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# Fitogotchi - An Exergame Designed to Change People's Everyday Physical Activity Habits

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## Abstract

As people in the modern society adopt increasingly sedentary lifestyles, health problems like obesity, cardiovascular diseases, bone and joint diseases and some types of cancer, became more widespread then before. In addition to reducing people's life quality, these diseases put great expenses on the society. It is, therefore, of great interest to find ways to increase people's physical activity levels. This work on expanding the field of exergames aims to contribute to this goal.

This study has explored existing exergames, technologies that can track players' physical movements, theory on how to design an enjoyable game and the health benefits gained by performing physical exercise. Different game genres were also studied and reasoned about in order to determine in what ways these genres could be used in exergames. The knowledge gained from this review was used to design a game that aims to increase the players' everyday physical activity level.

This game was then tested on a total of 43 people in Norway and South Korea, in order to determine how players enjoyed playing the game and to what extent players were motivated by the game to increase their activity level. These metrics were measured in the beginning and end of a two week long test period. Furthermore, the study investigates to what extent the game affected what kind of physical activity the players performed and whether potentially new habits were maintained after the test period was over.

The results from the experiments indicate that participants enjoyed playing the game, and that a reasonable amount of players were motivated by the game to increase their physical activity level, though to various extents. The study also showed a decrease in these two metrics over time. The game also had an impact on the type of physical activity the players performed, but it failed to motivate them to do types of physical activities they disliked. Furthermore, the results indicate that some players might have maintained a higher activity level after they stopped playing the game, but further research are needed to confirm these results.



## Sammendrag

Fordi mennesker i det moderne samfunn utvikler en stadig mer stillesittende livsstil, er helseproblemer som fedme, hjerte- og karsykdommer, skjellet- og ledd-sykdommer og noen typer kreft mer utbredt enn tidligere. I tillegg til å redusere menneskers livskvalitet, er disse sykdommene også en kilde til store utgifter for samfunnet. Det er derfor av stor interesse å finne måter å øke befolkningens fysiske aktivitetsnivå. Dette arbeidet med utvide utvalget av treningsspill sikter på å bidra mot dette målet.

Dette studiet har utforsket eksisterende treningsspill, teknologier som kan spore spillernes bevegelser, teorier om hva som gjør dataspill morsomt å spille og helseeffektene som oppnås ved å utføre fysisk aktivitet. Forskjellige spillsjangre har også blitt studert for å utforske hvordan disse sjangrene kan bli brukt i treningsspill. Kunnskapen som ble tilegnet fra denne studien, ble brukt for å designe et treningsspill som sikter på å øke spillernes hverdagslige fysiske aktiviteter.

Dette spillet ble deretter testet på totalt 43 forsøkspersoner i Norge og Sør-Korea for å finne ut av hvor morsomt de syntes spillet var og til hvilken grad de ble motivert av spillet til å øke aktivitetsnivået deres. Disse kvalitetene ble målt i begynnelsen og slutten av en toukers forsøksperiode. Videre ble det undersøkt i hvilken grad spillet påvirket hva slags type fysisk aktivitet spillerne utførte og om potensielt endrede vaner ble vedlikeholdt etter at deltakerne sluttet å spille spillet.

Resultatet fra eksperimentet indikerer at deltakerne syntes spillet var morsomt og at en del spillere ble motivert av spillet til å øke aktivitetsnivået deres, dog i varierende grad. Studien viser også en nedgang i disse to faktorene iløpet av den touker lange testperioden. Spillet hadde også en innvirkning på hvilken type fysisk aktivitet en del av spillerne utførte, men spillet klarte ikke å motivere spillerne til å utføre fysisk aktivitet de ikke likte å utføre i utgangspunktet. Resultatene viser også at noen spillere opprettholdt et høyere aktivitetsnivå etter at de sluttet å spille spillet, men videre forskning kreves for å bekrefte disse resultatene.



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# Part I

## Introduction

In this part, the project will be introduced. First, a brief motivation for this research is explained both in regards of how the project can benefit the society as well as my personal motivation for conducting this research. Furthermore, the project will be described and put into the context of other research, before the research questions and a brief description of the research methodology used to answer these questions are presented. This introduction will be concluded by giving a brief outline of the report.





# Chapter 1

## Motivation

These days, health problems related to lack of physical activity are steadily increasing (Chan, 2012). The activity level among kids and early teenagers has decreased significantly over the last few years in favor of video games, watching television and using computers. This has led to an increase in obesity among young people, which again leads to an increased risk of cardiovascular diseases such as hypertension, insulin resistance and type 2 diabetes. The health care cost related to obesity in the United States alone was 70 billion USD in 1995. Physical activity and weight loss have been proven to reduce these health issues (Manson et al., 2004).

Because of issues with overweight and sedentary lifestyle, it is important to find ways to motivate people to exercise. Exergames might be a fun and motivating way for people to exercise without even being aware of it. Hopefully, further research in the field of exergaming might have a positive impact on the activity level of people in the future.

A recent success story in the field of exergaming is Pokémon Go. This game showed that it is possible for an exergame to make many people increase their activity level significantly, also people who normally did not exercise regularly before the game was released (Felber, 2016; Althoff et al., 2016).

The problems presented here and the potential video games has to change people's lifestyle, are together with my sincere interest for video games and exercise, the motivation for conducting this research. My goal is to make a game that can motivate people to be more physically active and be enjoyable to play.



# Chapter 2

## Project and Context

The task given is as follows:

*[ExerGames] Play to get fit* In this project, the goal is to come up with new game concepts and game technologies for exergames - games where the player carries out physical exercise at the same time. There are several approaches for exergames, and the challenge is to find the balance between something that is fun to play as well as you get a real physical exercise from playing the game.

*The first phase of the project will consist of a theoretical study of exergames and mechanisms for how games can be used as a motivator. The second phase focuses on implementing a prototype using various technologies. In third and final phase, the prototype will be evaluated and tested.*

This work is my master's thesis, and is based on the work that was done in the specialization project. During the specialization project, the first phase was performed, studying the state of the art in exergames, how games act as a motivator for exercise and the existing technology that makes it possible to track players' movement. Moreover, parts of an exergame concept were presented.

During the work on the master's thesis, the exergame concept that was designed during the specialization project was further refined, then later developed as a game for Android smartphones. The thesis was written in Seoul, South Korea, hence this prototype was tested on participants both in Norway and in Korea to gather data which can determine the effects the game has on its players. This data was then used to answer the research questions listed in Chapter 3.

This master's thesis is a part of the EPOS XL project, where the goal is to use game technology to promote learning and physical exercise. My work will contribute knowledge, an experiment and a prototype that other contributors on this project can benefit from.

# Chapter 3

## Research Questions and Method

This chapter will present the research questions aimed to be answered in this report and which methodologies that will be used to answer these research questions.

### 3.1 Research Questions

In the specialization project, theory was studied to understand how games could be designed to be motivating and enjoyable, in addition to getting an understanding of how games can increase players' physical activity levels and hopefully benefit from the physical and psychological benefits of physical exercise. This knowledge was used to develop a game that aims to be enjoyable for players to play, while at the same time changing players' physical activity habits. Another important goal was to make a game that has these effects on players for an extended period of time.

The main research approach used in this project is based on the Goal, Question, Metrics approach (Basili, 1992). I will first define a research goal, which is the conceptual level. Furthermore, I define a set of research questions, the operational level, before describing a set of metrics which will help answer the research questions.

**Research goal:** Examine if an exergame can make a positive impact on players' daily habits in regards of physical exercise.

By decomposing the research goal, the following research questions were formed:

***RQ1*** *How does this exergame affect players' enjoyment?*

This research question investigates to what extent people enjoy a specific game concept promoting physical exercise. Player enjoyment is important for exergames, as players are likely to play games they enjoy more than less enjoyable games.

***RQ2*** *How does this exergame affect players' enjoyment over time?*

This research question investigates how the players' enjoyment of the game changes over time. In order to change players' habits, it is important that the exergame is enjoyable for an extended period of time.

***RQ3*** *How will this exergame affect the players' motivation to perform physical activity?*

This research question investigates if the game has affected the players' motivation to perform physical exercise and if the game has affected their physical activity levels.

***RQ4*** *How will this exergame affect the players' motivation to perform physical exercise over time?*

This research question will examine how the game's ability to motivate players to perform physical exercise changes over time.

***RQ5*** *How does this exergame affect what kind of physical exercise the players perform?*

This research question will examine whether the game will affect what kind of physical exercise the players perform.

***RQ6*** *How will this exergame impact the players' activity levels after they stop playing the game?*

This research question studies if the game is able to change the players' physical activity habits to the extent that players who increased their activity levels while playing the game, also maintain a higher physical activity level after they stop playing it.

## 3.2 Research Methodology

Various already accepted research methods were used to gather and analyze data in a way that would be useful to answer the research questions presented in Section 3.1. The methods used are described in this section. For a more detailed description about the data gathered and how the data collection was performed, see Chapter 18.

### Literature Review

During the specialization project, a literature review was conducted on previously developed exergames, the latest of game technology, movement tracking and game platforms. A literature review is an evaluative report of information in one or more research fields that are relevant to the thesis. It goes beyond simply being a summary of existing articles, as information from different articles should be combined in order to, in this case, give the writer and readers an academic understanding of the relevant background information needed to conduct research in this field, and for the readers, to understand the topic in the thesis clearly (Taylor, 2008; CQUniversity Library, 2016).

The knowledge gained from the literature review was used as the theoretical foundation to design a game possessing desired characteristics.

### Triangulation of Data

*Triangulation of data* is the process of combining different methods to study one particular phenomenon. By gathering data about the same phenomenon using different methods and data sources, data can be cross-validated in order to increase the *reliability* of the results. Combining different methods can also contribute to deeper understanding of a phenomenon, as it might be studied from different perspectives that would otherwise not have been investigated (Jick, 1979; Denzin, 1978).

Both *qualitative* and *quantitative* data were collected and used when inves-

tigating the effects of the game.

### **Qualitative Data**

In order to gather in-depth data about the effects of the game, interviews were conducted with a selection of the participants both in Norway and Korea. Additionally, some of the participants in Korea were observed while playing the game, in order to understand how they played it and how they enjoyed playing it.

### **Quantitative Data**

Three methods were used to gather quantitative data about the game's effect on the participants and how they played the game:

- A survey including questions about the participants' *perceived* enjoyment of the game as well as the effect they perceived the game had on their physical activity habits – both in the longer and shorter terms.
- Google Fit data from the participants' smartphones.
- Game usage data.



# Chapter 4

## Report Outline

This report consists of three parts.

- Part I** has introduced the report, the research questions and the research methodology.
- Part II** contains a prestudy on already existing exergames. Furthermore, a review of technology relevant to exergames is conducted, with focus on the opportunities it can provide in the field of exergaming. From there, theories on how to design enjoyable games are presented, before the health benefits of general exercise are discussed.
- Part III** will start by presenting several common video game genres in today's game market together with thoughts on how these genres might be tweaked in order to include physical activity in the gameplay. Furthermore, some specific ideas for potential exergames will be presented.
- Part IV** contains a description of my suggested exergame. This part contains a description of the game, the theory used to design, the exercise design implemented in the game and brief information about the technical aspects of the game.
- Part V** describes the research methodology that was used to evaluate the game. A description about the data collection methods, experiment execution and limitations of the study are presented in this part.

**Part VI** presents the results of the conducted experiment. The results from the experiment conducted in Norway are presented first, before the results from the Korean experiment are presented. Lastly, the results are presented as a whole.

**Part VII** consists of a discussion of the results from this research, a conclusion answering the research questions presented in Chapter 3 and a description of future work that should be done related to this research.

# Part II

## Prestudy

The prestudy is performed to get an overview of currently existing exergames, capabilities of modern technology and lay the foundation needed in order to design a new exergame concept. In this part I will first describe what an exergame is, before giving a brief overview of some already existing exergames. Furthermore, a technology review will be conducted and theory on what makes game enjoyable to play will be presented. Lastly, health effects of physical activity, how much and what kind of activity that is recommended to perform in order to stay healthy, will be researched. This in order to be able to design an exergame enabling players to get a healthier lifestyle.



# Chapter 5

## What is Exergames?

Exergames, also called fitness games or exertion games (Wikipedia, 2016c), are video games that require users to engage in physical activity in order to play the game. The movement in these games should extend to more than the users' fingers and should make the players exerted to some degree. Exergames often need controllers different from the traditional gamepads in order to be played, ranging from cameras that can track body motion to dance mats. Recently the use of smartphones and their advanced sensors has become an interesting input device for exergames (Apple, 2016b; Samsung, 2016).

Exergames aim to be fun and enjoyable for users to play while they also benefit from the positive health effects of physical exercise. Commercial exergames have existed since the beginning of the 1980's and some of the early games used exercise bikes and dance mats as game controllers (Sinclair et al., 2007). The interest for exergaming has grown significantly lately. The increasing health problems related to the population's increasingly sedentary lifestyles is one of the reasons for this (Sinclair et al., 2007). Exergames might be one of many means to prevent this trend.

Technologies and input devices for exergames will be presented later in the thesis (Chapter 7), and a selection of already existing exergames will be presented in Chapter 6.



# Chapter 6

## Existing Exergames

In this project, a concept for an exergame will be developed. Research has been conducted to understand what has been done earlier in the field of exergaming and to foster new ideas for a new exergame concept that will be developed during the work of this project. In this chapter, a small selection of existing exergames will be briefly explained and evaluated in regards of how exerting the games are.

### 6.1 DanceDanceRevolution

The DanceDanceRevolution(DDR) games are a series of dancing games. These games are used together with a dance mat with eight buttons, and the player has to stamp on the correct button at correct time in the rhythm of the music. The game series have been released for many different systems for use at home, in game arcades and for use in physical education classes (as shown in Figure 6.1) (Konami, 2016; Wikipedia, 2016d).



Figure 6.1: *Dance Dance Revolution.*

Due to the DDR games popularity, a lot of research has been conducted on the health effects of playing these dancing games. In a study performed for five months at an elementary school in Oregon, students played DDR for some time during every school day. This research showed that the students' mile run times were improved by an average of 14% (Lieberman, 2006). Another study investigating the intensity of DDR gameplay, came to the conclusion that the game, while being played on medium difficulty, corresponded to a medium intense aerobic dance, where the test participants had an average heart rate of about 70% of their maximum heart rate (Tan et al., 2002). In order to maintain or increase cardiorespiratory fitness, a heart rate of minimum 60% of maximum heart rate is required, according to the American College of Sports Medicine (Pollock et al., 1998). This proves the DDR series to be games that manage to be both fun and good exercise for the players.



## 6.2 Zombies, Run!

Zombies, Run! is a smartphone exergame released on Android and iOS, illustrated in Figure 6.2. The story of the game is set in a world hit by a zombie apocalypse and is told to the player through an engaging audio story. In the game, players play as a runner – a person who runs out of one of humanity’s last remaining outposts to gather supplies, rescue other survivors and defend one of the last remaining human outposts.

