therapists, the pediatrician as well as the Psychologist and Health and Society graduates mentioned that a point of attention in developing a serious game would be the time until the game would become obsolete. As Drummond et al. assessed several serious games and their pros and cons, it becomes clear that developing a serious game that grabs attention and manages to keep it for a longer period of time, is not easy. He mentions three main points that should be discussed during the development of serious games; ensuring the learning activity in the game is desirable for the user, maximizing the learning potential, and evaluating the game to ensure its education is evidence-based. (Drummond, Hadchouel, & Tesnière, 2017) Based on both the statements from Drummond and Freeman, it might be concluded that a

combination of the best of both worlds, a game that is not developed specifically as an influencer for healthy behavior combined with a serious game that has a learning activity that is desirable for the user, might be the best option here. This also ensures that the game is not only focused on children with obesity, but all peers can join in on the game, ensuring stigmatization is less likely to take place. The pediatrician also suggested a game where the child is able to upgrade after certain amounts of time played. For example in the situation of a (Healthy Buddy, the child would be able to change the color of the animal after a month of playing, add accessories after half a year of playing and unlock new mini-games after a year of playing. She stated that the child would be more inclined to keep using the game if he or she experiences benefits from playing the game.

6.2.4. The increase of screen time

A concern posed by the respondents included the fact that children should decrease their screen time and be physically active, while using a serious game ironically increases screen time. However, Robinson et al. states that a decrease in screen time only leads to a small, incremental increase in physical activity. Children who are allowed more screen time apparently consume fewer healthy foods and more energy-dense snacks and fruits, consume more fats and have a higher energy-intake over the day. This is caused by the television distracting the child from the food, triggering or extending the eating process. Furthermore, current media food and beverage marketing is mostly focused on children instead of adults. (Robinson, et al., 2017) Therefore, the use of active video games or serious games in combination with wearables can be used to pull away children from the television and increase physical activity in the meantime.

6.3. To investigate

6.3.1. Transition from game to real life

One of the respondents and both the graduates in Psychology and Health and Society posed the question if there would be a transition from the use of the game and wearable to a sustainable healthy lifestyle change in real life. Peng et al. researched whether the use of a serious game had influence on the willingness to help of their research population against a control group not using the serious game. They found that the research population using the game showed an increase in their willingness to help after finishing the game compared to the control group. (Peng, Lee, & Heeter, 2010) Furthermore, Girard et al. executed a meta-analysis researching the effects of serious games. They found that the use of serious games in promoting health related behavior showed a positive effect. By ensuring the users are engaged and motivated by the game there are playing, the time until the user is “fatigued” with the game will be elongated, and a positive contribution will be made to the progress of the user. They motivate developers of serious games to achieve a compromise between the stimulating ways of engaging the players while keeping their attention focused on learning in the meantime. (Girard, Ecalle, & Magnant, 2012) Based on the statements from these researches, it can be said that the possibility that the children transition the learned skills from the serious game into real life is present if they are motivated to use the game and are freely allowed to play the game and implement the learned skills in their daily life. The pediatrician added to this that positive benefits for both the parents and the child would improve the chance of the lifestyle changes stimulated by the game while also improving the chance of sustainable changes.

7. Discussion

This research aimed to assess the opinion of medical professionals working with children with obesity on implementing the combination of serious games and wearables. According to scientific literature, this combination would be favorable, considering both the use of wearables and serious games have showed positive effects in changing the lifestyle of their users. However, there is currently still a lack of rigorous and trialing scientific research on whether the combination of the serious game and a wearable is suitable for use in children with obesity. As Schulz et al. concluded that children stand favorably towards this subject, the next step was to assess whether the medical professionals, the pediatricians, have a positive opinion (Schulz, Spil, & de Vries, 2017). After an exploratory conversation with a pediatrician, it turned out that the medical professionals relevant to the case of children with obesity were the physical therapists specialized on children. Pediatricians were only involved if the child had physical complaints. Therefore, the research population was changed to this subtype of medical professionals.

This study shows that, according to the physical therapists specialized in children and the pediatrician, the use of a serious game in combination with a wearable can have an added value in the process of helping children with obesity to attain a healthy lifestyle. As the number of people with obesity increases and several health risks of physical and psychological character are tied to pediatric obesity, there is a necessity to help children implement a healthy lifestyle. Serious games and wearables are modern technologies appealing to children, and therefore currently the most suitable option. As Spil et al. and Schulz et al. noted, consumers experience an overall positive attitude towards the combination of gamified apps and wearables, as it might have the power to create an engaging experience and influence behavioral change. (Schulz, Spil, & de Vries, 2017) (Spil, Thiebes, & Sunyaev, 2017)

The opinion of the physical therapists specialized in children was asked through a questionnaire with an open character. The questionnaire contained questions based on the literature review that was executed in this research. Furthermore, the gathered information was supplemented with knowledge from a second pediatrician and two graduates in the fields of Psychology, and Health and Society. All respondents expected that the combination of serious games and wearables provided the child, parents and medical professional insight in the child’s progress, and giving the child a modern technological and trendy solution to increase their motivation to implement a healthy lifestyle. They stated the requirements for; personalization of the goals of

the serious game for each child, the technology to be an addition to the current treatment plan instead of a replacement and that it should stimulate the child, its peers and preferably also its parents to work together. The mentioned limitations according to respondents included the option of the child trying to sabotage the process to be able to gain rewards while not being physically active, increasing screen time in a setting where screen time should be decreased in favor of physical activity, the possibility of the technology being a hype and the influence of parents on the process.

Therefore, developing a serious game and adding a wearable is not by default a successful formula. There are many factors that should be taken into account, including the influence and motivation of parents, financial aspects, the possibility of including peers and friends in a friendly competition, ensuring the game is still interesting after certain period of use, sustainability of the lifestyle changes and developing a catchy game the children are willing to use.

According to literature, several factors can be considered to increase the chance on a successful combination of a serious game and a wearable. To ensure the child stays motivated, visualizing progress and providing visual feedback through the game and the physical therapist might be the best solution. Furthermore, the technology should also be made in a way that peers can also engage in joining, indirectly providing social support and decreasing stigmatization. Parental influence might be converted from an inhibiting factor to an encouraging factor by ensuring the parents have a better understanding of the weight status of their child, by informing the parents and using the position and knowledge of the medical specialist. The option of children trying to sabotage the process might not yet have a solution except for trying to motivate the child and trying to convince the child that any attempts at cheating will be noticed. To prevent the game from only being a hype, the serious game should not specifically be designed as an influencer for healthy behavior, and should incorporate rewards only unlocked after certain goals are reached. As the use of the serious game might increase screen time, research by Robinson et al. stated that media food and beverage marketing is focused on children. By ensuring the child is not exposed to these kind of commercials, and ensuring there is sufficient motivation for the child to be physically active, the influence of increasing screen time will be negligible.