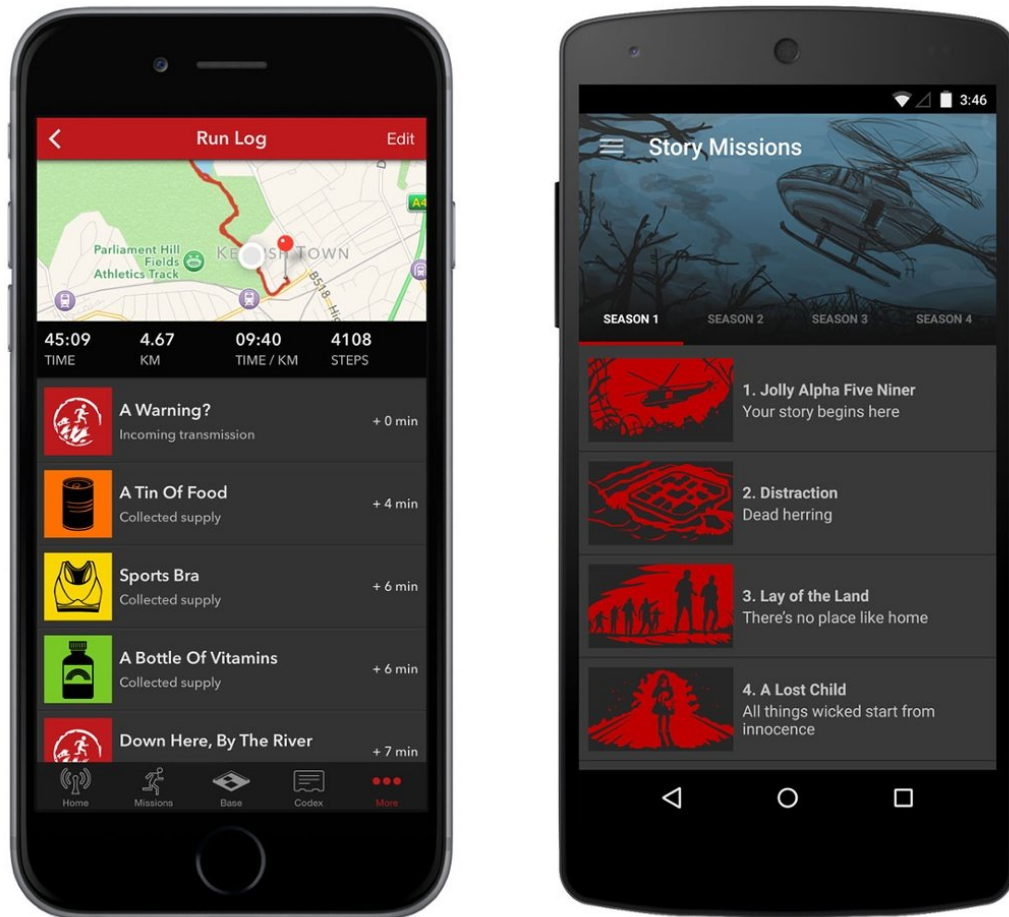


Figure 6.2: *Zombies Run!*

The game tracks the player's movement using the GPS sensor on the phone, and the story progresses as the player moves in the real physical world. Regularly while players run, they get chased by zombies. To get rid of them, they need to run faster to loose the zombies and get to safety. In this way, players are encouraged to add speed changes into their workout, hence they get the health benefits interval training provides. By telling this interactive story through the players' head phones, the game motivates them to exercise more often and push their limits during workouts (Alderman, 2016).

### **6.3 Nike+ Kinect Training**

Nike+ Kinect Training is an exergame released for Xbox 360 in 2012. The game contains many different strength and cardiovascular exercises that players perform together with a virtual trainer, as shown in Figure 6.3. The software uses the Xbox Kinect camera to track the users' movement. In this way, the game can give feedback on the players' technique and give in-game points only for the repetitions of the exercise that was correct (Wilson, 2012). The game provided, according to reviews, a good exercise, but it might have failed to be really fun to play (Beck, 2012).



Figure 6.3: *Playing Nike+ Kinect Training*

## 6.4 Wii Sports

Wii Sports was released together with the Nintendo Wii in 2006. This game showed the potential of the Wii's motion controllers and it made people who normally did not play video games want to play. The game contains five different games: Golf, bowling (as shown in Figure 6.4), baseball, boxing and tennis (Nintendo, 2016). The intensity of the different sports varies quite much, ranging from the boxing game that is the most physically demanding, to the golf game where the energy expenditure is the least (Russo, 2008).



Figure 6.4: *Wii Sports*.

## 6.5 Wii Fit

Wii Fit is a game released for the Nintendo Wii game system. The game is mainly played using the Wii Fit Balance Board as the game controller, complemented by the Wii Remote for some of the exercises. The game includes yoga, aerobics, balance and various different strength exercises games (illustrated in Figure 6.5) to be performed in the living room. Wii Fit turned out to be very popular and is one of the best-selling exergames of all time (Bloxham, 2008; Wikipedia, 2016b)



Figure 6.5: *Strength exercise in Wii Fit.*

Mullins et al.'s research on the health benefits of Wii Fit concluded that playing the game increases players' energy expenditure, showing that the game provides an enjoyable way for players to engage in light intensity physical activity (Mullins et al., 2012). Another study (Bumgarner and Senchina, 2013) concludes that playing Wii Fit increases players' heart rate and increase the energy expenditure, although the same activities done in the gym were proven to be significantly more effective.

## 6.6 PedalTanks

PedalTanks is a research prototype of an exergame. The goal was to make an exerting game with a lasting entertainment value. The game is an online multiplayer game, where players control tanks. Four players can play the game simultaneously, and they are organized into two teams of two players as shown in Figure 6.6. The objective for each team is to capture the other team's flag and bring it back to their own base.

The game controller is a stationary bike, customized with different sensors and buttons attached to it. When players pedal, their tank moves and the speed of the tank depends on the pedaling speed. The rest of the tank is controlled using the attached buttons. The game achieved to be both enjoyable for players to play, in addition to providing a high intensity workout for the test participants (Hagen and Weie, 2015).





Figure 6.6: *PedalTanks* (Hagen and Weie, 2015).

## 6.7 Location-Based Tower Defense

This game, made for research purposes, works like a traditional tower defense game, where enemies move along a predefined path. Players make towers near the path that inflicts damage to enemies when they are near. The goal of the game is to kill all the enemies before they reach the end of the path. The twist is that the game board is actually situated in the real world, and players need to run or walk to the locations they want to build towers (shown in Figure 6.7). In addition, power-ups regularly pop up at random locations across the game board and if players can reach the power-up's position before a timer runs out, they will get them (Brandt, 2016).

The game was very intensive and most of the test participants were out of

breath when they finished playing the game. However, most people would not play this game instead of performing a normal exercise. Instead they thought of this game as something entertaining they would play regularly just for fun, especially if the game had implemented some kind of multiplayer functionality, which the game currently lacks (Brandt, 2016).

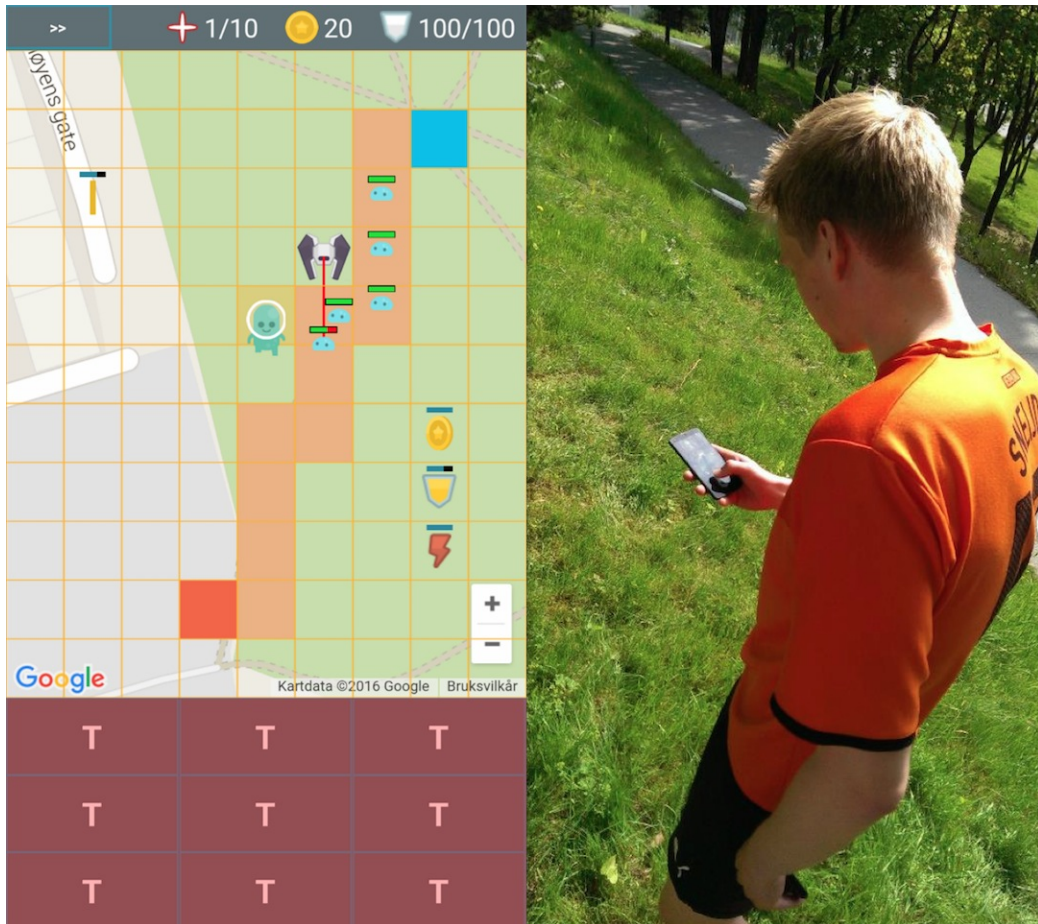


Figure 6.7: Location-Based Tower Defense in action (Brandt, 2016).



## 6.8 Exermon

Exermon (Høivik and Olsen, 2015) is an exergame made for research purposes. It is developed for Android smartphones, and the focus of the game is on strength exercise. In the game, players choose an exermon who will be their personal monster during the game. By performing various kinds of strength exercises, players' monsters will grow stronger and more powerful. These monsters can later be used to play against other monsters generated by the game, as well as other players' monsters. Screenshots showing how this works are shown in Figure 6.8.

The smartphones were used to track players' movement in order to count how many repetitions they performed of the exercises. The motion tracking turned out to be imprecise, but the game managed to make the test participants exercise more often than they did before the test period. 37.5% of the participants believed they had improved their strength because of the game (Høivik and Olsen, 2015).

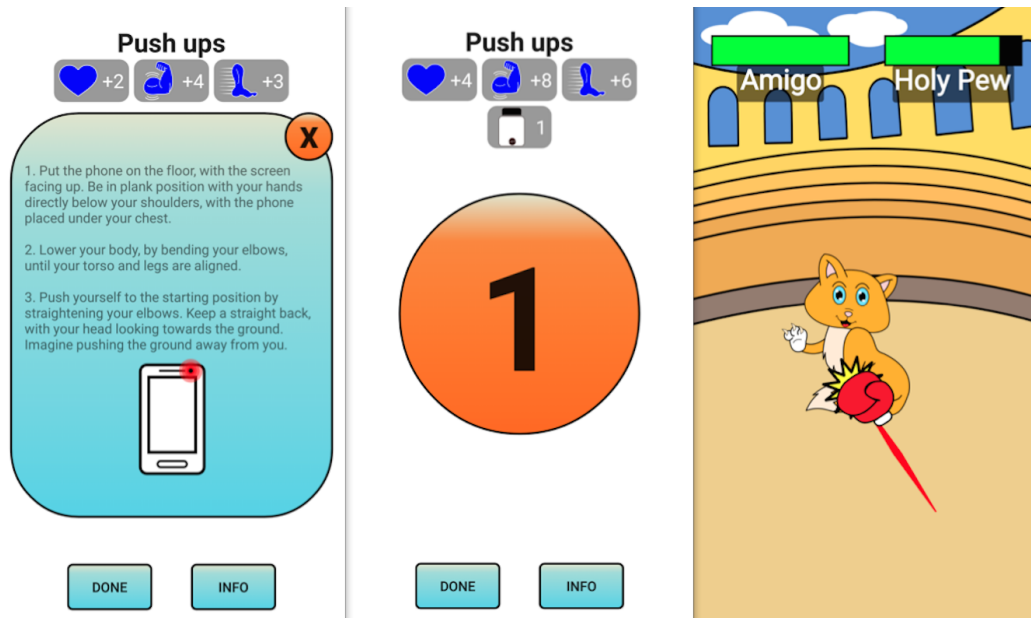


Figure 6.8: *Exermon* (Høivik and Olsen, 2015).

## 6.9 Fitocracy

Fitocracy is a smartphone workout application for Android and iOS. Through various means, it motivates users to exercise more. This is done by suggesting workout routines the users might be interested in and provide tailored coaching. In addition to this, some gamification elements are included in the application: Users get points for completing workouts, they can do quests of various types to get even more points or challenge their friends for a duel. When users get enough points, they level up. Furthermore, users get achievements that are visible to other users, by completing different goals (Fitocracy, 2016; Physical Therapy Web, 2015). Screenshots showing some of these features are displayed in Figure 6.9.

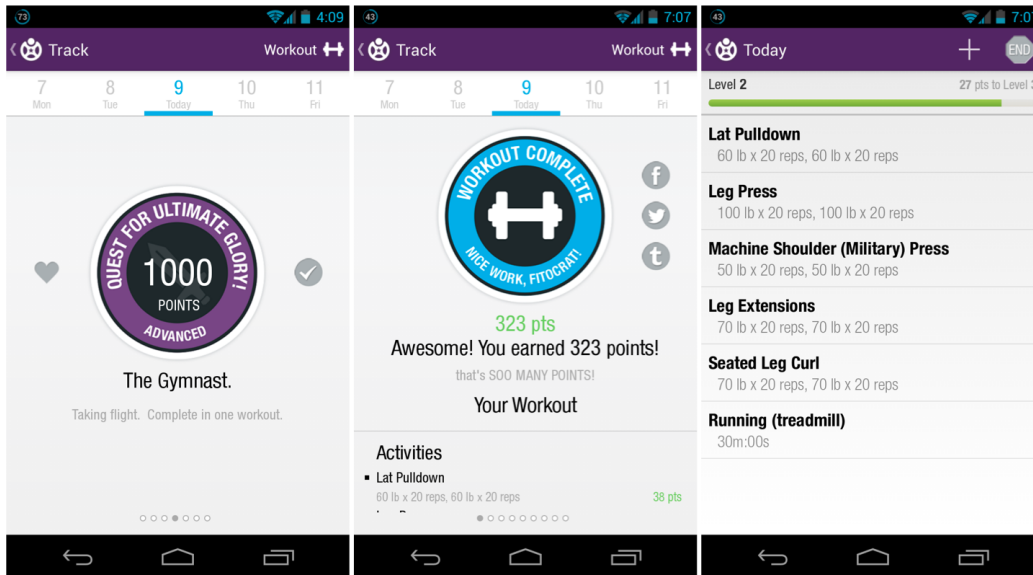


Figure 6.9: *Fitocracy*.

Fitocracy is more like a serious workout community and a workout log with some gamification elements in it, rather than a game. The game elements might motivate users who need the extra push to get to the gym, but it can also be used as a more normal workout log by other users.

## 6.10 Pokémon GO

Pokémon GO is a smartphone game based on the popular Pokémon franchise (Niantic, 2016). The goal of the traditional Pokémon games released on Nintendo's handheld systems, is to catch as many different creatures as possible, called Pokémon, by exploring the in-game world. The Pokémon players collect can later be used to fight other Pokémon and Pokémon trainers. Pokémon GO's gameplay is similar in most ways, but in Pokémon GO, the Pokémon are situated in the real-world and players have to go outside to look for Pokémon in their neighborhood, rather than in the couch at home. When players try to catch a Pokémon, the camera is used to make an augmented reality experience, where the player can see the Pokémon in the real world by looking at the screen on the phone as Figure 6.10 shows.

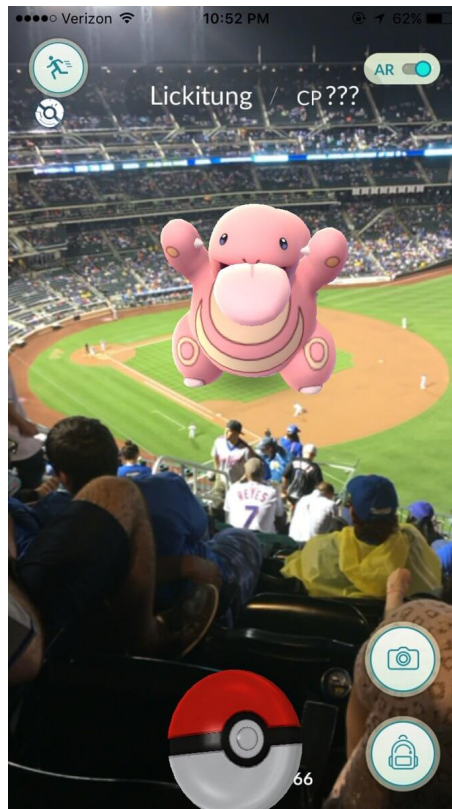


Figure 6.10: Augmented reality in Pokémon Go.

The game uses GPS to track players' position and data from Google Maps are used to construct the game world. Pokéstops, places where players can go to fill their inventory with useful items, and gyms, where players can fight other players' Pokémons, are placed on different locations on the map. Players are encouraged to constantly move to different Pokéstops and gyms. Additionally, players can hatch eggs containing Pokémons by walking a specified distance. These mechanisms encourage players to stay active while playing the game.

The game has been very popular and a lot of people have played it. Studies have shown that players increased their activity level significantly when they played Pokémon Go, compared to their prior activity level (Felber, 2016; Althoff et al., 2016). In addition, the game was able to increase the activity level of people of both genders, regardless of weight status and prior activity level. This is particularly interesting, because many other mobile health applications mainly draw the attention of already active people (Althoff et al., 2016).

## 6.11 Summary of Existing Exergames

A lot have happened in the history of exergames. While many of the games I have researched are mostly from recent times, it is clear that new technologies open opportunities for new types of exergames and to make exergames that most people can enjoy on hardware they already own. Today's advanced smartphones, with big screens, powerful hardware and extensive collection of built in sensors, offer several possibilities for motion tracking and gameplay mechanics. Furthermore, the popularity of these devices makes games developed for smartphones available for a lot of people in today's society.

By studying existing exergames, I have learned how games have been combined with various kinds of activity. Some of the games studied in this chapter have proven to be popular, and have given health benefits to many people. The latest example, Pokémon GO, described in Section 6.10, made millions of people walk or run considerably more than they used to during the summer in 2016, when the game was released.

The degree of exertion players experience when playing different exergames varies a lot. Some games are really intensive and might be equivalently exerting as a normal exercise, while other games focus more on being fun than actually providing an intensive exercise.

After evaluating existing exergames, I have gained inspiration for possible new game concepts, got an idea of what might have made previous exergames successful and got an overview of the possibilities today's technology provides in the domain of exergames. This is all valuable knowledge that is useful when designing my own exergame.



# Chapter 7

## Technology Review

In order to get an overview of the opportunities technology today can provide for an exergame, this chapter will present a brief overview of relevant already existing technology.

### 7.1 Motion Controllers

After the success of the Nintendo Wii, both Sony and Microsoft released their own motion controllers for their game systems. Sony's Playstation Move controllers and Nintendo's Wii remote work quite similarly. Both of them are controllers held in one hand, with different sensors detecting the users' hand motion.

Microsoft's Kinect is a camera that tracks the entire user's body movement. It is not limited to detecting hand motion as it can detect movement of any part of the body. An example of how Kinect has been used is showed in Figure 7.1, where two people are playing soccer in the game Kinect Sports.



Figure 7.1: *Kinect Sports*.

## 7.2 Dance Mats

Dance mats have been released both for use at home and for physical education classes in school (Konami, 2016; Wikipedia, 2016d). Up until now, there has been released mostly dancing games to use with these controllers, but there might be potential for use of these controllers in games outside of the music genre.



## 7.3 Virtual Reality Headsets

Recent years, the development of virtual reality headsets has caught a lot of attention in the technology world. Virtual reality headsets are head-mounted displays including different sensors to track the motion of the users' head. By showing slightly different images on each, eye users are immersed in a convincing 3D experience. Together with head tracking, users can turn their head to look in the game world, and get the experience they are actually present in the virtual world. Some virtual reality experiences also include motion controllers to track the hand motion of the player, like the popular VR headset HTC Vive (Wikipedia, 2016i) shown in Figure 7.2.



Figure 7.2: *HTC Vive.*

## 7.4 Smartphones

Modern smartphones include a variety of built-in sensors. This can make today's smartphones interesting devices for many new gameplay experiences not possible on traditional game consoles and PCs. Common sensors included in modern smartphones are sensors to track position (GPS, WiFi, cellular, NFC and Bluetooth), accelerometer, gyroscope, magnetometer, barometer,

proximity sensor, microphone, light sensors and often two cameras (Samsung, 2016; Apple, 2016b). Advanced functionality is also provided in modern smartphones' software, where the three most popular smartphone operating systems today are iOS, Android and Windows phone. Examples of devices running these operating systems are shown in Figure 7.3.

The sensors in smartphones provide many applications, including but not limited to tracking of users motion, augmented reality applications, tracking where users are and how many meters they are above sea level. Health applications like Google Fit and Apple Health (described in Section 7.5), track a variety of different health related data by using movement data from these sensors. Additionally, these sensors, together with cameras, make augmented reality possible. Pokémon GO, as described in Section 6.10, is one popular game that implemented AR functionality in a smartphone game.

The possibilities sensors in the smartphones provide, together with their large, vibrant touch sensitive screens, built-in speakers and powerful hardware, make modern smartphones suited to be portable game platforms. That being said, when designing games for smartphones, it should be taken into consideration that it might be difficult for users to look at the screen while they perform physical activities that require significant amounts of movement.



Figure 7.3: *Smartphones running iOS, Android and Windows Phone.*

## 7.5 Activity Wristbands

Activity wristbands are wristbands with built-in sensors to track users' activity level. There exist a variety of different activity wristbands, ranging from simple bands including only an accelerometer, to the most advanced ones, often coming in the form of a smartwatch (a selection of activity wristbands and smartwatches are shown in Figure 7.4) (Fitbit, 2016a; Apple, 2016a). These activity wristbands might be interesting for use in exergames, since data from these sensors can be used as input for exergames. For instance it is possible to sense players' arm movement by getting data from an accelerometer, or players' heart rate can be used to affect gameplay.

It is possible to track movements quite precisely using accelerometer and gyroscope sensors. In an experiment conducted at the University of California, Davis, researchers showed it was possible to even track finger gestures with an accuracy of over 90% (Xu et al., 2015). Therefore I have carried out a prestudy to check what kind of sensor data is possible to get from the different activity wristbands on the market, in case they will be used in my final game concept.



Figure 7.4: From left: Fitbit Flex 2, Microsoft Band 2, Apple Watch and Motorola Moto 360 (Android Wear).

### 7.5.1 Fitbit

Fitbit makes a wide range of different activity wristbands, ranging from a simple wristband containing only an accelerometer, to advanced smartwatches containing a variety of different sensors (Fitbit, 2016b). Unfortunately, from a developer perspective, the APIs provided to developers are limited to getting data collected and preprocessed by Fitbit's systems. Reading data straight from the sensors of their wristbands is therefore not possible. Hence, this puts constraints on the possibilities a Fitbit wristband may provide for sensory input to an exergame.

### 7.5.2 Microsoft Band

Microsoft Band is Microsoft's activity wristband. It contains ten sensors (Microsoft Band 2 contains a barometer in addition to these). Among these are an optical heart rate sensor, 3-axis accelerometer, gyroscope, GPS and a microphone (Microsoft, 2016).

Microsoft provides an open and comprehensive Software Development Kit (SDK) for developers who develops applications taking advantage of the Band's abilities. Their SDK supports development for the most widespread smartphone OSs these days: Android, iOS and Windows Phone. Through the Microsoft Band SDK it is possible to get access to sensor readings from the Microsoft Band, in addition to make tiles and update information on the wristband's screen. The application logic runs on the smartphone and data from the sensors are fetched to the phone wirelessly using bluetooth.

Previous research has been made using sensory data from the Microsoft Band, proving it is possible to get the sensory data needed to track arm movement from the Microsoft Band SDK (Bai et al., 2016).

### **7.5.3 Apple Watch**

Apple's smartwatch, Apple Watch, is a wearable device that only works together with Apple's iPhones. It contains a heart beat sensor, an accelerometer and a gyroscope (Apple, 2016a). The accelerometer is available for developers to use, whereas the gyroscope is not possible to access directly (Sparks, 2015). Heart rate is possible to get in intervals, but not as a direct stream of readings from the watch to the phone.

### **7.5.4 Android Wear Devices**

Android Wear is Google's operating system for wearable devices, primarily smartwatches. The Android Wear smartwatches typically include many different sensors, like accelerometer, gyroscope and a heart rate monitor. Through Androids extensive APIs it is easy to get readings from these sensors continuously (Google, 2016a). Android Wear devices are compatible with devices running Android 4.3 and above, and iOS 8.2 and above (Google, 2016b).

### **7.5.5 Summary: Activity Wristbands**

After examining different activity wristbands, it is evident that except from Fitbit, all the investigated wristbands should make great game controllers for exergames. The Fitbit's restricted API limits the possibilities of it. The three other devices/platforms give direct access to sensor readings, though with minor constraints on the Apple Watch, and therefore provide a wide array of possibilities, mostly limited by the accuracy of the sensors.

## 7.6 Health Trackers

In 2014, both Apple and Google released their own health platform – Apple Health and Google Fit (Kessler, 2014; Apple, 2014). Both of the applications aim to gather most of the health related data, collected by the applications on the phone, into one application. Both Apple and Google provide APIs giving developers access to this data, if the user accepts it (Apple Inc, 2016; Google, 2016c). In addition, they track this data automatically:

- Step count
- Walking and running distance
- Biking distance
- Flights climbed: the smartphone needs to contain a barometer in order to track this.
- Exercise time: in Apple Health, an Apple Watch is required to track this.

Even though these applications are quite similar to each other, there are some important differences to them that I will discuss in Section 7.6.1 and 7.6.2.

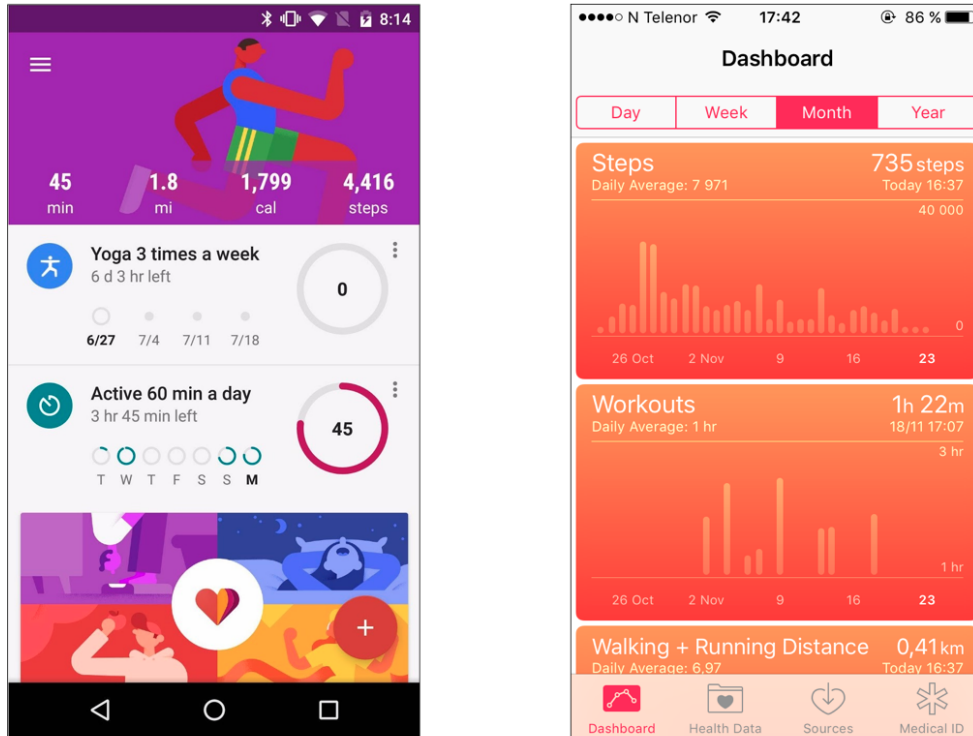


Figure 7.5: Google Fit and Apple Health.

## 7.6.1 Apple Health

Apple Health is pre-installed on all iPhones running iOS 8 or later. Furthermore, iPhone 5S and newer all contain a low-power co-processor that makes it possible to track fitness activity at all times without significantly draining the battery. Apple Health collects all the data mentioned in the list in Section 7.6, but it also tracks the number of *stand hours* - the number of hours during the day that the user has been standing for one minute or more. Standing hours and exercise time-tracking requires an Apple watch to be monitored.

The measurements of flights climbed require a phone with a barometer inside. For iOS devices, this currently (November 2016) means iPhone 6 and newer, with the exception of iPhone SE.

### 7.6.2 Google Fit

Even though Google Fit is similar to Apple Health in many ways, there are some significant differences. First of all, Google Fit is not pre-installed on Android devices, but users can download it free of charge from Google Play. Secondly, while Apple Health is limited to being a container for all health related data gathered by the phone, Google Fit also works like an exercise application – it can track different kinds of workout and show information about the current exercise in real time (Google, 2014).

If the user owns a Google Wear smartwatch, the application can, in addition to the features mentioned in Section 7.6, register exercises like push-ups, hang-ups and squats (Google, 2016d).

## 7.7 Smart Exercise Equipment

Another form of controller previously used in exergames is gym equipment connected to different sensors. For instance, stationary bicycles with sensors connected to the pedals have been used for instance in Pedal Tanks, described in Section 6.6, to control the game. Sonic Athletics, shown in Figure 7.6, used a treadmill as the game controller. The possibilities here are endless, and most gym equipment should be viable to use as game controllers with the correct sensors. In many cases, an inexpensive Arduino and some sensors should be sufficient to get the job done (Arduino, 2016).





Figure 7.6: *Sonic Athletics*.

## 7.8 Summary of the Technology Review

By gathering information about existing technology, I have gained ideas for new game concepts as well as getting an understanding of the opportunities and limitations of modern technology. There are many opportunities and a variety of different platforms that suit exergaming.

The motion tracking systems described in Section 7.1 offer interesting input methods for exergames to be played in players' living room. This has already been demonstrated by some of the games mentioned in Chapter 6, by games like *Wii Sports* (Section 6.4), *Wii Fit* (Section 6.5) and *Nike Kinect* (Section 6.3). Although these games are interesting approaches for using motion controls in exergames, they do not hide the exercise very well. It would be interesting to see more ideas that focused on the fun, while at the same time being exerting as a side effect.

Smartphones have recent years risen in popularity as gaming machines, and recently, *Pokémon GO*, described in Section 6.10, has proved that smart-

phone games can get millions of people out of the sofa and out in the real world catching Pokémons in a way that requires more physical activity than ever before. Due to the prevalence of smartphones in today's market, smartphone games have the potential to reach out to a wide audience. This is of great significance when designing an exergame aiming to contribute to public health. Because of powerful hardware and big screens, they are also suitable game platforms. Additionally, the advanced sensors in the smartphones enable them to track players' motion and even more possibilities arise when they are combined with wristbands or smartwatches (Section 7.5). The data health tracking software (Section 7.6) gathers might also be used to make new interesting exergame gameplay mechanics.