7.1. Limitations

For the purpose of this research, 8 physical therapists specialized in children were asked to fill in a questionnaire. These physical therapists were included during a meeting with a pediatrician, organized to talk about new technologies that could be implemented in the care process of children. Therefore, these physical therapists were already interested in new technologies and more open to implementing these technologies in their own practices. This factor ensured that the physical therapists were able to provide responses based on their own experiences with new technologies, which provided insight in the pros and cons of the combination of serious games and wearables. However, it can be assumed that some physical therapists in the Netherlands would not be this willing to discover new technologies and implement them in their treatment plans. Developing a serious game combined with a wearable might therefore not be as easily accepted by other physical therapists.

Furthermore, a better option in gathering opinions on serious games and wearables would have been through open interviews with the physical therapists instead of questionnaires. This would have allowed for more probing on exactly why the physical therapists are of a certain opinion. However, in the flow of this research, the questionnaire turned out to be the best option given the available resources.

In explaining the use of wearables and serious game in both the questionnaire and in the conversations with the pediatrician and the graduates in Psychology and Health and Society, a self-made Tamagotchi-based example dubbed “Healthy Buddy” was provided to give the respondents an understanding of how the technology would be used. To get a clearer opinion on the usability of the combination of a specific serious game and a wearable, a prototype should be designed and the respondents should be allowed to use it for a specific amount of time so they can get a feel of the technology. This ensures the respondents have a clear understanding of what the technology implicates and do not have to provide answers based on what they assume the technology looks like. However, it could be possible that the example of “Healthy Buddy” might have influenced the opinion of the respondents as they weren’t given the option of visualizing their own combination of a serious game and a wearable. This should also be taken into account when introducing a prototype.

7.2. Recommendations and future research

Implementing a serious game and a wearable in the process of battling obesity seems to be an innovative way of trying to motivate children to uptake a healthy lifestyle. Based on this research, physical therapists and pediatricians were enthusiastic about the idea of trying the technology in their treatment plans. As both children (Schulz, Spil, & de Vries, 2017) and, apparently also medical professionals had a positive opinion on this technology, it might be assumed that parents would also stand favorably. However, this should be checked, as parents have a very influential role in the success of the technology and a lack of their support has influence on the success of their children. For further research, the recommendation can be made to ensure some kind of prototype of a serious game and wearables are available for the research population, both children and their parents, to try for a certain amount of time. This would allow the research population to get a better look and feel of the technology and therefore also more specific answers on whether the specific technology would be implementable and which improvements should be considered.

For a prototype of the serious game and wearable to be developed, certain guidelines that should be taken into account in the developing process came forward in this research. First of all, the game should not be specifically aimed at children with obesity. It should be playable and enjoyable by all peers of the child with obesity. This ensures stigmatization based on the game will be limited. Furthermore, the game might incorporate characters from tv series or games the children are known with or be promoted by persons the children look up to. Based on the success of Pokémon Go it seems that using well-known or relatable characters ensure the game is also likeable for both children with and without obesity and might increase motivation to play. The game should include friendly competition between players and use visual cues and feedback on progress. Lastly, the game should provide the children with education on sustainable changes in lifestyle.

As a final note, it should be researched whether Virtual Reality has the ability to play a role in the process of letting children use a wearable and a serious game to learn how to live a healthy lifestyle. By allowing the child to be literally surrounded by the game, being able to be physically active and seeing the progress they made in real-time in the game, a whole new and perhaps even more successful technology might be implemented in the future.

8. Conclusion

The main objective of this study was to assess the opinion of the medical professional, in this case specifically the physical therapist specialized in children, on the use of a wearable and a serious game to coach children with obesity to a healthy lifestyle. According to this research, the physical therapists specialized in children were very enthusiastic about the option of implementing a serious game and a wearable in their treatment sessions, as they felt that the technology enabled children to see the progress made, the therapists and parents had insight into and control over the progress made and were able to provide feedback based on that data. They felt the technology is a trendy solution based on the wishes of modern society.

Based on the results of this study, it can be said that further research into using a serious game and a wearable in the treatment of children with obesity would be recommendable, especially focused on stimulation and motivation of parents and the specific design of the game, possibly even the use of VR. This research found that the ideal serious game for use with a wearable should consist of a game with well-known or relatable characters focused on not only overweight children but also their peers, an option for friendly competition, options for visual feedback and rewards both from the game as well as from the therapist, recurring novelty “unlocks” or “updates”, and educational aspects of transitioning into a healthy lifestyle. Ideally, the combination of the wearable and the serious game should be budget friendly. If all of these factors are taken into account, success is possible.

9. What should the game look like?

Based on the literature review and the opinions from the respondents, the pediatrician and the graduates in Psychology and Health and Society, an image of how the game might look like can be set out. Below, an overview of the points of attention that should be taken into account when developing a serious game combined with a wearable is given. However, it should be stressed that developing the most optimal, most motivating game in this setting is not with certainty a key to success, as there are several other factors influencing the children. For example, a child that is playing the game but does not have motivated parents that are willing to support, will have a lesser chance to succeed.

The most important part of the game should comprise of motivating the child to play the game. This can be accomplished by, first of all, ensuring the game incorporates a known (anime) character or series. Based on the success of Pokémon Go, it appears that children are drawn to the characters they are already interested in. Another possible way to interest the child might be to involve persons the children are looking up to, like vloggers on Youtube or music artists, and asking them to promote the game and the wearable. Secondly, the game should not only be designed for children with obesity, as to avoid stigmatization and ensure peers are also willing to play the game. By developing a game that is enjoyable and interesting for “normal” children, while also incorporating ways to ensure “overweight” children increase their physical activity and take on a healthy lifestyle, both the stigmatization effect and playing with peers problems are solved. By incorporating a (friendly) competitive aspect, motivation to succeed in the game might also increase.

Furthermore, the game should include an aspect of feedback and show progress in a visual form. As shown in literature, feedback provides stimulation to pursuit the goal of the game. Showing the child that it has made progress provides a bigger chance of the child still being motivated to play the game, as it influences the child’s self-efficacy and self-regulation

The game should also provide the child with guidance to taking on a more healthy lifestyle. It should make it clear to the child, in an age-appropriate way, why it is sensible for the child to take on a healthy lifestyle instead of only prompting the consumption of fruit at a certain time during the day. This might also positively change the lifestyle of overweight children not in treatment with a physical therapist specialized in children. Ensuring the child knows why it is taking on a healthy lifestyle might also discourage children from trying to cheat the system,

however, being modern tech-savvy and therefore trying to find “lazy” ways to reach goals can never be fully halted.

Furthermore, the game should provide an option for physical therapists of children with obesity to keep track of progress. It should be the possibility for the physical therapist to check whether the child (attempted) to reach his goals. This ensures the physical therapists have more control and more insight in pattern of food intake and physical activity. Ideally, the game should also provide the physical therapists with an option to reward a child for its progress.