The findings in this technology review have given important insights that will be useful when designing my own game. Studying opportunities in today's technology have sparked new ideas, while at the same time giving me insights in the constraints that need to be kept in mind when developing an exergame concept.

# Chapter 8

## How to Design an Enjoyable Game

When designing an exergame with the goal of increasing people's motivation to exercise, it is important to design a game that people enjoy playing. In this way people might want to play longer every time they play, and they are more likely to come back to play the game again. This is essential if players' activity habits are going to change.

It has been done research on what are the characteristics that make a game enjoyable to play. Two frameworks for evaluating to what degree a game is enjoyable and theory about rewards in games will be described in this chapter. Later this theory will be used when developing the game concept, in order to make a game players enjoy and want to play regularly.

### 8.1 GameFlow

The GameFlow model was developed because of, at that time, the lack of an accepted model to describe player enjoyment in games. The model is based on the concept of flow, a model that was suggested by Nakamura and Csikszentmihalyi (Nakamura and Csikszentmihalyi, 2002). This model was then adapted to work for enjoyment in games by Sweetser and Wyeth (Sweetser and Wyeth, 2005).

The model describes eight elements affecting players' enjoyment when playing games: Concentration, challenge, skill, control, clear goals, feedback, immersion and social interaction.

### **8.1.1 Concentration**

The first element described in the GameFlow model is the importance of grabbing players' attention early and keep their concentration while playing. In order to keep their concentration, they need to be engaged in tasks that require their attention and provide a heavy workload. When all relevant skills are required to take care of the challenges, players focus completely on the situation and get absorbed into the experience.

In order to keep the players' concentration, it is just as important to make them feel the tasks they perform are important. Furthermore, they should not be distracted from the major game tasks.

A detailed and interesting game world will also increase the players' concentration. With this in mind, the user interface in the game should be as minimal as possible to make more screen space devoted to the action in the game and the content of the game world.

### **8.1.2 Challenge**

A game should provide a challenge that matches each player's skill level, the difficulty should vary during gameplay and the game should keep an appropriate pace. If the game is too easy, players will most likely get bored. On the other hand, if the game is too difficult, players will get a feeling of anxiety. It is also important that the game does not start out too difficult. Instead, it should give players freedom to explore new strategies that can later be used when the game becomes more difficult. When players complete challenges that are sufficiently difficult, they get a sense of mastery which again may boost their self-confidence.

As players' skills normally differ, it is rarely enough to provide only one difficulty level in a game. Hence, different difficulty levels should be provided. This can be done by allowing players to choose difficulty themselves or make the game automatically adjust the difficulty depending on how the player performs.

### **8.1.3 Skill**

It is crucial that players get a feeling of improving their skills while playing the game, in order to really enjoy it. The player's skills and the challenges in the game should match, in order to make the player's experience flow.

The first thing players need to do when playing a new game, is to learn how to play it. Therefore, it is important that it is fun to learn to play the game. An interactive tutorial is better than an extensive game manual and the game should provide online help and hints, so the player do not need to exit the game to get help.

### **8.1.4 Control**

In order for the player to experience flow, it is crucial that players feel in control of their actions – they should be able to translate their intentions into actions within the game.

Games should provide an easy-to-use user interface, make it possible for players to save the game and turn the game on and off when preferred. This is in order to make them easy to use.

Regarding design of the game world, it is important that players get a feeling that their actions have an impact on the game world. They should make decisions that impact the world, but on the other hand it is important not to burden the player with choices that do not have any impact on whether he will win or lose the game. For players to be truly immersed in the world, they need to be given options for what they can do, be and have in the game, and there should not be only one optimal strategy to win the game.

### **8.1.5 Clear Goals**

A game should give clear goals to the players. Games need to present one overriding goal early in the game. This is often done by showing an opening

cinematic explaining the story of the game. During the game, smaller goals should also be given to the player.

### **8.1.6 Feedback**

Games should provide relevant feedback at the correct time in order to be really immersive and enjoyable. Feedback needs to be provided immediately when players perform an action, and players must receive feedback regularly so they can determine their progress towards the goal. When players lose, they should get notified immediately and they should get hints pointing them to the right direction so they can perform better next time.

### **8.1.7 Immersion**

Players are immersed in a game when they become less aware of the real world and stop thinking about things not relevant to the game.

Games often use players' senses to draw them into the game experience. Examples of this are narratives telling the game's story, music in the game and sound and visual effects.

### **8.1.8 Social Interaction**

People enjoy socialization, leading to many people playing games for social interaction – regardless of their opinion of the rest of the game. People like to chat with their friends, fight them and cooperate to manage difficult tasks together. Therefore, adding elements of social interaction to games can make people enjoy the game even more. As a result, they might play the game more often.

However, adding elements of social interaction should be done with care, since it adds a link out of the fantasy world to the real world as players can interact with other real people. Earlier experiments have also shown that people enjoy

ruining other people's game experience, therefore it is important to put some constraints to the interaction (Achterbosch et al., 2008).

## 8.2 Challenge, Fantasy and Curiosity

Another framework to evaluate player enjoyment in educational games, suggested by Malone, proposes three elements an educational game needs to be enjoyable: *Challenge*, *fantasy* and *curiosity* (Malone, 1980). Although this framework was developed with educational games in mind, it is also useful for serious games in general.

### 8.2.1 Challenge

Like the GameFlow model described in Section 8.1, this model also states that it is important to provide challenges to the player. For the game to be challenging, it needs to provide a goal that is difficult enough to make the player uncertain whether he will make it or not. The difficulty should also be adapted to each player's individual skills, so they are able to complete the goals, though without ease. This is in order to boost players' self-esteem.

Goals should not be to use a specific skill, but to be a more practical problem, where a skill has to be used indirectly in order to be able to complete the goal. In exergaming, this means that the goal of exergames should not be to perform a certain number of repetitions of an exercise, but rather have a more abstract goal that disguises the fact that they have to exercise, resulting in players doing those repetitions anyway.

For a game to be engaging, players should be uncertain of the outcome of the goal. There are several ways to make the outcome of a goal uncertain:

1. It should be possible to *vary the game's difficulty level*. This can be done either by letting players choose difficulty level themselves or make the program adjust the difficulty level automatically depending on the player's skills. It can also be determined by the opposite player's skills,

like in online gaming where opponent's skills are unknown before playing against each other.

2. A goal can contain *multiple levels of achievement*. Instead of having just a basic goal in a game, there can be multiple ways to complete the goal in better ways. This can be to complete a goal the fastest or with the highest score possible.
3. *Hiding information* from users and intentionally revealing it little by little, introduces some uncertainty to the outcome.
4. Including an element of *randomness* also adds up to this uncertainty.

### 8.2.2 Fantasy

The fantasy of a game is the setting and environment where the game is happening. Different fantasies often appeal to different kinds of people and it is therefore important to have the audience in mind when choosing fantasy. Malone suggested two kinds of ways the player and the fantasy can interact with each other:

*Extrinsic fantasy:* In an extrinsic fantasy, players' skills affect the fantasy, but not the other way around.

*Intrinsic fantasy:* In intrinsic fantasies on the other hand, players' skills affect the fantasy, and the fantasy affects players' skills.

Malone argues that intrinsic fantasies are both more instructional and interesting than extrinsic fantasies. One reason for this is that these fantasies can show players how these skills can be used on real world problems.

### 8.2.3 Curiosity

To trigger players' curiosity is an effective mean to make a game more interesting. Curiosity is the desire people have to learn. To trigger players'



curiosity, enough information should be provided to the player so he can get expectations about what might happen next. These expectations should sometimes be unmet in order to make the game unpredictable.

Malone mentions two types of curiosity: *sensory curiosity* and *cognitive curiosity*.

*Sensory curiosity* is the attention-attracting value of shift in light, sound and other sensory stimuli in the surroundings. This kind of curiosity is commonly triggered in video games by use of audio and visual effects.

These effects can be used either:

- as *decoration*, where the effects are used regardless of what the player does. These effects might increase players' initial interest in the game, but will get boring quickly.
- to *enhance the fantasy* in a way that immerse players more in the fantasy.
- as a *reward*, where effects are played when the player performs well.
- to *represent a system*.

*Cognitive curiosity* is the desire people have to make structure to their knowledge. People want their knowledge to be complete and consistent. Therefore, to trigger this kind of curiosity in a game, the game can hide some information to make players feel that their information is incomplete and inconsistent. In this way, players want to play more to fill the holes in their knowledge.

Malone suggests that in order to trigger players' cognitive curiosity, the feedback in the game should be surprising by either using randomness - or better, make the underlying system in the game in such a way that the outcomes seem surprising at first, but will be logical to the users when they figure out how the system works. It is also important that the game gives hints that help players understand the underlying system of the game.

### 8.3 Dual Flow

Sinclair et al. describes a framework to evaluate the success of exergames (Sinclair et al., 2007). This framework is called the *dual flow* framework and is based on the frameworks previously mentioned in Section 8.1 and 8.2. In the dual flow framework, an additional dimension is suggested to describe success of exergames. As in the frameworks for traditional video games, the attractiveness of the game is rated, but in exergames, the effectiveness of the exergame is also important to consider. For the exergame to be effective, it is important to make the intensity of the exergames match the player's fitness level (Sinclair et al., 2007).

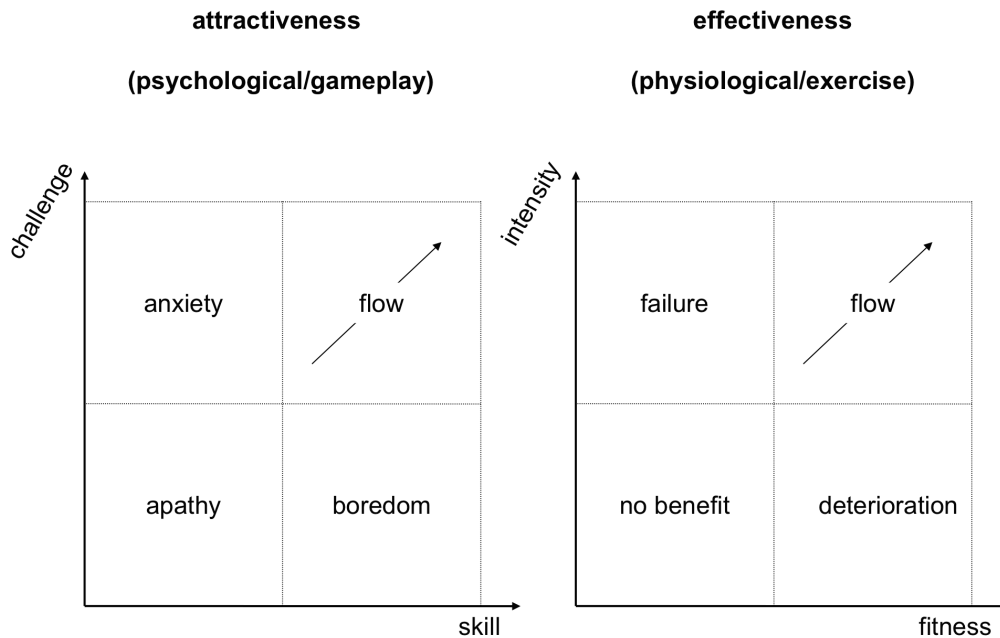


Figure 8.1: *The dual flow model (Sinclair et al., 2007).*

The dual flow framework suggests that it is possible to reach a dual flow, where players are totally immersed in the game while gaining the benefits exercising provides.

Sinclair et al. emphasizes that it is important to design the intensity of the

game according to the fitness level of the player. If a game is too intensive, the player will get exhausted before the game session ends. On the other hand, if a game provides too low intensity, players' fitness level will deteriorate.

## 8.4 Rewards

Rewarding players in different ways is important for a game to be desirable to play. Being rewarded releases dopamine in our brains and makes specific goals desired to accomplish (Berridge and Robinson, 1998). Björk and Holopainen even state that games do not work without incentives for the players to perform actions and reach their goals in the game (2005).

Hallford and Hallford defined four different types of rewards in role-playing computer games (2001). These types of rewards are also believed to apply for other genres of video games (Salen and Zimmerman, 2004).

These categories of rewards are defined as:

- *Rewards of glory*: rewards of glory are rewards that do not give players any real benefits or advantages in the game, but they still perceive as desirable to get. These rewards can often be considered to be *social rewards*, that players can discuss with other players and friends (Björk and Holopainen, 2005). An example of rewards of glory is a score system in a game. This makes incentives for players to play the game multiple times to beat their own, or their friends' high score. A leaderboard further strengthens this incentive, as they can beat other players, even if they do not know them.
- *Rewards of sustenance*: are rewards that enable players to keep the items and progress they have earned in the game so far, in addition to keeping their character intact. Examples of this are health packs, armors in the game that protect them from being damaged, invincibility and so on.
- *Rewards of access*: these rewards let players reach new spatial locations in the game world or get resources that were previously unavailable for

them. Keys, lock picks and unlocking a more powerful car in a racing game are examples of rewards of access.

- *Rewards of facility*: enable the players' in-game character to improve their already existing skills and abilities or grant them an entirely new skill.

One reward does not necessarily belong to only one of the categories mentioned above. Some of the medals in Pokémon Go, shown in Figure 8.2, are examples of this. Unlocking a medal is a reward of glory, which players can compare to other friends and use to brag about their feats in the game. But in addition to this, some of these medals give players a catch bonus, making it easier to catch some types of Pokémon after unlocking them. Thus, medals in Pokémon Go are also rewards of facility according to Hallford and Hallford.



Figure 8.2: Medals in Pokémon Go.

Another common example is when players' avatars learn new skills that also

enable them to reach new environments within the game. In the Pokémon games, players need the help of specific Pokémon attacks to be able to access new parts of the world. Therefore, when a player's Pokémon learns one of these attacks, this is a kind of reward of access. Additionally, the new attack is also used in Pokémon battles making the character stronger, hence, it is also a reward of facility.



Figure 8.3: Using a Pokémon attack to access new in-game areas.

## 8.5 Summary Game Design Theory

The three frameworks mentioned in this chapter will be important when designing my exergame. There are many considerations that need to be taken into account when making an engaging exergame that make players want to play the game regularly. This is really essential if an exergame should be able to change people's habits, and is crucial to make a successful exergame.

*Clear goals* is important in order to give meaning to games and for players to know what to focus on. Moreover, the game should not tell the users to use a specific skill in order to progress, but rather do a more abstract task that still require this skill to be used as a consequence of the nature of the goal.

The *challenges* players face should be adapted to the players' *skills*, and players' skills should improve throughout the game. The *dual flow* framework also mentions these things in the context of the physical challenge of the game. The game should not be too *intensive* nor too easy as players will either fail or their fitness will deteriorate if the workout intensity is not adjusted to the players' fitness level.

Games should also make players feel in *control* of their actions, and get

*feedback* immediately as they perform an action – otherwise the gameplay experience might lead to frustration. Feedback should also be given regularly, so players can determine their progress towards the goal.

Furthermore, the intended audience is vital to consider when choosing the *fantasy* of the game, as different players prefer different kinds of fantasies. Effective ways to trigger players' *curiosity*, include use of audio and visual effects, in addition to hiding some information to the players or giving them surprising feedback. Players will enjoy to try to understand the underlying system, but in this case it is also important that the players get help to understand this system.

It is also important to *reward* players regularly, so that players feel motivated to play and make progress in the game.

Not all games should implement all the elements listed in this chapter (Sweetser and Wyeth, 2005), but being aware of them as a game developer and including appropriate elements into the game design can help elevate the gameplay experience and make a better game.

# Chapter 9

## General Physical Activity

This chapter will describe some of the health benefits general activity have proven to provide. In addition, I will get an overview of how much activity that is recommended to perform in order to gain significant health benefits from physical activity. Physical science is not the main focus of this thesis, but in order to get an understanding of how much activity an exergame should promote in order for players to benefit from positive health effects, a brief literature review is performed on this topic.

### 9.1 Health Problems Related to Inactivity

These days, health problems related to inactivity and sedentary lifestyles are steadily increasing (Chan, 2012). Heart diseases, type 2 diabetes, hypertension, bone and joint diseases like osteoporosis and osteoarthritis, and some types of cancers have proven to occur more often among people with sedentary lifestyles compared to more active people (Warburton et al., 2006). In addition to physiological health problems, it is also proved that physically active people suffer less from depression and anxiety and feel more energized (Paluska and Schwenk, 2000; Kim and McKenzie, 2014).

### 9.2 Health Benefits of Physical Activity

A lot of research have been conducted on the health benefits of physical activity and it is clear that the health benefits of exercising are both significant and many. According to a review aiming to prove the health benefits of

physical activity, being physically active can significantly reduce the risk of all the health problems mentioned in Section 9.1 (Warburton et al., 2006). Additionally, being active can prevent obesity although an active lifestyle alone cannot prevent weight problems if it is not combined with a sensible diet (Chan, 2012).

Reducing the risk of the diseases mentioned in Section 9.1, leads to an increased life expectancy. A study aiming to calculate the consequences of different levels of physical activity on life expectancy of people older than 50 years old, concluded that people with a moderately physically active lifestyle had a life expectancy of 1.3 years more than people with the least physical activity level. People with high activity levels had 3.7 years higher life expectancy than the group with low activity. For women, these numbers were slightly higher (Franco et al., 2005).

In addition to being good for physical health, physical activity is also good for psychological health. Studies have shown that there is a positive correlation between physical activity levels and improved mental health and higher energy levels. Strength exercise, aerobic exercise and flexibility training were all benefiting the test participants' mental health and moderate intensity levels were sufficient to gain the psychological health effects of exercise. It is important to keep in mind that overtraining should be avoided as it might lead to other psychological disorders (Paluska and Schwenk, 2000). Furthermore, people performing exercise are more likely to have fewer stress symptoms (Kim and McKenzie, 2014).

### **9.3 Recommended Activity Level**

It is difficult to define a specific activity level leading to optimal health benefits. The World Health Organization (WHO) recommends 150 minutes of moderate-intensity physical activity or 75 minutes of vigorous-intensity physical activity during a week for people 18 years and older. Children and adolescents aged 5-17 years old are recommended to perform 60 minutes of moderate to vigorous intensity physical activity every day. They also state that doubling the recommended amount of physical activity for adults, and kids and adolescents being more active than the 60 recommended minutes a day



will provide extra health benefits. Within this physical activity, activities that strengthen muscle and bones should be done at least 3 times per week for the youngest age group, while muscle-strengthening activities involving major muscle groups should be performed at least two times a week for adults and elder people (World Health Organization, 2016).

Additionally, Warburton et al. states that the more active people are, the more health effects they benefit from. Although they conclude that the greatest improvements happen when people who are the least fit become physically active. They also conclude that the probability of suffering some kinds of cancer, diabetes type 2 and cardiovascular diseases was decreased even with moderate intensity activities, although higher intensity workouts would provide even more health related benefits (Warburton et al., 2006).

Furthermore, in regards of psychological health, Paluska and Schwenk state in their research paper on the mental health effects of physical activity that users benefited just as much of moderate intensity physical activity as they did from more rigorous intensity. They also point out that many people might get unmotivated of too intense workouts, and therefore recommend moderate intensity workouts in order to treat depressed patients (Paluska and Schwenk, 2000).

## **9.4 Summary of Health Effects of Physical Activity**

I have now studied the health effects of physical exercise in general. I have gained insight in common health problems related to lack of physical exercise, which include increased risk for cardiovascular diseases, including but not limited to heart diseases and type 2 diabetes, bone and joint diseases and some kinds of cancers. Moreover, I gathered information about the health effects physical exercise can provide. Logically, the health effects are tied with preventing the health problems related to lack of physical activity.

Lastly, I have gained insight into the World Health Organization's recommended activity level, in addition to studying research going more into the

details of how much and how intensive the physical exercise needs to be in order for people to benefit from the health effects of physical exercise. It turns out the recommendations from WHO will lead to significant health benefits, although being even more physically active can yield further health benefits. It is though important not to exaggerate in order for people not to lose motivation and get overtrained.

These insights will be taken into consideration when designing my own exergame concept. It is important to use this knowledge in order to design an exergame that can provide health benefits for the players in addition to being enjoyable for them to play.

## Part III

# Ideas for Potential New Exergame Concepts

In this part I will contribute some new ideas to the field of exergames. I will first review different well-defined game genres and investigate how physical activity can be incorporated into games of these different genres. Secondly, I will combine components from the results of the review of game genres, in order to make specific concepts for exergames. In addition to contributing ideas for how technology presented in Chapter 7 can be used to incorporate physical activity in well-established game genres presented in Chapter 10, this work has enabled me to, in a structured way, develop ideas for a game concept, Fitogotchi, that was developed and tested on users in the work on this thesis. Fitogotchi is described in detail in Part IV.



# Chapter 10

## Game Genres

In order to contribute to the research field of exergames, I have carried out research on different game genres with the goal of finding ways physical exercise can be implemented into games of different genres. By combining insights in these genres with the knowledge gained from the study of existing exergames in Chapter 6, the technology review in Chapter 7 and the video game frameworks in Chapter 8, I have come up with some ideas on how physical exercise can be implemented in a handful of common game genres. The results are presented in this chapter.

### 10.1 Role-Playing Games (RPG)

Role-playing games are games where players take the role of one or more fictional character(s) exploring some well-defined world (Wikipedia, 2016e). Role-playing games are characterized by their immersive worlds and deeply engaging stories. Players explore these rich worlds taking the role of a character existing in this fantasy universe. Character development is an important aspect of these games and in many modern role-playing games these avatars are often highly customizable. By performing different tasks and fighting monsters, the character levels up, gains new skills or becomes more powerful in other ways. Examples of popular role-playing games are The Elder Scrolls: Skyrim, Mass Effect, Pokémon Sun/Moon and The Witcher 3: The Wild Hunt (as seen in Figure 10.1).



Figure 10.1: *The Witcher 3: The Wild Hunt*.

There are many ways to design a role playing exergame. Let me suggest one approach where character development happens when players perform exercise. The in-game character can become stronger when players perform strength exercises, or get better stamina if the player performs cardiovascular exercises. In addition, when in-game fights take place, attacks can be performed by letting players perform sword swinging movements or punching gestures. Quests can also require activity to be completed, an example being quests requiring players to walk or run for a distance in order to get to different story significant in-game locations. All these features would be possible to implement on a smartphone (for more information of smartphones' capabilities, see Section 7.4).

## 10.2 Music Games

Music games are games where music is the foundation of the gameplay (Wikipedia, 2016g). Throughout the years, a variety of different music games have been released. Games ranging from karaoke games like Singstar, band

simulators like Guitar Hero, to dancing games like DDR and Dance Central 2 (see Figure 10.2) have been popular games in this genre.



Figure 10.2: *Dance Central 2 for Xbox 360.*

These kinds of games provide many ways of incorporating physical activity into the gameplay. Popular series like the Dance Dance Revolution game series described in Section 6.1, have already proven that these kinds of games can provide a good exercise. Traditional activities like dancing is something humans have participated in at all times. Thus, making people move to rhythm might provide many interesting opportunities for making both fun, engaging and intense exergames.

Despite music games' natural potential for being exergames, this genre will not be explored any further in this thesis. My research aims to explore new and innovative concepts for exergames, and due to the already saturated selection of music games incorporating physical activity, I will put more effort into exploring the potential of other less explored game genres for exergames.

## 10.3 Sports Games

Humans have engaged in sports for thousands of years as a way to be entertained (Wikipedia, 2016h), and sports games aim to simulate these sports into the video game world (Wikipedia, 2016g). FIFA (see Figure 10.3), Football Manager, Madden NFL and Mario & Sonic at the Olympic games are examples of popular modern sports games.



Figure 10.3: *FIFA 16*.

These games can be "exergamified" in many different ways, for instance by connecting a screen to either a treadmill or an exercise bike and then simulate a race on the screen. Another option would be to connect sensors to sport participants, track their motions and give them points and achievements for performing feats in the sport.



## 10.4 Simulation Games

Simulation games is a broad genre of games that simulate different aspects of the real world or fictional reality. Goals in these kinds of games are often loosely defined and players have a lot of freedom to play freely in the simulated world (Wikipedia, 2016g). Countless things have been simulated throughout the years, including but not limited to simulating racing in games like Gran Turismo for Playstation, everyday life in games like The Sims (see Figure 10.4), flying planes in Flight Simulator and city building in games like Cities Skylines.



Figure 10.4: *The Sims 4*.

An idea for putting exercise into simulation games could be a life simulator, where players need to perform certain exercises to develop the character they control. These developments can be required to progress in the game, and in that way motivate people to exercise.

## 10.5 Party Games/Mini Games

Party games are games that are developed specifically with multiplayer in mind, often where players are situated in the same location (Wikipedia, 2016g). Games in this genre often consist of various mini games, that are performed individually or in teams. These games range from games like Mario Party (Figure 10.5), Wario Ware, Rayman Raving Rabbids and Nintendo Land.



Figure 10.5: *Mario Party 10*.

An interesting concept for an exer-party game would be a game where players have to beat series of mini games that require players to perform various kinds of exercise to beat the mini games. In this way, different exercises could be implemented in different mini games, and the game would make players perform a kind of circuit training while playing the game.

## 10.6 Strategy Games

Strategy games are games where players face strategic and tactical challenges that need to be solved by planning and skillful thinking in order to win. These games often give players a God-like view to give them an overview of the situation so players can make educated decisions based on plenty of information (Wikipedia, 2016g).

A subgenre within strategy games is called tower defense games. In these games, monsters will try to get to the end of a predefined path and the players' goal is to build armed towers strategically to stop the monsters from reaching the end of this path. These games range from the cartoony Pixeljunk Monsters (Figure 10.6) to games like Defense Grid 2.



Figure 10.6: *Pixeljunk Monsters*, a tower defense strategy game.

The Location-Based Tower Defense game by Audun Johannes Brandt, described in Section 6.7, is an example of a game exploring the potential of tower defense strategy games as exergames. This game puts the game board in the real world using maps on the phone and tracks the player's position on the board using GPS. Players then have to physically move in the game world



in order to build towers and collect power-ups (Brandt, 2016). Depending on the pace of the game, players need to walk or run in order to win the game.

## 10.7 Idle Games

Idle games are games where players make progress even while not playing the game, hence the name *idle* games (Wikipedia, 2016g). These games might require players to log into the game regularly to make progress and unlock rewards to further increase their idle-rewards. They are often simple and addictive, making players always want to improve their score all the time.

Cookie Clicker, as seen in Figure 10.7, was one of the first popular idle games released, and since then a variety of different idle games have emerged building on the same formula (Davis, 2013). In this game, players got cookies by pressing a cookie on the screen. Players could later purchase facilities that automatically generated cookies, even while players did not play the game. The goal of the game is to get more cookies and upgrade the facilities to get even more of them.

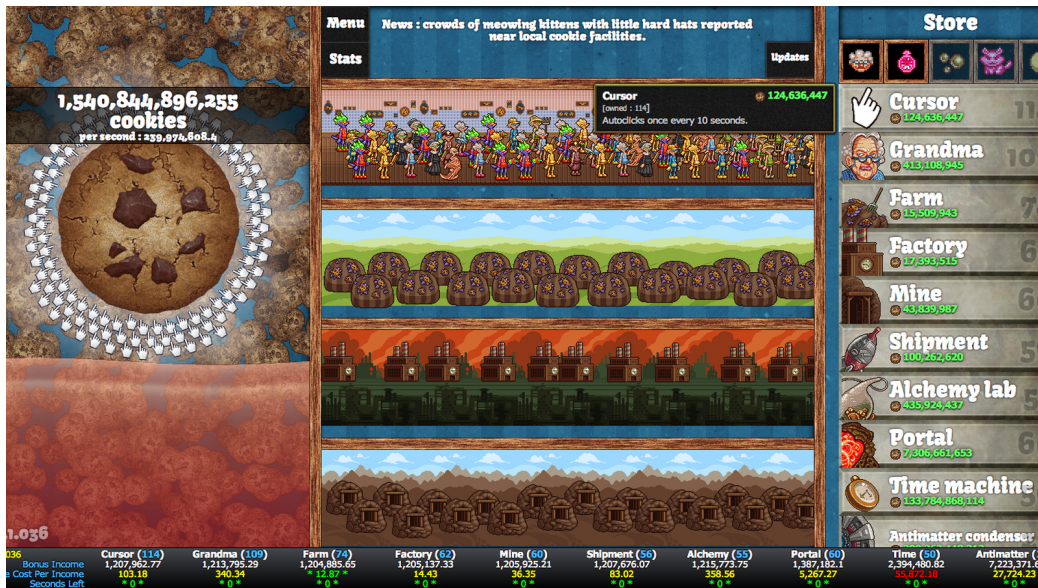


Figure 10.7: *Cookie Clicker*.

There are various ways to make an exer-idle game. One idea, presented by professor Alf Inge Wang in a conversation with him, would be to let players perform exercise in order to train a monster. When the game is idle, players will automatically fight other players they pass in the real world and get rewards when they win a fight. The more the player exercise, the stronger the monster will be. Thus the player will get more rewards, which should be motivation to exercise more.

## **10.8 Workout Logs/Applications with Game Elements**

Another approach to make an exergame would be to make a more ordinary exercise diary and then implement game elements into this diary. Many people use diaries to track their workouts and implementing game elements to these diaries might motivate people to exercise more than they normally do. Fitocracy (see Section 6.9) is an example of a workout log that has added social functions and game elements into the application. There should be many ways to develop this concept further and some ideas to expand upon this concept are presented in Section 11.8.

## **10.9 Summary of Game Genres**

During this chapter I have explored some popular game genres in today's video game market and reasoned about some possible ways to implement exercise into games in different genres. This has given me valuable inspiration to boost my creativity, and during the work on this chapter I have invented some new ideas for exiting exergame concepts that I will present in Chapter 11.



# Chapter 11

## Ideas for New Exergames

During the prestudy, I invented many different ideas for different exergame concepts. In Chapter 6, I got an overview of already existing exergame concepts and in Chapter 7, an overview of the technological capabilities modern technologies provide was established. In Chapter 10, I invented many new ideas by studying popular game genres and discussing possible ways to implement exercise into games of different genres. I will now combine the results from the work so far to make specific exergame concepts and then evaluate them. This is in order to contribute new ideas to the research field of exergames and to be able to make a more educated choice for which concept I want to develop further.

### 11.1 Mini Exergames

One of my ideas would be to make an exergame inspired by Nintendo's Wario Ware series as seen in Figure 11.1 (Nintendo, 2005). The Wario Ware games consist of short mini games lasting for only a few seconds each, before a new mini game is introduced. The more mini games the player completes, the more difficult the games get and the goal of the game is to be able to complete as many mini games as possible without failing.