To ensure children are still playing the game after a year, it should incorporate options that are only unlocked after the child has played for a specific amount of time or after it has performed a certain amount of physical activity. For the “Healthy Buddy” example, options of changing skin color, unlocking mini-games and “buying” accessories have been opted. By giving the children the possibility to experience a novelty factor in the game, the children might be stimulated to keep using the game.

Summarizing this chapter, the game should ideally involve a character or series the child is interested in, not only be designed for children with obesity to encourage playing with peers, include feedback, rewards, novelty, show progress in a visual way and educate the user on taking up a healthy lifestyle.

10. References

Almoosawi, S., Jones, A. R., Parkinson, K. N., Pearce, M. S., Collins, H., & Adamson, A. J. (2016). Parental Percention of Weight Status: Influence on Children's Diet in the Gateshead Millennium Study. *PLOS One*. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4757535/

Althoff, T., White, R. W., & Horvitz, E. H. (2016). Influence of Pokémon Go on Physical Activity: Study and Implications. *Journal of Medical Internet Research*. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5174727/

ARS technica. (2017, 02 04). *How wearable heart-rate monitors work, and which is best for you*. Retrieved from https://arstechnica.com/gadgets/2017/04/how-wearable-heart-rate-monitors-work-and-which-is-best-for-you/

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist*, 122-147.

Baughcum, A. E., Burklow, K. A., Deeks, C. M., Powers, S. W., & Whitaker, R. C. (1998). Maternal feeding practices and childhood obesity: a focus group study of low-income mothers. *Archives of pediatrics & adolescent medicine*. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/9790612

Broussard, S. C., & Garrison, M. E. (2004). The relationship between classroom motivation and academic achievement in elementary school-aged children. *Family and Consumer Sciences Research Journal*, 106-120.

Callender, C., & Thompson, D. (2017). Text Messaging Based Obesity Prevention Program for Parents of Pre-Adolescent African American Girls. *Children*. Retrieved from http://www.mdpi.com/2227-9067/4/12/105/htm

Clark, H. R., Goyder, E., Bissell, P., Blank, L., & Peters, J. (2007). How do parents' child-feeding behaviours influence child weight? Implications for childhood obesity policy. *Journal of Public Health*, 132-141. Retrieved from https://academic.oup.com/jpubhealth/article/29/2/132/1505733

Davison, K. K., & Birch, L. L. (2001). Childhood overweight: a contextual model and recommendations for future research. *Obesity Reviews*, 159-171. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2530932/

Deterding, S., Khaled, R., Dixon, D., & Nacke, L. (2011). From Game Design Elements to Gamefulness: Defining Gamification. *Mindtrek '11.*

Dietz, W. H. (1998). Health Consequences of Obesity in Youth: Childhood Predictors of Adult Disease. *Pediatrics*, 518-525. Retrieved from http://pediatrics.aappublications.org/content/101/Supplement_2/518.long

Drummond, D., Hadchouel, A., & Tesnière, A. (2017). Serious games for health: three steps forward. *Advances in Simulation*. Retrieved from https://advancesinsimulation.biomedcentral.com/articles/10.1186/s41077-017-0036-3

Eisenberg, M. E., Neumark-Sztainer, D., & Story, M. (2003). Associations of weight-based teasing and emotional well-being among adolescents. *Archives of Pediatric and Adolescent Medicine*, 733-738. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/12912777

Fishbach, A., Eyal, T., & Finkelstein, S. R. (2010). How Positive and Negative Feedback Motivate Goal Pursuit. *Social and Personality Psychology Compass*, 517-530. Retrieved from https://faculty.chicagobooth.edu/ayelet.fishbach/research/FEF%20Compass%202010.pdf

Freeman, B., Chau, J., & Mihrshahi, S. (2017). Why the public health sector couldn't create Pokémon Go. *Public Health Research & Practice*. Retrieved from http://www.phrp.com.au/wp-content/uploads/2017/07/PHRP2731724.pdf

Fusch, P. I., & Ness, L. R. (2015). Are We There Yet? Data Saturation in Qualitative Research. *The Qualitative Report*, 1408-1416. Retrieved from https://nsuworks.nova.edu/cgi/viewcontent.cgi?referer=https://www.google.nl/&httpsredir=1&article=2281&context=tqr

Girard, C., Ecalle, J., & Magnant, A. (2012). Serious games as new educational tools: how effective are they? A meta-analysis of recent studies. *Journal of Computer Assisted Learning*, 207-219. Retrieved from file:///D:/Persoonlijke%20bestanden/Downloads/13JCALGirardetalseriousgames.pdf

Gortmaker, S. L., Must, A., Perrin, J. M., Sobol, A. M., & Dietz, W. H. (1993). Social and Economic Consequences of Overweight in Adolescence and Young Adulthood. *The New England Journal of Medicine*, 1008-1012. Retrieved from http://www.nejm.org/doi/full/10.1056/NEJM199309303291406#t=article

Guest, G., Bunce, A., & Johnson, L. (2006). How Many Interviews are Enough? *Sage Journals*, 59-82. Retrieved from http://journals.sagepub.com/doi/pdf/10.1177/1525822X05279903

Guixeres, J., Saiz, J., Alcaniz, M., Cebolla, A., Escobar, P., Banos, R., . . . Lurbe, E. (2013). Effects of Virtual Reality during Excercise in Children. *Journal of Universal Computer Science*, 1199-1218. Retrieved from https://pdfs.semanticscholar.org/bcce/20e219157965bc7fef295881dd704a19c417.pdf

Hartman, S. J., Nelson, S. H., Cadmus-Bertram, L. A., Patterson, R. E., Barbara, A. P., & John, P. P. (2016). Technology- and Phone-Based Weight Loss Intervention; Pilot RCT in Women at Elevated Breast Cancer Risk. *American Journal of Preventative Medicine*, 714-721. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5502803/

Hurling, R., Catt, M., De Boni, M., Fairley, B. W., T, H., Murray, P., . . . Singh Sodhi, J. (2007). Using Internet and Mobile Phone Technology to Deliver an Automated Physical Activity Program: Randomized Controlled Trial. *Journal of Medical Internet Research*. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1874722/

Johnson, D., Deterding, S., Kuhn, K., Staneva, A., Stoyanov, S., & Hides, L. (2016). Gamification for health and wellbeing: a systematic review of the literature. *Internet Interventions*, 89-106. Retrieved from https://reader.elsevier.com/reader/sd/1D35B2252823C7D67FCB2CB45F04DA07FC9FA32B249C3DC8BEF0D1BBBA0FF13DCD0C86D346D9BE79A19158C331AF22C2

Kar, S. S., Dube, R., & Kar, S. S. (2014). Childhood Obesity- An insight in preventive strategies. *Avicenna Journal of MEdicine*, 88-93. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4183902/