By making mini games that require players to perform exercise could make up for a varied and fun way to exercise. By adapting the difficulty level of the mini games and cleverly organizing the mini games in a sensible order, reasonable workout routines can be implemented into the gameplay. This game would fit many platforms, but Kinect would be a good option as the game controller for this game.

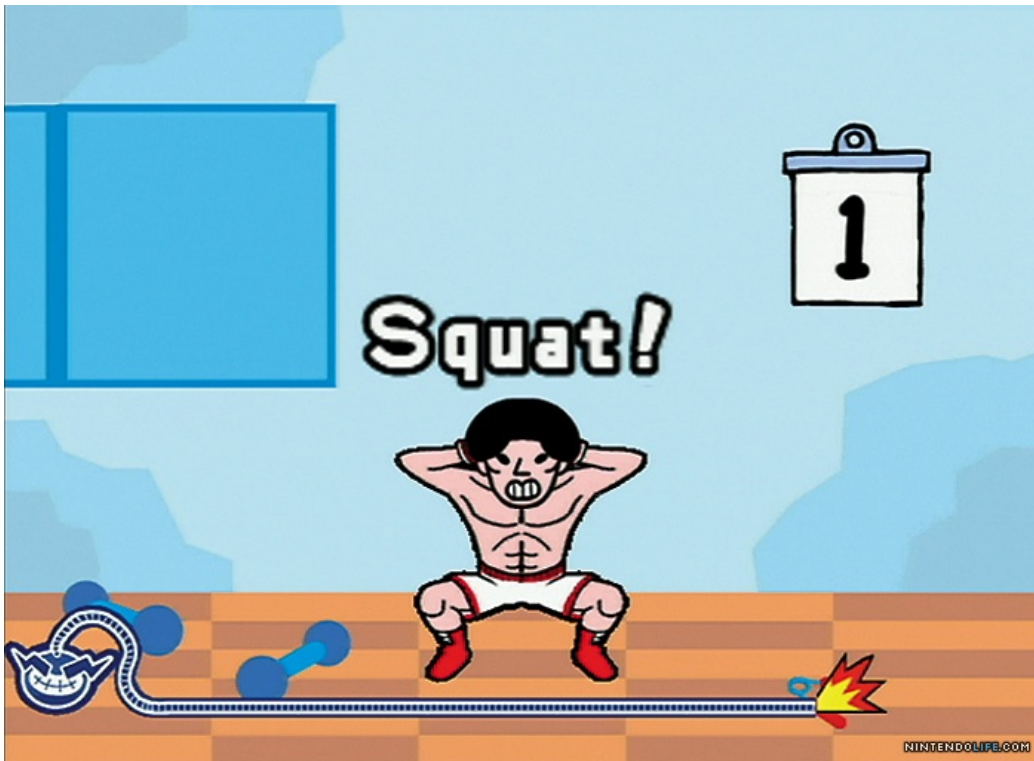


Figure 11.1: *Wario Ware: Smooth Moves for Nintendo Wii.*

## 11.2 Tamagotchi Exercise-edition

Imagine an exergame version of the popular Tamagotchi games made by the Japanese company Bandai (Wikipedia, 2016f). Like in the Tamagotchi games, players get a creature they need to take care of. Instead of feeding the creature, the creature will develop and get energy from the users' movement. Different activities develop different attributes of the creature, but all kinds of physical activity will lead to progression.

The game should not require to be in the foreground on the device in order to track players' activity, such that all the activity the player performs during should count. In this way people can play the game and make progress doing their favorite activity, whether it is running, walking, biking or strength



exercise. In this way the game would reach out to a wide variety of different players and people can choose the intensity level appropriate for themselves. In addition, there are great opportunities for including multiplayer functionality to this game, by making the creatures able to interact with other players' creatures in some way, either as enemies or friends.

This game concept would work well on smartphones, due to their advanced built-in sensors and portability. Furthermore, as discussed in Section 7.6, both the Android- and iOS-platform can provide functionality for tracking health related data in the background. This data can then be used in applications running on these systems, which in this case could enable the game to get data while not being active on the device.

### 11.3 Clicker Heroes Exergame

The idle game Clicker Heroes (Playsaurus, 2015) is probably one of the most popular existing idle games (Grayson, 2015), and the game is highly addictive due to the fact that players can always upgrade their skills and fighters in the game so they get exponentially stronger. The fact that the game is so addictive, makes it interesting to explore the possibilities for making an exergame based on this concept.

In Clicker Heroes players can both click the monsters in order to inflict damage, and they can also hire heroes that inflict certain amount of damage per second. Instead of clicking the monsters in order to inflict damage, players could perform attacks by doing different strength exercises. It could also be possible to implement repetitions of strength exercises as a currency in the game, so players could upgrade the heroes in the game by using both gold retrieved when defeating enemies, and perform a certain number of repetitions in order to unlock new characters and level up existing ones.

Figure 11.2 and 11.3, visualize the concept in more detail and are based upon screenshots from the Clicker Heroes game.

Should require both exercise and coins in order to upgrade heroes so the player has a reason to beat monsters and earn coins



Can do extra damage to monsters if doing exercise (instead of clicking in Clicker Heroes).

This might be particularly useful in boss fights. Some bosses will also require the user to perform strength exercises.

Figure 11.2: Exer Clicker Heroes idea sketch.

Statistics about the game as well as exercise data

Different achievements for performing different feats in the game.



Figure 11.3: Exer Clicker Heroes idea sketch.

## 11.4 Exermon Extended to use Strength Exercises at the Gym

An interesting thought would be to expand on the idea of Exermon by Høivik and Olsen (Høivik and Olsen, 2015), described in Section 6.8. In this game, only body weight exercises are supported. A similar concept where players

can train their creatures not only using body weight, but expanding it to also supporting strength exercises at the gym would be interesting. Exercises like bench press, military press and biceps curls, which consists of mainly arm movements, could be tracked using a smart watch or an activity wristband as discussed in Section 7.6.

## 11.5 Exer-Sims

The first the Sims game released is still one of the best selling PC games ever (Wikipedia, 2016a). The game is a simulator simulating everyday life. Players control humans' day and night, making families, building their houses, send them to work, educate them and so on (EA Games, 2016). Imagine a similar life simulator that requires users to perform exercise in order to develop their character and perform everyday tasks. They can develop their characters by performing strength exercises at home, for instance, when the character in the game needs to go to school, the player needs to go to a specified location in order for the simulated character to go there. There are many possibilities for implementing activity and exertion in a concept like this and it should be a concept well-suited for smartphones.

## 11.6 Text-based Strength Exercise Game

This game works like an interactive book, telling a story through text. The story contains missions players have to complete in order to make the story progress. In a game like this, every chapter of the story could correspond to one workout session. In the story, players will regularly need to perform missions in order to progress. These missions require users to perform various strength exercises. During the breaks between the sets, the story progress for an appropriate amount of time before a new mission is presented to the users, requiring them to perform another set of the exercise. In this way the breaks get more fun, and hopefully people will be motivated to exercise in order to read more of the story. Smartphones would be a reasonable platform to develop this game for, as it is easy to bring everywhere. This will make it

possible to support weightlifting exercises performed at the gym, as well as body weight exercise at home.

## 11.7 Hurdles VR Exergame

A hurdles game with some twists from the real life sport would be interesting to make for virtual reality. In this game, obstacles will move against the player and they should either jump, dodge or move to the sides in order to avoid the obstacles. As the player progress, the game could increase in difficulty by making the obstacles approach the player faster and the obstacles could get bigger so they are more difficult to avoid.

This game could be implemented for HTC Vive, mentioned in Section 7.3. HTC Vive tracks hand- and head-motion, and this would have made it possible to sense when players jump, move to the side, crouch and so on.

## 11.8 Gamified Workout Log

When performing exercise, it is important to repeat the same exercises regularly in order to make progress (Kraemer and Ratamess, 2004). Therefore, a workout logging application that reminds people to exercise when it is time to repeat the workout, might be useful in order to improve people's fitness levels. The application should include basic workout log functionality. In addition, the workout log should motivate users to exercise more often by implementing a point system where they get points for every exercise they perform. To boost players' desire for points even more, a leaderboard should be implemented, so that users can see how well they perform compared to their friends.

In fact, social functions should play an important role in this application. Players should be able to challenge other players and friends in workout challenges. In these challenges friends can challenge each other in many different ways. One approach is that two or more players decide one specific

strength exercise and a time frame for the challenge to last. The goal of the challenge is to increase the most in strength during the specified period of time, and the winner is the one who has increased the most in the end of the challenge. Other approaches could be to let users compete in running the fastest in a predefined route or skip the least amount of exercises during a predefined period of time. The possibilities for these challenges are endless, and can provide both great fun and motivation for exercising, although there are reasons to believe that this kind of game would mainly attract people who already do exercise.

This workout log should be developed for smartphones, as users can bring the phone to their exercise and enter data about the exercise while they perform the workout. Smartphones can also track users' movement using GPS, which is necessary when tracking people's running workouts.

## **11.9 Summary of Ideas for New Exergames**

By coming up with different ideas for exergame concepts and exploring them in more detail, I have gained better insight in the potential of the different concepts. In this way I am able to do an educated choice for which game concept I want to develop further. This process has been an important inspiration in the work of designing the final game concept that will be presented in Chapter 12. The final concept combines ideas from several game concepts discussed in this chapter and should appeal to a broad audience of people – no matter how sedentary or active their lifestyle currently is.



## Part IV

# Fitogotchi

Fitogotchi is a game encouraging players to perform more physical exercise and change people's everyday habits on physical exercise. It is developed with the frameworks discussed in Chapter 8 in mind, in order to develop a game concept that should be enjoyable for players to play. Ideas explained in Chapter 11 have been used in the design of the game concept. Additionally, the results from the technology review in Chapter 7 have been useful in order to choose technology that can realize the game. The targeted audience are people who normally do not exercise regularly and hopefully this game will motivate a wide range of people to exercise more than they currently do.

This part will describe in detail the game concept, gameplay, the technologies that have been used to realize the game concept and an overview of the development process.





# Chapter 12

## Fitogotchi

In this chapter, Fitogotchi, the exergame that was developed in the work on this thesis, is described and shown in detail using screenshots from the game and descriptions to explain how the game works.

The game consists of two parts: a *character development*-part and a *endless runner*-part. The *character development* will be described in Section 12.1 and the endless runner of the game will be described in Section 12.2.

### 12.1 Character Development

Players of Fitogotchi take care of their own monster called a Fitogotchi. The name Fitogotchi is a combination of the two words *fitness* and *Tamagotchi*.

Tamagotchi is a classic game where players take care of their own hand-held pet, called a Tamagotchi (Wikipedia, 2016f). While players took care of their Tamagotchi by feeding it and playing with it in the Tamagotchi games, Fitogotchis are kept healthy by performing physical exercise. As the Fitogotchis follow their players wherever they go, the Fitogotchis benefit from the players' exercise, hence they get stronger as the players perform physical activity.

The Fitogotchi has three types of stats that can be improved. Leveling up each stat gives the player an advantage in the endless runner in the game. The different stats also require the player to perform different kinds of exercise in order to level up, as explained in Table 12.1.

<b>Stat</b>	<b>Advantage</b>	<b>Required Exercise</b>
<i>Endurance level</i>	The Fitogotchi's health and endurance increases.	Walking
<i>Dash level</i>	The Fitogotchi gets more dash energy and can dash more in the endless runner of the game. The coins' value also increases.	Running
<i>Regeneration level</i>	The Fitogotchi's health decreases slower, dash energy regenerates faster while character is not dashing and coins increase in value.	Biking
<i>Level</i>	The Fitogotchi's main level. This is the average of the above mentioned sub-levels. By increasing this level, the Fitogotchi evolves. Evolution of the character implies a change in appearance, and sometimes also an increase in the Fitogotchi's size. The different evolutions of the Fitogotchi are shown in Figure 12.1.	Walking, biking and running.

Table 12.1: *The different stats of the Fitogotchi character.*

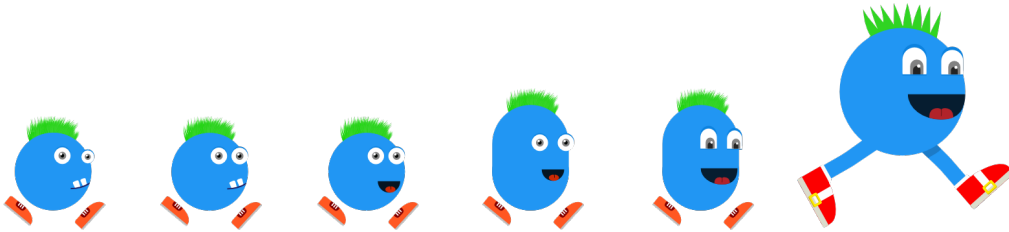


Figure 12.1: *The Fitogotchi's development stages.*

As the character levels up and gets stronger, it also changes appearance, as seen in Figure 12.1. Evolving the character also gives players an advantage in the endless runner of the game, as it can be able to collect more coins as the Fitogotchi grows taller.

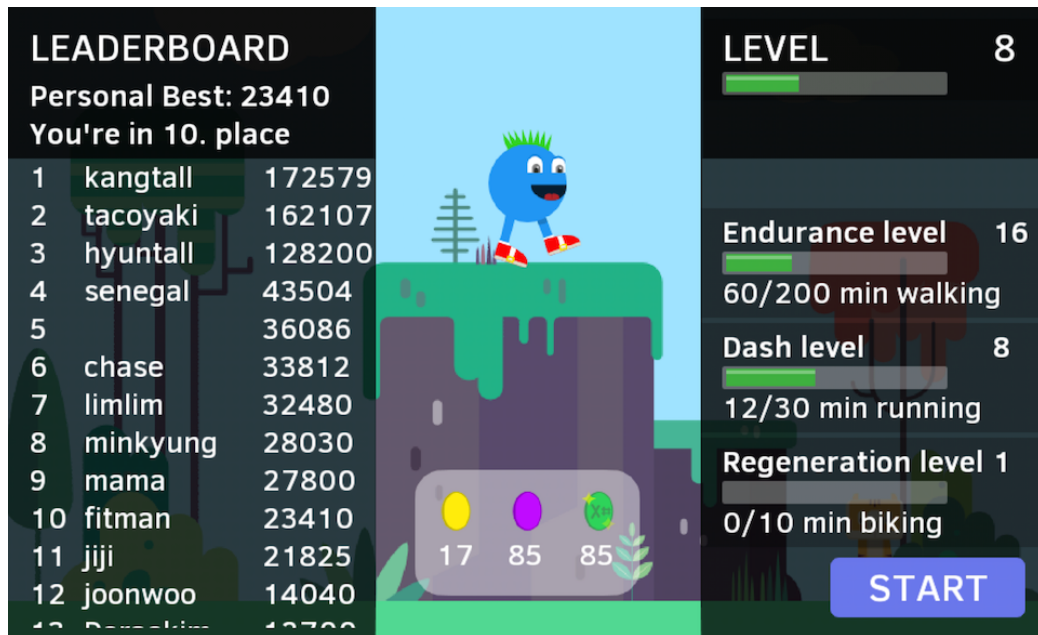


Figure 12.2: The main screen of the game, with an online leaderboard on the left and the Fitogotci's stats on the right.

Figure 12.2 shows the main screen of the game. As indicated in the stats view on the right side of the screen, the player levels up each sub-level by performing the required activities for a specific duration. The activity players perform will be detected automatically and counts towards the progress of the character no matter if the game is open on the phone or not. In this way players do not need to remember to start the game every time they perform physical activity or keep the screen of the phone turned on at inconvenient times – for instance, when biking or running.