Kurti, A. N., & Dallery, J. (2013). Internet-based contingency management increased walking in sedentary adults. *Journal or Applied Behaviour Analysis*, 568-581. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/24114220/

Lai, E. R. (2011). Motivation: A Literature Review. *Pearson Assessments*. Retrieved from https://images.pearsonassessments.com/images/tmrs/Motivation_Review_final.pdf

Laing, B. Y., Mangione, C. M., Tseng, C., Leng, M., Vaisberg, E., Mahida, M., . . . Bell, D. S. (2014). Effectiveness of a smartphone application for weight loss compared to usual care in overweight primary care patients: a randomized controlled trial. *Annals of Internal Medicine*, 5-12. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4422872/

Lemstra, M., Bird, Y., Nwankwo, C, Rogers, M., & Moraros, J. (2016). Weight loss intervention adherence and factors promoting adherence: a meta-analysis. *Patient Preference and Adherence*, 1547-1559. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4990387/

Lin Tzou, I., & Chu, N. (2012). Parental influence on childhood obesity: a review. *Health*, 1464-1470. Retrieved from https://file.scirp.org/pdf/Health_2012123112452366.pdf

Lister, C., West, J. H., Cannon, B., Sax, T., & Brodegard, D. (2014). Just a Fad? Gamification in Health and Fitness Apps. *JMIR Serious Games*. Retrieved from https://games.jmir.org/2014/2/e9/

Lobstein, T., Baur, L., & Uauy, R. (2004). Obesity in children and young people: a crisis in public health. *Obesity Reviews*, 4-85. Retrieved from http://onlinelibrary.wiley.com/doi/10.1111/j.1467-789X.2004.00133.x/full

Maslakovic, M. (2018, 03 18). *More school kids are using smartwatches to cheat in exams*. Retrieved from Gadgets and Wearables: http://gadgetsandwearables.com/2018/03/18/students-smartwatch/

MedicineNet.com. (n.d.). *Pedometers*. Retrieved from https://www.medicinenet.com/pedometers/article.htm#what_are_the_benefits_of_stepping_out_with_pedometers

National Institute of Diabetes and Digestive and Kidney Diseases. (2012, December). *Understanding Adult Overweight and Obesity*. Retrieved from https://www.niddk.nih.gov/health-information/weight-management/adult-overweight-obesity

National Institute of Diabetes and Digestive and Kidney Diseases. (2015, February). *Health Risks of Being Overweight*. Retrieved from https://www.niddk.nih.gov/health-information/weight-management/health-risks-overweight

National Institute of Diabetes and Digestive and Kidney Diseases. (2016, July). *Types of Bariatric Surgery*. Retrieved from https://www.niddk.nih.gov/health-information/weight-management/bariatric-surgery/types

National Institutes of Health. (2017, April 13). *Rates of new diagnosed cases of type 1 and type 2 diabetes on the rise among children, teens*. Retrieved from https://www.nih.gov/news-

events/news-releases/rates-new-diagnosed-cases-type-1-type-2-diabetes-rise-among-children-teens

NHS. (2016, June). *Obesity Overview*. Retrieved from https://www.nhs.uk/conditions/obesity/#defining-obesity

NHS. (2016, June). *Obestiy Diagnosis*. Retrieved from https://www.nhs.uk/conditions/obesity/diagnosis/

Paez, S., Maloney, A., Kelsey, K., Wiesen, C., & Rosenberg, A. (2009). Parental and Environmental Factors Associated with Physical Activity Among Children Participating in an Active Video Game. *Pediatric Physical Therapy*, 245-253. Retrieved from https://journals.lww.com/pedpt/Fulltext/2009/02130/Parental_and_Environmental_Factors_Associated_with.5.aspx/?trendmd_shared=0

Pautasso, M. (2013). Ten Simple Rules for Writing a Literature Review. *PLOS Computational Biology*. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3715443/

Peng, W., Lee, M., & Heeter, C. (2010). The Effects of Serious Game on Role-Taking and Willingness to Help. *Journal of Communication*, 723-742. Retrieved from https://pdfs.semanticscholar.org/0aae/80b62943f9cf11f0c4f154d5d37748c25831.pdf

Piwek, L., Ellis, D. A., Andrews, S., & Joinson, A. (2016). The Rise of Consumer Health Wearables: Promises and Barriers. *PLOS Medicine*, http://journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.1001953.

Plowman, L. (2015). Researching Young Children's Everyday Uses of Technology in the Family Home. *Interacting with Computers*, 36-46. Retrieved from https://academic.oup.com/iwc/article/27/1/36/2357500

Pont, S. J., Puhl, R., Cook, S. R., & Slusser, W. (2017). Stigma Experienced by Children and Adolescents with Obesity. *American Academy of Pediatrics*. Retrieved from http://pediatrics.aappublications.org/content/pediatrics/early/2017/11/16/peds.2017-3034.full.pdf

Rabiee, F. (2004). Focus Group interview and data analysis. *Proceedings of The Nutrition Society*. Retrieved from https://www.researchgate.net/publication/7906250_Focus_Group_interview_and_data_analysis

Robinson, E., & Sutin, A. R. (2016). Parental Perception of Weight Status and Weight Gain Across Childhood. *Pediatrics*. Retrieved from http://pediatrics.aappublications.org/content/137/5/e20153957

Robinson, T. N., Banda, J. A., Hale, L., Lu, A. S., Fleming-Milici, F., Calvert, S. L., & Wartella, E. (2017). Screen Media Exposure and Obesity in Children and Adolescents. *Pediatrics*, 97-101. Retrieved from Barriers to and motivators for physical activity among people with Type 2 diabetes: patients' perspectives

Rosik, C. H. (2005). Psychiatric symptoms among prospective bariatric surgery patients: rates of prevalence and their relation to social desirability, pursuit of surgery, and follow up attendance. *Obesity Surgery*, 677-683. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/15946460

Sahoo, K., Sahoo, B., Choudhury, A. K., Sofi, N. Y., Kumar, R., & Bhadoria, A. S. (2015). Childhood Obesity: causes and consequences. *Journal of Family Medicine and Primary Care*, 187-192. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4408699/

Saunders, B., Sim, J., Kingstone, T., Baker, S., Waterfield, J., Bartlam, B., . . . Jinks, C. (2017). Saturation in qualitative research: exploring its conceptualization and operationalization. *Quality and Quantity*, 1-15. Retrieved from https://link.springer.com/article/10.1007/s11135-017-0574-8

Schulz, L., Spil, A. A., & de Vries, S. A. (2017). Gamified wearables in obesity therapy for youth-Successful Fundamental app design guidelines. *Masterthesis*. Retrieved from http://essay.utwente.nl/72929/1/Schulz_MA_BMS.pdf