## 12.2 Endless Runner

The main goals of the endless runner are to reach as far as possible and to get as many points as possible. The endless runner is strictly speaking not endless, as it contains 5 worlds with a limited length. But the length and number of these worlds were designed to make it hard for players to com-

plete all of them during the two week game-testing period in the experiment described in Part VI.

Every time the players play the endless runner, they always start at the first world. As they reach the end of one world, they come to the next world. When a new world starts, the player's dash energy is replenished, but health is not. When the player dies and tries again, they start from world 1 again. As the players level up the stats of their Fitogotchi, they will be able to reach worlds they were not able to reach before and increase their personal best score.

The five different worlds have a different theme, design and music, and every consecutive world gets harder and harder. The worlds contain different paths to encourage players to explore the different worlds. Some of the paths are harder than others, but reward the player with more coins, hence the game gives players a strategic choice of risking to lose health for more coins, or play it safe and go for the easiest path. In this way, players can also choose the path that matches their skill level. Some of these paths are also hidden, so players have to explore the world thoroughly in order to find them. The five worlds in the game are as follows:

- World 1: City world (Figure 12.3).
- World 2: Jungle world (Figure 12.4).
- World 3: Snow world (Figure 12.5).
- World 4: Ice world (Figure 12.6).
- World 5: Lava cave world (Figure 12.7).



Figure 12.3: *World 1, the city world.*

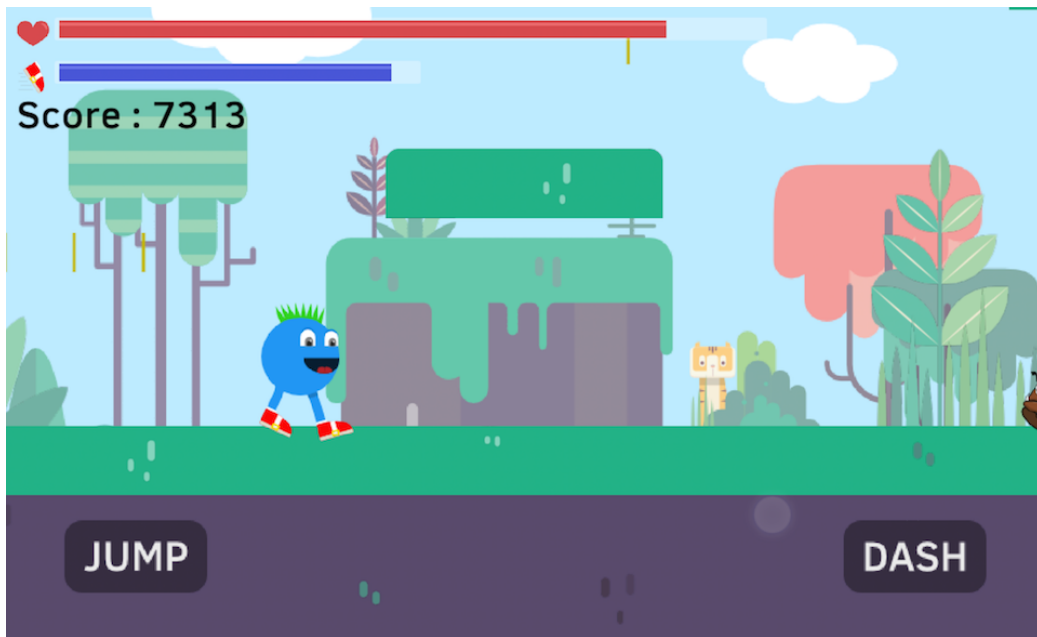


Figure 12.4: *World 2, the jungle world.*

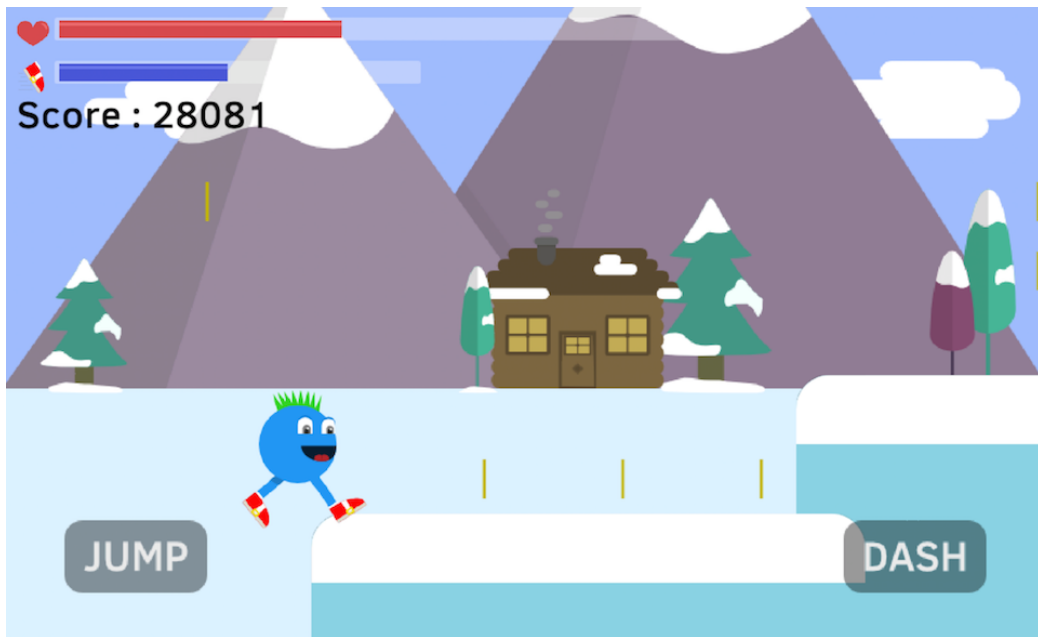


Figure 12.5: *World 3, the snow world.*



Figure 12.6: *World 4, the ice world.*



Figure 12.7: World 5, the lava world.

### 12.2.1 Gameplay

This section describes how the game is played.

#### Controls

In the endless runner in the game, the player's Fitogotchi is running by itself and the player can jump, double jump and dash using the two on-screen buttons visible in the screenshots in Figures 12.3 to 12.7. When players dash, the character's speed is boosted, and if the character is in air, the character will maintain its height like it is flying. Figure 12.8 shows the Fitogotchi while dashing.

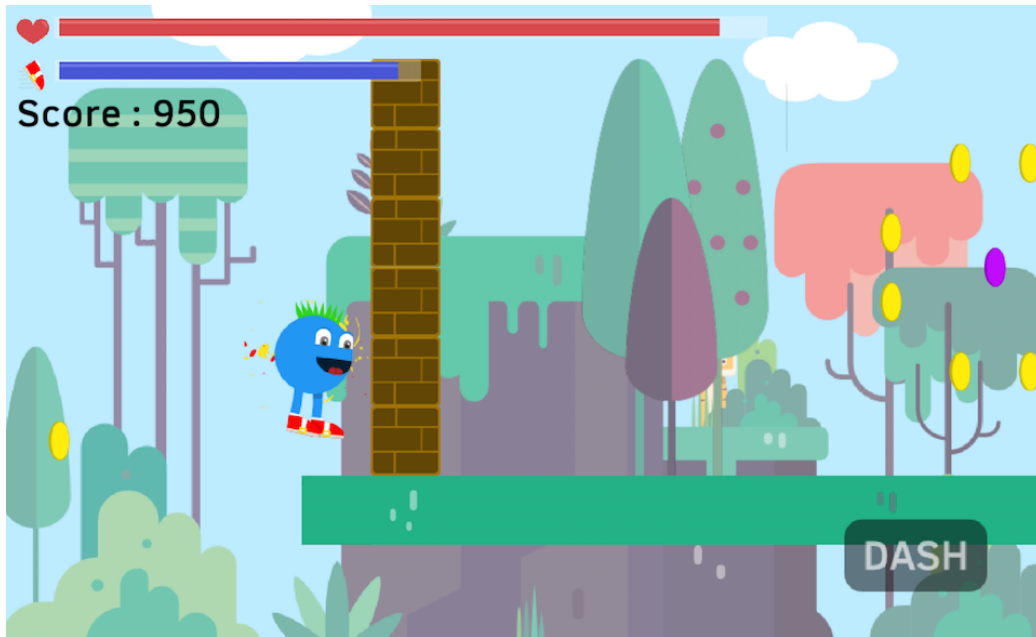


Figure 12.8: *The Fitogotchi while dashing.*

The Fitogotchi has a certain amount of health and dash energy. As explained in Section 12.1, the amount of health and dash energy the Fitogotchi has depends on the Fitogotchi's level, which again is determined by the players' physical activity level. The health and dash energy are visualized by the two bars on top of the screen (as seen in Figures 12.3 to 12.7), the topmost being health and the other being dash energy.

The Fitogotchi's health is drained in two ways:

1. The player hits an obstacle or enemy.
2. Over time, the Fitogotchi slowly loses health as it gets exhausted from running.

The Fitogotchi can dash only if it has dash energy left. While players are dashing, their dash energy decreases, and while not dashing, the dash energy is recovering. The higher the Fitogotchi's regeneration level is, the faster the dash energy recovers again.



## Enemies and Obstacles

In the different worlds, players meet different kinds of enemies and obstacles. Hitting an obstacle or getting hit by an enemy reduces the Fitogotchi's health.

Obstacles are dangerous hindrances placed in the worlds, and the player has to avoid these in order not to get hurt. They can be easily recognized as they have a pulsating red outline to make them extra visible and to indicate that they pose a danger to the player. Obstacles look different in each level, as shown in Figure 12.9.

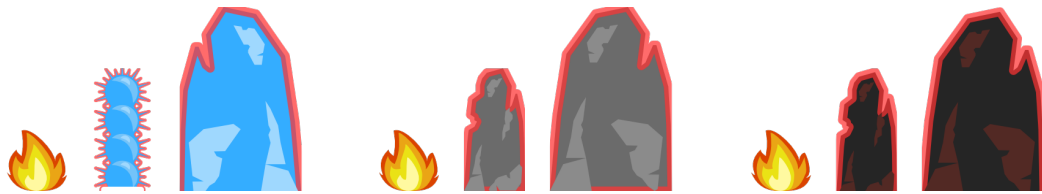


Figure 12.9: *Obstacles from different worlds in the game.*

Enemies (see Figure 12.10) move and players can jump on their head to defeat it to get points – or they can try to avoid it.



Figure 12.10: *Left: enemies in the game, Right: dash box.*

Additionally, players will encounter dash boxes (see Figure 12.10). Dash boxes are bricks that players have to dash through, otherwise the Fitogotchi will get hurt.

## Leaderboard and Score

Every time players log into Fitogotchi, an online leaderboard where each player is ranked against all the other players of Fitogotchi in their region, is displayed as seen in Figure 12.2. As Fitogotchi was played in both Korea and Norway, there were separate leaderboards for these two regions. By getting a higher score, players can climb the leaderboard.

Players get points when jumping on enemies, dashing through dash boxes, finishing a world and when they collect coins. As shown in Figure 12.11, there are a variety of different coins in the game:

- *Yellow coins* which have a base value of 10 points and increase by 1 point for every level the player increases its Fitogotchi's dash- or regeneration level.
- *Purple coins* which have a base value of 50 points and increase by 5 points for every level the player increases its Fitogotchi's dash- or regeneration level.
- *Multiplier coins* which have the same base value as the purple coin, but for every consecutive coin the player picks up, the score of the coin is multiplied by 2. Hence, the first coin is worth 50 points, the second 100 points, the third 200 points, the fourth 400 points and so on. If the player miss a coin, the multiplier is reset.

Yellow coins are the most common coins, the purple are rare in the first few worlds and get more common when players reach the later worlds, while multiplier coins are rare and placed in positions that are hard to reach.

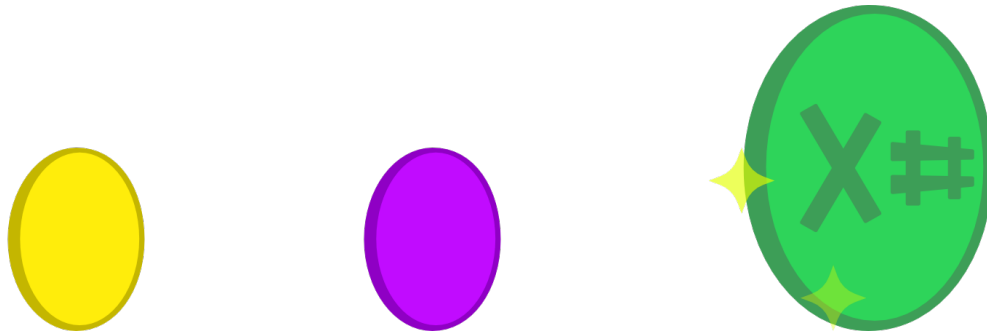


Figure 12.11: *The different coins in Fitogotchi.*

### 12.3 Summary Fitogotchi

Fitogotchi is an exergame where players can perform three different kinds of cardiovascular exercises to level up three different sub-levels of their pocket monster, called a Fitogotchi. As players perform physical activity and make their Fitogotchi stronger, they get advantages when playing the endless runner of the game, helping players to reach new worlds and improve their score. The player's high score is compared to the other players playing the game in their region in the leaderboard, adding an important *social* element to the game.

This chapter has described how the game works and the content available for the players of the game. Chapter 13 will describe how game theory from Chapter 8 has been used to increase the probability that players enjoy playing this game.



# Chapter 13

## Fitogotchi – Game Design

This chapter explains in more detail how theory from the three frameworks described in Chapter 8 have been used in the work of designing Fitogotchi. By consciously designing the game with these frameworks in mind, elements that should make the game more enjoyable for players to play have been added to the game. In order to make a game that aims to change people's physical activity habits, it is important that players enjoy the game in a way that makes them want to play the game regularly.

### 13.1 GameFlow

In the endless runner in Fitogotchi, the Fitogotchi runs continuously by itself and players have to avoid obstacles, kill enemies, dash through dash boxes and jump across endless holes, while at the same time collecting as many coins as possible and making sure they do not miss the green coins. All these tasks ensure that players need to focus and stay *concentrated*. All these tasks are important in order to improve the score in the game, hence players should not feel they are forced to do *unnecessary tasks*. The user interface of the game is also minimal, leaving more screen space for the action in the game and each world's unique design and music, making players more *immersed* in the game experience.

The difficulty is also getting harder as players are able to reach further in the endless runner, so that the difficulty level *matches the players' increasing skill levels* as they progress in the game.

The game also presents *clear goals* to the player early in the game - level up

the character to reach as many worlds as possible and climb the leaderboard. The game also has a simple control scheme, with invisible buttons covering each half of the screen, so that players are able to *convert their intended action to the correct action in the game*, even though they miss the visual button on the screen.

Players also get *feedback immediately* when they perform actions in the game, and players are notified immediately when they lose and a game hint is shown to *help the players improve* next time they play (Figure 13.1).