Segula, D. (2014). Complications of Obesity in Adults; a short review of the literature. *Malawi Medical Journal*, 20-24. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4062780/

Shaw, R., & Bosworth, H. (2013). Short Message Service (SMS) Text Messaging as an Intervention Medium for Weigh Loss; A Literature Review. *Health Informatiocs Journal*, 235-250. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3675895/

Spil, T., Thiebes, S., & Sunyaev, A. (2017). The Adoption of Wearables for a Health Lifestyle: Can Gamification Help? *Hawaii International Conference on System Sciences 2017.*

Staffieri, R. J. (1967). A study of social stereotype of body image in children. *Journal of Personality and Social Pshychology*, 101-104. Retrieved from http://psycnet.apa.org/record/2005-11105-001

Staiano, A. E., Abraham, A. A., & Calvert, S. L. (2012). The Wii Club: Gaming for Weight Loss in Overweight and Obese Youth. *Games for Health Journal*, 377-380. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3616880/

Strauss, R. S., & Pollack, H. A. (2003). Social marginalization of overweight children. *Archives of Pediatrics and Adolescent Medicine*, 746-752. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/12912779

Sugiyama, T., Horino, M., Inoue, K., Kobayashi, Y., Shapiro, M. F., & McCarthy, W. J. (2016). Trends of Child's Weight Perception by Children, Parents, and Healthcare Professionals during the Time of Terminology Change in Childhood Obesity in the United States, 2005–2014. *Childhood Obesity*, 463-473. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5107670/

Tom's Guide. (2017, 11 05). *Smartwatch buying guide: Everything you need to know*. Retrieved from https://www.tomsguide.com/us/smartwatch-buying-guide,review-3360.html

Turconi, G. (2012). Home Environment and Children Obesity: What a Parent has to Do. *Journal of Nutrition & Food Sciences*. Retrieved from https://www.omicsonline.org/home-environment-and-children-obesity-what-a-parent-has-to-do-2155-9600.1000e118.php?aid=10639

University of Twente - Pioneers in Health Care. (n.d.). *Doelstellingen van PHIC*. Retrieved from https://www.utwente.nl/business/ut-als-onderzoekspartner/innovatie-programmas/pioneers-in-healthcare/doelstellingen/#duurzame-samenwerking

White, D. A., Rofey, D. L., Kriska, A. M., Venditty, E. M., Gibbs, B. B., Gallagher, J. D., & Jakicic, J. M. (2016). PArental Influences on Child Weight: Perception, Willingness to Change, and Barriers. *Journal of Obesity and Weight Loss Therapy*. Retrieved from https://www.omicsonline.org/open-access/parental-influences-on-child-weight-perception-willingness-to-changeand-barriers-2165-7904-1000293.php?aid=67373

Wieczner, J. (2016, 06 10). *Fitbit Users Are Finding Creative Ways to Cheat*. Retrieved from Fortune.com: http://fortune.com/2016/06/10/fitbit-hack-cheat/

Wolfswinkel, J. F., Furtmueller, E., & Wilderom, C. P. (2013). Using grounded theory as a method for rigorously reviewing literature. *European Journal of Information Systems*, 45-55.

Wong, F. (2017). Influence of Pokémon Go on physical activty levels of university players: a cross-sectional study. *International Journal of Health Geographics*. Retrieved from https://ij-healthgeographics.biomedcentral.com/articles/10.1186/s12942-017-0080-1

World Health Organization. (2017, October). *Obesity and Overweight Fact Sheet*. Retrieved from http://www.who.int/mediacentre/factsheets/fs311/en/

11. Appendix

11.1 Appendix A: Overview of wearables

11.2 Appendix B: Questionnaire for medical professionals

11.3 Appendix C: Coding the open questions

11.1. Appendix A – Overview of wearables

1.1 Smartwatches

A smartwatch is a bracelet with a built in computer and display. It can be used for tasks like calculations, show a digital clock, game playing, function as a portable media player or even as an extension of a personal smartphone. Smartwatches have a rechargeable battery and a touchscreen, and they are fitted with “peripheral devices” as necessary for the function the smartwatch has, like a camera, accelerometer, heart rate monitor, microphone, compass, GPS receiver, speakers and a thermometer.

There are several producers of Smartwatches, for example Apple, Samsung, LG, Garmin, Huawei and Fitbit and they differ on several aspects, like size, casing, compatibility with Android or IPhone, option of being connected without smartphone around, handling of the screen or the presence of buttons, water resistance, speaker or phone function, heart rate sensor, activity tracker and price range. (Tom's Guide, 2017)

Below is an overview of different smartwatches that were popular in 2017 and their characteristics. Information about the devices has been collected from the Techradar website (https://www.techradar.com/reviews/wearables)

Make	Apple Watch	LG Watch
Model	2	R
Review	Can be used while swimming; has a function to block the screen and	Attractive watch with a physical power button. Bright, vibrant screen. Android
Speaker	Yes	Yes
Calls	Yes	Yes
Activity tracker	Yes	Yes
GPS	Yes	No
Water resistance	Resistant	Resistant
Compatibility	IOS	Android
Size (width/thickness/weight)	36 mm / 11 mm / 34 g	53 mm / 9,7 mm / 62g
Release Date	September 2016	February 2017
Price range	€350-€500	€400-€450

Huawei Watch	Samsung Gear	Apple Watch
2	S3	3
A bit sluggish performance and	Long lasting battery, GPS, heart rate monitor, NFC, altimeter and	Very good quality speaker and microphone. Changing
Yes	Yes	Yes
Yes	Yes	Yes
Yes	Yes	Yes
Yes	Yes	Yes
Resistant	Resistant	Resistant
Android/IOS	Android/IOS	IOS
45 mm / 12 mm / 40 g	49 mm / 13 mm / 62 g	36 mm / 11 mm / 32 g
April 2017	November 2016	September 2017
€370 -€440	€300- €400	€325-€400

1.2 Heart rate monitor

There are two different types of heart rate monitors on the market. The first type is the chest strap, which is a long elastic band that can be positioned on the chest, with a small electrode pad. As the wearer works out, the skin gets moist from sweat, which helps the pad to pick up electrical signals given off by the heart, which are then processed to the transmitter. In early times, the transmitter provided the information to wrist-worn bracelet with a display. Currently, it is possible to send the data via Bluetooth to other wearables or mobile apps.

A different type of heart rate monitor is the optical monitor. These types of heart rate monitors are mostly present in modern smartwatches and work with a principle called “photoplethysmography”. Wearables with this kind of heart rate monitor have small LEDs on their undersides which are used to measure bloodflow. As the light refracts off the bloodflow under the skin or reflects on the skin itself, this information is then send back to a sensor within the device. Together with information provided by the accelerometer in the device, this is then converted into pulse readings. (ARS technica, 2017)

1.3 Pedometers

Pedometers are devices that register every step a wearer has made. There are 2 different types of pedometers. The first type is spring-levered. In this type, a spring-suspended horizontal lever moves as a response to movement. The device is attached to the hip, and with every step, the lever makes contact with the electrical circuit and therefore registers a step. This device can only work if the person moves on a vertical plane.

The second type of pedometers is piezoelectic. These function on the principle that a certain material generates electric charge when deformed. With every step, a beam with a weight on it compresses a piezoelectric crystal, which then generates a voltage that is proportional to the intensity of the movement. Both kinds of pedometers are accurate at movement speeds above 3 miles per hour, below that speed they become increasingly inaccurate. (MedicineNet.com, sd)

11.2. Appendix B – Questionnaire for medical professionals

Vragenlijst combinatie serious gaming en wearables bij kinderen met overgewicht

Deze enquete is opgesteld in het kader van een onderzoek naar de vraag of het mogelijk is om kinderen met overgewicht te motiveren om een gezondere leefstijl aan te nemen met behulp van de combinatie van serious gaming en wearables. Hoewel de literatuur er al een lovende uitspraak over gedaan heeft, is het nog onduidelijk hoe de medische professional tegenover deze ontwikkeling staat. Met behulp van deze enquête hopen wij een beter beeld te krijgen van de opinie van de medische professional op dit gebied.

De gegevens die in dit onderzoek worden verzameld, zullen vertrouwelijk behandeld worden en zullen in de onderzoeksresultaten niet tot u als persoon herleidbaar zijn. Het invullen van de vragenlijst zal zo'n 10-15 minuten duren.

Bij voorbaat dank voor uw medewerking!

Algemene gegevens

Geslacht: M / V

Leeftijd: ……

Hoe lang bent u al werkzaam in uw vakgebied? …... jaar

Hoeveel individuele kinderen die onder de categorie “overgewicht” of “obees” vallen heeft u onder behandeling?

- □ *0-10 kinderen*
- □ *10-30 kinderen*
- □ *30 – 50 kinderen*
- □ *>50 kinderen*

Wat vindt u de grootste bijdragende factor aan het overgewicht van deze kinderen?

- □ *Invloed vanuit ouders of familie*
- □ *Beschikbaarheid van ongezond voedsel t.o.v. gezond voedsel*
- □ *Beschikbaarheid van gameconsoles en tv-programma’s*
- □ *Anders, namelijk;*

  ……

  ……

Wat is volgens u de beste manier om kinderen met overgewicht of obesitas te helpen met het aannemen van een gezonde leefstijl?

Wat mist u op dit moment nog in uw behandelmethoden om kinderen met overgewicht beter te helpen met het aannemen van een gezonde leefstijl?

Wearables

Een wearable is een apparaat dat metingen van gemaakte bewegingen van het lichaam omzet in zichtbare digitale output. Denk hierbij aan een smartwatch, een stappenteller of een hartslagmeter.

Gebruikt u een wearable of kent u mensen in uw directe omgeving die een wearable gebruiken?

- □ *Ja, ik gebruik zelf een wearable, namelijk een ……*
- □ *Ja, iemand in mijn omgeving gebruikt wearables, namelijk ……*
- □ *Nee, ik heb geen ervaring met wearables*

Indien u **wel** gebruik maakt van wearables of mensen in uw directe omgeving kent die wearables gebruiken, denkt u dat deze technologie toegepast kan worden om kinderen met overgewicht te motiveren om een gezondere leefstijl aan te nemen? *(Bijvoorbeeld door aan het kind te vragen om dagelijks minimaal 4000 stappen te zetten en dit te zelf ook bij te houden met de stappenteller)*

□ Ja, want

□ Nee, want

Indien u **geen** wearables kent of gebruikt, zou u zich dan voor kunnen stellen dat deze technologie gebruikt kan worden om kinderen met overgewicht te motiveren om een gezondere leefstijl aan te nemen? *(Bijvoorbeeld door aan het kind te vragen om dagelijks minimaal 4000 stappen te zetten en dit zelf ook bij te houden met de stappenteller)*

□ Ja want

□ Nee want

Indien u denkt dat met behulp van een wearable kinderen gemotiveerd kunnen raken om een gezondere leefstijl aan te nemen, wat zouden dan volgens u de voordelen van deze technologie zijn?

Wat zijn volgens u de nadelen van het gebruik van deze technologie ?

Serious games

Een serious game is een spel dat bedoeld is om de gebruiker naast plezier en ontspanning ook een leerzame ervaring te geven en zijn gedrag (positief) te beïnvloeden. Enkele voorbeelden van serious games zijn bijvoorbeeld:

- Nintendo Sport op de Nintendo Wii; met behulp van een controller met daarin bewegingssensoren kan de speler verschillende sporten uitoefenen die gesimuleerd worden op beeld. Zo kan de speler bijvoorbeeld tennissen, yoga doen, hardlopen of bowlen. De speler kan een beweegdoel instellen en het spel probeert te motiveren om dit doel te halen.
- Pokémon Go; de speler kan met behulp van zijn smartphone op zoek naar Pokémons, animatiekarakters uit een bekende tv-serie, in zijn omgeving en die proberen te verzamelen. Hoe groter de afstand is die de speler aflegt, hoe groter het aantal (zeldzame) Pokémons hij kan verzamelen.

Kent u of gebruikt u serious games?

- □ *Ik ken serious games maar ik gebruik ze niet*
- □ *Ik gebruik serious games of heb serious games gebruikt*
- □ *Ik ken geen serious games*

Denkt u dat het gebruik van een serious game, zoals bijvoorbeeld het hierboven genoemde Nintendo Wii of Pokémon Go, bij kan dragen aan het motiveren van kinderen met obesitas/ overgewicht om meer te bewegen en een gezondere leefstijl aan te nemen? Motiveer uw antwoord.

Wat zouden volgens u voordelen zijn van het implementeren van een serious game in de behandeling van een kind met overgewicht?

Wat zouden volgens u de nadelen zijn van het implementeren van een serious game in de behandeling van een kind met overgewicht?

Indien een serious game gekoppeld zou worden aan een wearable, zou u dan overwegen om dit te gebruiken in uw behandeling? *(Bijvoorbeeld het eerder genoemde Pokémon Go koppelen aan een stappenteller, zodat een kind dat een 4000 stappen gezet heeft, een minigame kan doen en daarmee een bijzondere Pokémon kan verdienen)*

- Ja, want

- Nee, want

Indien nee, wat zou er volgens u moeten veranderen voordat u zou overwegen om de combinatie serious games en wearables te gebruiken?

Indien ja, wat zouden voor u voorwaarden zijn waaraan voldaan moet worden voordat u de combinatie serious games en wearables in uw behandelmethode toe zou willen voegen?

Stelt u zich voor dat de kinderen die u behandelt de beschikking hebben over een stappenteller met daaraan een serious game gekoppeld. De serious game, voor deze situatie benoemd tot “Healthy Buddy” en afgekort tot “***HB***”, bestaat uit een interactief spel waarin het kind verantwoordelijk is voor een digitaal huisdier. Door per dag een x- aantal stappen te zetten, verdient het kind muntjes (hoe meer stappen, hoe meer muntjes). Met deze muntjes kan hij eten en toebehoren “kopen” voor zijn huisdier, maar ook spelletjes vrijspelen die hij met zijn digitale huisdier of met andere kinderen die over dezelfde game beschikken, kan spelen. Daarnaast heeft het kind de optie om op een schaal van 1-10 een eigen beoordeling te geven aan zijn eetpatroon van de afgelopen dag, wat ook weer beloond wordt met muntjes (hoe gezonder, hoe meer muntjes). U kunt via een online omgeving inzien hoe veel stappen het kind gezet heeft in de dagen en/of weken en wat voor score hij zijn eigen eetpatroon gegeven heeft. Ook heeft u de mogelijkheid om beloningsmuntjes toe te kennen aan kinderen die regelmatig hun eigen eetpatroon als gezond beoordelen en voldoende stappen zetten.

Indien u de situatie met daarin de serious game “***HB***” vergelijkt met uw huidige situatie waarin u kinderen met overgewicht begeleidt, wat is dan uw mening over de volgende stellingen?

	Helemaal mee eens	Mee eens	Neutraal	Niet mee eens	Helemaal niet mee
Ik zou positief tegenover het gebruik van ***HB*** staan indien het een bestaand spel zou zijn					
Met ***HB*** verwacht ik meer inzicht in het beweegpatroon van het kind in de thuissituatie te krijgen ten opzichte van de huidige situatie					
Met ***HB*** verwacht ik meer inzicht in het eetpatroon van het kind in de thuissituatie te krijgen ten opzichte van de huidige situatie					
Met ***HB*** verwacht ik meer inzicht in de mentale gesteldheid van het kind te krijgen ten opzichte van de huidige situatie					
Ik kan in de huidige situatie voldoende tijd besteden aan het geven van benodigde coaching aan het kind					
Ik kan in de huidige situatie het kind voldoende ondersteuning geven waar nodig					

HB zou voor mij een toegevoegde waarde hebben ten opzicht van de huidige situatie					
Ik kan het kind in de huidige situatie voldoende motiveren om een positieve gedragsverandering teweeg te brengen					
Met ***HB*** verwacht ik dat het kind voldoende motivatie krijgt om een positieve gedragsverandering teweeg te brengen					
HB zal na een jaar nog steeds interessant zijn voor kinderen om te gebruiken					
De behandeling zoals ik deze geef in de huidige situatie is ruim voldoende om kinderen een gezonde leefstijl aan te leren					
Ik verwacht dat ik kinderen via het gebruik van ***HB*** beter kan helpen een gezonde leefstijl aan te laten nemen ten opzichte van de huidige situatie					

Dit is het einde van de vragenlijst. Hartelijk dank voor uw deelname!

Indien u na afloop van het onderzoek op de hoogte gebracht wilt worden van de resultaten, kunt u hieronder uw emailadres invullen. Er zal dan een samenvatting naar u opgestuurd worden

zodra het onderzoek afgerond is.

Indien u bereid zou zijn om, mochten er onduidelijkheden uit de analyse van de resultaten komen, een mondelinge toelichting te geven, zou u dan zo vriendelijk willen zijn hieronder uw naam en emailadres in te vullen?

Naam:

Emailadres:

Mocht u zelf nog vragen hebben naar aanleiding van deze vragenlijst, kunt u contact opnemen met Mireille Scholten, Masterstudent Health Sciences, Universiteit Twente. Emailadres: m.scholten-3@student.utwente.nl

11.3. Appendix C – Coding the open questions

Below, the answers of the respondents of the questionnaire are provided, together with the codes linked to their answers, as used to write the results section

Wat is volgens u de beste manier om kinderen met overgewicht of obesitas te helpen met het aannemen van een gezonde leefstijl?		Code
1	een leefstijl interventie multidisciplinair, diëtist, psycholoog en kinderft/sportcoach	LF + MT
2	kinderen moeten het van huisuit mee krijgen. Gezond eten, voldoende bewegen.	LF
3	Lifestyl verandering van het gezin	LF
4	Samen met ouders aanpassen van beweeg en eet gewoontes, minder schermtijd, meer activiteit	LF
5	gezonde voeding i.c.m. (plezier in!) voldoende bewegen	LF
6	Multidisciplinaire aanpak met grote rol kinderpsycholoog / systeem aanpak	MT
7	Beweging verhogen, voedinspatroon aanpassen en het gedrag van ouders / kind en omgeving beinvloeden dmv voorlichting	LF
8	De leuke kant van bewegen laten zien. Inzicht geven en daarbij heel duidelijk en soms ook hard zijn.	BW

LF=leefstijlverandering, MT= multidisciplinaire aanpak, BW= bewegen motiveren.

Wat mist u op dit moment nog in uw behandelmethoden om kinderen met overgewicht beter te helpen met het aannemen van een gezonde leefstijl?		Code
1	controle op voeding en beweging en samenwerking	CT
2	ik mis niets, maar het blijkt enorm lastig om ouders te motiveren om kinderen te helpen en het goede voorbeeld te geven.	PT
3	Controle dmv harde inzichten over inname voeding versus beweging e	CT
4	Controle, motivatie van kind en zijn omgeving. Manieren om een gezondere leefstijl leuker te maken	CT+ PT + LE
5	motivatie, betrokkenheid familie	PT
6	Ouderbetrokkenheid kunnen vergroten (geen geld vanuit gemeente)	PT + MO
7	Wij maken gebruik van Cool2BFit, een wetenschappelijk onderbouwd programma waarbij bovengenoemde aspecten gedurende 18 maanden wordt geboden	-
8	Voldoende vergoedingen	MO

CT= controle, PT= invloed ouders, MO= invloed geld, LE= leuker maken

Denkt u dat een wearable gebruikt kan worden om kinderen met overgewicht te motiveren om een gezondere leefstijl aan te nemen?		
1	Het is concreet en zichtbaar	VI
2	inzicht verbeterd altijd de motivatie. mooi weergeven in tabellen ed, complimenten geven, stok achter de deur	VI
3	Zoals ik al zei inzicht verschaffen over bijv hartfrequentie stappen activiteiten	VI
4	Visualiseren van doelen lijkt vaak goed te werken voor kinderen. Krijgen direct feedback, wat voor motivatie kan zorgen.	VI
5	extra motivatie- direct zichtbaar voor het kind	VI
6	Veel visuele feedback	VI
7	Kinderen hebben vaak visuele ondersteuning nodig. Het zal hun inzicht geven	VI
8	Kinderen kunnen op die manier direct zien wat ze doen. Het reduceren van gewicht duurt langer en is voor kinderen niet vatbaar.	VI

VI= visueel

Wat zijn volgens de u voordelen van deze technologie?		
1	Niet zo veel kosten, wel concreet	VI
2	kind krijgt direct feedback, hulpverlener inzicht, leuke gadget voor kind, eventuele voortgang ook voor het kind direct zichtbaar.	FB+VI+IN
3	Inzicht voor patiënt en professional	IN
4	Goed inzicht in beweegpatronen.	IN
5	kind wordt bevestigd of extra getriggerd om doelen te behalen	GO
6	Monitoring, feedback	IN+FB
7	Een kind krijgt meer inzicht in eigen bewegen en kan dit mogelijk vergelijken met andere kinderen	IN+CO
8	Het kind ziet direct resultaat. Het 'wedstrijdelement' maakt het motiverender.	VI

FB= feedback, VI= visueel, IN= inzicht, GO= doelstellingen, CO= vergelijking

Wat zijn volgens u de nadelen van deze technologie?		
1	Vergeten te dragen, kwijtraken	DV
2	kunnen kapot gaan, de lol gaat er misschien vanaf	DV
3	Big brother	BB
4	Proberen op andere manieren dan bewegen (bv schudden met stappenteller) een hogere score te halen. Kinderen vinden dit vaak heel interessant.	SA
5	gebruik van wederom een "apparaat"; al verstrengeld aan de smart Phone	SC
6	Te veel gefocussed op technologie en minder voelen in je lijf	TE
7	Kosten, focus kan ook te veel hierop liggen. Er zijn ook andere vormen van bewegen, zoals zwemmen	TE
8	Het is te saboteren. Kinderen leren hierdoor niet dat het belangrijk is.	SA

DV= dataverlies, BB= Big brother, SA=saboteerbaar, SC= screentime, TE= te veel focus

Beargumenteer waarom u denkt dat dat het gebruik van een serious game bij kan dragen aan het motiveren van kinderen met obesitas om meer te bewegen en een gezondere leefstijl aan te nemen?		
1	Je kunt bij de sport Wii ook scoren met minimale bewegingsuitslagen, enkel in de pols bewegen geeft ook een score bijv bij tennis	-
2	zeker, spelenderwijs (met beloning) actief zijn.	SP
3	Ja dat kan zeker omdat ze via een spel uitgedaagd worden en mogelijk ook onderling leeftijdsgenootjes maar ook andere kinderen met overgewicht	SP+CO
4	Ja, combinatie met technologie/ computers, apps spreekt kinderen aan.	TC
5	ja, dat heeft z'n bijdrage al geleverd in het verleden	-
6	Jazeker! Binnen Cool2BFit wordt ook gewerkt aan de inzet van deze games. Het stimuleert en draagt bij aan enthousiasme voor bewegen	-
7	Ik denk het wel. Ik verwacht alleen dat de duur beperkt. Een kind is ook een keer uitgekeken op het spel (motivatie wordt minder)	BP
8	Ja, alle (extra) beweging is goed.	-

SP= spelenderwijs (beloning), CO= vergelijking, TC= technologie, BP= Beperkte duur

Wat zouden volgens u de voordelen zijn van het implementeren van een serious game in de behandeling van een kind met overgewicht?		
1	Positief voor de motivatie van de kinderen	MV
2	zie boven (zeker, spelenderwijs (met beloning) actief zijn.)	SP
3	Motivatie kind	MV
4	Minder stil zitten tijdens gamen	BW
5	motivatie- past bij de huidige trends	MV+TC
6	Motivatie omhoog, Beweging omhoog	MV
7	Kortdurende verhoging van spelletjes, door motivatie omhoog	MV
8	Het kind is beter gemotiveerd en kan het langer volhouden.	MV

MV= motivatie, SP= spelenderwijs (beloning), BW= beweging motiveren, TC= technologie

Wat zouden volgens u de nadelen zijn van het implementeren van een serious game in de behandeling van een kind met overgewicht?		
1	minimale inspannningen	MS
2	moet middelen ter beschikking hebben	MI
3	Kosten	MO
4	Mogelijk eenzijdigheid, verveeld na korte tijd, waardoor andere games (die iedereen op school speelt) weer leuker worden.	BP
5	op deze wijze stimulatie om nog meer tijd met smart Phone door te brengen	SC
6	Geen	-
7	Ik vraag me af of er een transitie wordt gemaakt naar meer bewegen bij andere activiteiten	OV
8	Kinderen kunnen het thuis niet altijd toepassen.	TP

MI= middelen, MO= invloed geld, SC= screentime, OV= overdracht, TP= toepasbaarheid, MS= minimale inspanning, BP= beperkte duur

Indien een serious game gekoppeld zou worden aan een wearable, waarom zou u dan overwegen om dit te gebruiken in uw behandeling?		
1	Ik zou het een kans geven, het is wel behoorlijk individueel	-
2	leuk, keer wat anders, ik denk dat kinderen dit erg leuk vinden	-
3		-
4	Kind heeft een duidelijk doel, met beloning, dat ook nog op een leuke manier bereikt kan worden.	GO
5	past bij huidige tijd alhoewel dat nog wel tegen mijn gevoel (lees; het ouderwetse spelen, bewegen) in gaat	TC
6	Sluit aan bij belevingswereld van het kind en motiveert tot bewegen	BW
7	Mits een kind bewust is wat het betekent als het 4000 stappen heeft gezet. Maar hangt ook af van het start niveau. Het moet wel een haalbaar doel zijn.	GO
8	Dit motiveert nog meer.	MO

GO= doelstelling, BW= bewegen motiveren, MO= motivatie, TC= technologie

Wat zouden voor u voorwaarden zijn waaraan voldaan moet worden voordat u de combinatie serious games en wearables in uw behandelmethode toe zou willen voegen?		
1	Meer samenwerking uitlokken,	TP
2	makkelijk toepasbaar, niet te duur, niet snel kapot gaan, mee naar huis	TP, MT
3	Leeftijdsadequaat en inzichtelijk en goedkoop	TP
4	veiligheid, mogelijkheid zelf doelen in te stellen, variatie en uitdagend	GO
5	moet een onderdeel zijn van de behandeling- geen complete vervanging. Liefst zou ik dan wel met bijv stappenteller werken maar dan met een beloning in de zin van: 10 dgn op rij 4000 stappen gezet dan als beloning (buiten-)speelgoedje, winkelen, drankje op terras...	TP
6	Kosten laag	MT
7	Kostenplaatje. Eenvoudig toepassen van methode. Aangepast voor kindderen met verminderde conditie -> lage instapniveau	MT
8	Geld, wie gaat dit betalen?	MT

MT= invloed geld, GO= doelstelling, TP= toepasbaarheid