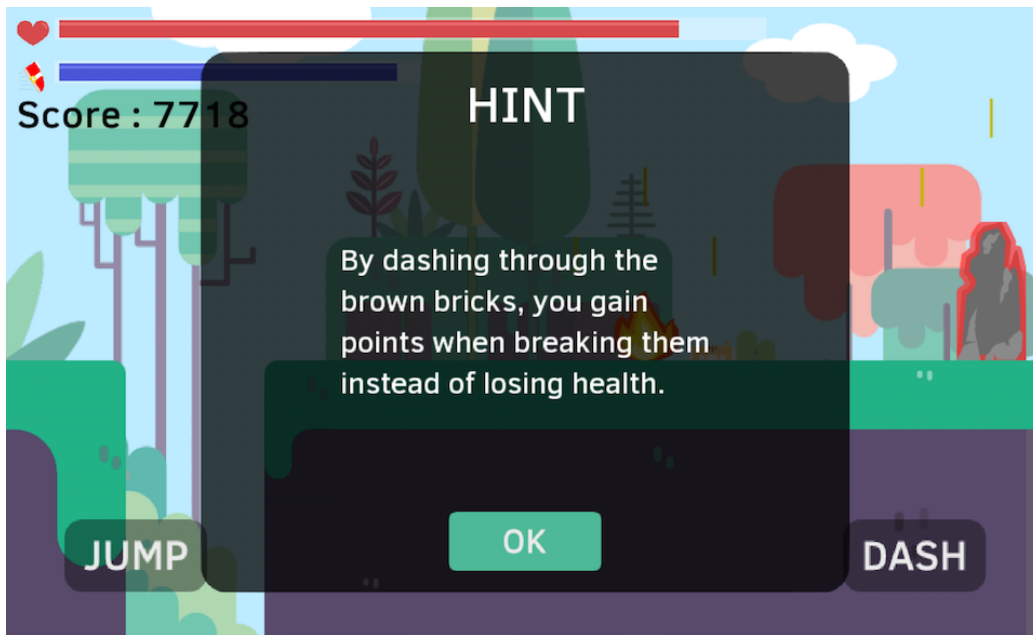


Figure 13.1: A hint showing up when the player dies.

The leaderboard, an important motivation to play in the game, enables *social interaction* among the players in the game, so people can show and compare their current high score to other players.

In order to comply to *dual flow*, players can choose among three different types of physical exercise to level up different skills of their character. The stat related to walking is the most important stat to increase early in the game, but later the stats increased by running and biking get increasingly im-

portant for players to improve to make progress in the game. This is purposely implemented to challenge players physically as their fitness levels increase – players can start by increasing their walking, but will later need to run and go biking if they want to progress in the game. Players can choose the length of each exercise themselves, but performing more exercise will develop the character faster – an incentive for players to push themselves.

## 13.2 Challenge, Fantasy and Curiosity

In Fitogotchi, each consecutive world gets harder than the previous one, so that players' skills are always *challenged* as they get better and progress in the game. As players can find secret passages, reach new passages blocked by dash boxes as they level up the dash level of the character and can collect coins to reach higher scores, there is *multiple levels of achievement* as players finish a run in the endless runner part of the game with various score. Hence players will always be able to improve their performance in the game.

The fantasy in the game is to take care of a pocket monster, called a Fitogotchi, by performing physical exercise. The Fitogotchi can then run for longer and reach new worlds as the Fitogotchi gets healthier and more physically enduring. Taking care of a pocket monster has proven to be a fantasy that appeals to a wide audience before in games like Pokémon and Tamagotchi, which have been very popular games (Wikipedia, 2016f; Karmali, 2013). As the game tries to appeal to a variety of different people, it was important to choose a fantasy with a wide appeal.

Players can perform physical activity to level up their character, even while their smartphone is in sleep mode. In this way, players' physical activity affects the fantasy, but the fantasy does not directly affect how the physical exercise is performed, hence the *fantasy* in the exercise part of the game is *extrinsic*. Malone argues, as discussed in Section 8.2, that intrinsic fantasies are the most instructional and interesting fantasies, but an extrinsic fantasy was chosen as it is less tied to the activity itself and therefore provides more flexibility to vary the activities that can be performed in the game.

In order to trigger players' *sensory curiosity*, every world has a unique design

and theme to it. Considerable effort has been put into making the worlds feel unique and interesting to explore, by making the level design as well as the visual design varied and visually appealing. Sounds and visual feedback are used to *reward* players as they level up the Fitogotchi's stats, get a new high score (as seen in Figure 13.2) or finish a world. Also, as players level up their character's main level, the Fitogotchi evolves and changes appearance.

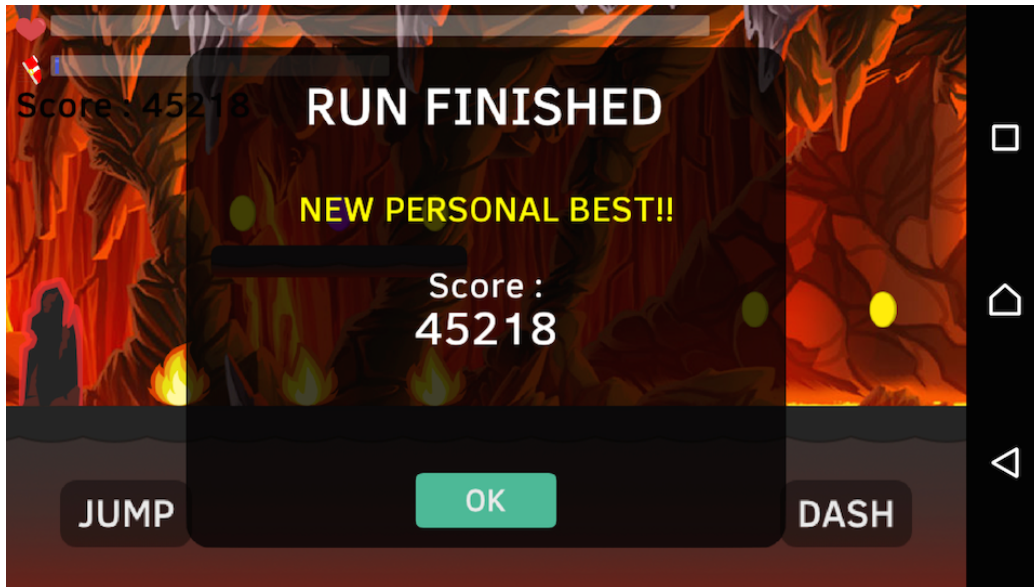


Figure 13.2: In-game notification showing player that he beat his personal best score.

Hidden passages and alternative paths in the worlds that are hard to reach trigger the players' *cognitive curiosity* as players will want to explore these alternative paths and understand the structure of the worlds. To further trigger this curiosity, a hint telling players that a secret cave exists is shown without telling them how to find it (as seen in Figure 13.3). Additionally, the theme of the worlds and how the character's appearance changes as it evolves are kept secret – also as means to trigger their *cognitive curiosity* to make them want to find out themselves.



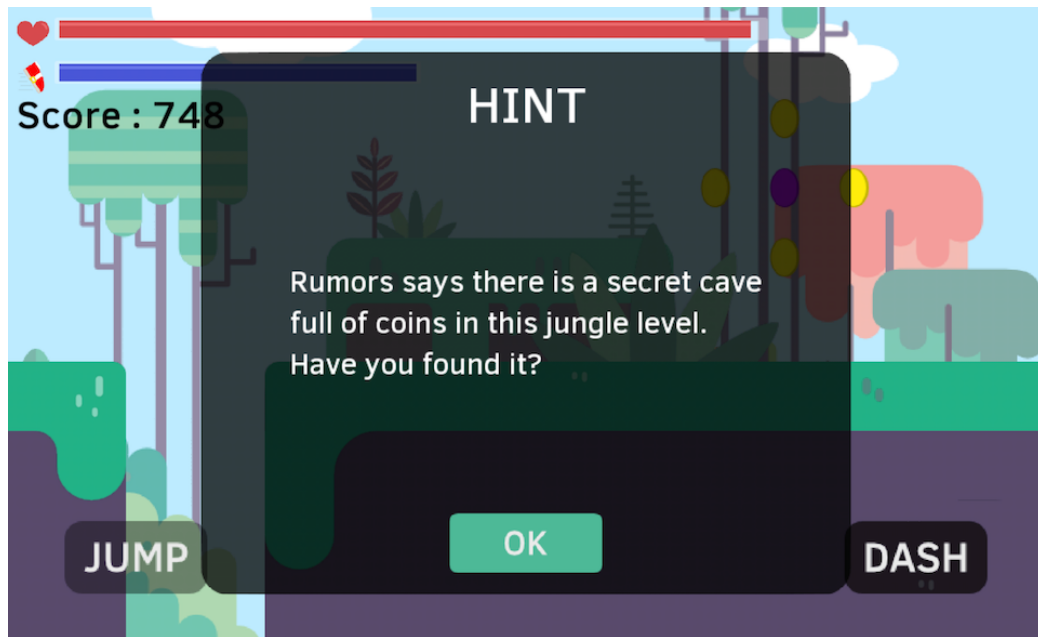


Figure 13.3: A hint revealing to players that a secret cave exists.

### 13.3 Rewards

In order to facilitate player enjoyment and motivation to play the game, rewards have been carefully implemented into the game according to the theory discussed in Section 8.4.

In Fitogotchi, *rewards of glory* has been implemented using a score system to give players reasons to constantly improve their performance in the game. The players' high scores are displayed for everybody to see on the online leaderboard of the game, and players are celebrated by sound and visual feedback when they beat their own high score as seen in Figure 13.2. Additionally, when players level up the dash- and regeneration level of their Fitogotchi, coins increase in value.

In order to make players feel constant progress while playing the game, *rewards of facility* is implemented through the level system. When the different

levels of the characters increase, its abilities and skills grow stronger. This makes the reward tied to leveling up the dash- and regeneration level belong to more than one reward-category.

This also goes for the endurance level. In the endless runner, the character's health drains slowly as the Fitogotchi gets exhausted, in addition to getting hurt when hit by an enemy or obstacle. By increasing the endurance level, the character's amount of health is increased and lets the player play for a *longer time* when playing the endless runner. Hence, increasing the endurance level is not only a *reward of facility*, but also a *reward of sustenance*.

An effect of this is also that players can reach further in the worlds by increasing the endurance level, meaning that the reward players receive when leveling up the endurance level is also a *reward of access*. The same goes for the leveling up the character's *dash-* and *regeneration level*. Increasing the *dash level*, boosts the characters dash energy, making it possible to enter paths previously impossible to enter, such as the one shown in Figure 13.4.



Figure 13.4: Upper right: an alternative path blocked by dash boxes.

Increasing the *regeneration level* slows down the health drain resulted by

character exhaustion and replenishes dash energy faster, hence making it possible to reach further worlds and enter paths blocked by dash boxes. Rewarding players access to new parts of the game world through the level system will enable players to gradually explore more of the game world and hopefully motivate players to come back to the game after they have leveled up their character to see the new areas of the game world they can reach.

Furthermore, by giving players multiple advantages for leveling up the different stats of their character, they will have multiple reasons to perform physical exercise to level up their Fitogotchi. This might help the game motivate a broader spectrum of players, as players can now perform physical exercise to achieve those rewards that appeal to themselves. Additionally, it can possibly increase the motivation for players who perceive all the rewards to be desirable.

## 13.4 Summary Game Design

By devoting most of the screen space for the varied game worlds and the action that happens within them, Fitogotchi facilitates player *immersion*. Keeping the tempo high and presenting important tasks while players play, the game should keep them *concentrated* while they try to reach the *clear goals* presented to them. A simple control scheme, well adapted to the smartphones' small screens, should make players *feel in control of their actions*.

The leaderboard facilitates *social interaction* that should encourage competition among the players and a reason for them to increase their score and play the game multiple times. Steady progression over the course of time is ensured by the level system, meaning players will be able to explore new worlds and increase their scores continuously, giving motivation to play the game for an extended period of time.

The increasing difficulty in the later worlds in the game, in addition to alternative paths with various difficulty should make sure players feel that the game is *challenging* while not being *frustratingly hard*. A fantasy with *wide appeal* has been chosen and various means have been made to trigger players' *curiosity*. In order to motivate players to play the game, they are rewarded

various *rewards* for their actions in the game and the physical exercise they perform.

# Chapter 14

## Fitogotchi - Exercise Design

Fitogotchi is a game that aims to change players' everyday physical activity habits. In order to reward players for all the changes they make to their activity routines, the game automatically detects what kind of physical exercise the player performs and for how long they perform them, even when the game is idle on the phone.

The game encourages players to walk, bike and run. As these exercises also act as means of transportation, they are easily incorporated in people's everyday life, for instance by walking detours to school or by biking instead of using public transport or a car when traveling short distances. Hence, these activities provide a good foundation to change players' everyday physical activity habits.

A hint system, giving tips to how players can incorporate more physical exercise in their normal lives, is implemented in the game. This is to give players motivation and ideas for how this can easily be done in their everyday routines.

Players are free to choose from which of the supported physical activities they want to perform. Nevertheless, as players progress in the game, the importance of the benefits players get by leveling up the dash- and regeneration level increases. These two sub-levels require, as mentioned earlier, the players to run and bike. The increased need to level up these sub-levels is intended to encourage players to perform more rigorous physical exercise as their fitness level increases.

Players are also free to decide the duration and frequency of each workout, but they are rewarded with more level progress the more physical exercise they perform, hence they have a reason to push themselves. More exercise are also

needed to level up as the players' characters reach higher levels. When one of the sub-levels are high, it will be easier to increase one of the less developed sub-levels than their higher sub-level, hence players are encouraged to vary the type of exercise they perform.

# Chapter 15

## Chosen Technologies

There were two main concerns that needed to be addressed when choosing which platform Fitogotchi should be developed for: first, the game needed to be able to register as much of the players' daily physical activity as possible. In order to achieve this, the game hardware should be portable. Second, the game needed to recognize and gather data about a variety of different physical activities performed by the players – the more different activities that could be tracked, the better it was.

In order to address these needs, the game was developed for Android smartphones and Google's health tracker, Google Fit, was used to track the players' physical activity.

### 15.1 Android Smartphones

Due to the need for the game platform to be able to register players' activity wherever they go, the game was developed for smartphones. These devices are really portable and most people carry them wherever they go. Additionally, as described in Section 7.4, these devices contain a variety of different sensors that enable tracking of many different types of motion, addressing the second requirement for the game platform. Even more health related data can be tracked if smartphones are combined with an activity wristband or a smartwatch as described in Section 7.5, but this was not done in Fitogotchi, due to time constraints.

In today's market, there are three major smartphone operating systems: Windows Phone, Android and iOS. It would be possible to make the game for

all these platforms, but due to the short time available to develop this game, there was only enough time to implement the game for one platform. As Figure 15.1 shows, Android is by far the most used smartphone operating system today (International Data Corporation (IDC), 2016), and in order to reach out to the most users, the game was developed for this platform first. In addition to this, I have more experience developing for Android than the other platforms, so this choice of platform also sped up the development process.

Period	Android	iOS	Windows Phone	Others
2015Q3	84.3%	13.4%	1.8%	0.5%
2015Q4	79.6%	18.6%	1.2%	0.5%
2016Q1	83.4%	15.4%	0.8%	0.4%
2016Q2	87.6%	11.7%	0.4%	0.3%

Figure 15.1: *Smartphone OS market share (International Data Corporation (IDC), 2016).*

## 15.2 Frameworks

To free time so that more features could be implemented into the game, a simple open source Super Mario clone was used as a foundation. This source code is available at <http://boontaran.com/posts/view/free-android-game-source-code>. The useful components of this game were modified to the needs of Fitogotchi and kept, while the rest was disposed. This freed a lot of time, as Fitogotchi’s physics and collision detection did not need to be built from scratch.

As the Super Mario clone was developed using the libGDX-framework (Badlogic Games, 2017), this framework was naturally used to develop Fitogotchi. The libGDX framework provides many useful features as a physics engine, API’s to help handling sprites and textures and support for cross-platform development among many other features. The game was not developed for multiple platforms, as some platform specific functionality, like Google Fit,



was used in the game. To use Apple's alternative, Apple Health on iOS, would have taken time to implement. Hence, this was not prioritized now, but if the game will later be ported to other platforms, it will require significantly less effort as it is developed using libGDX.

As I had never used libGDX before, it took some time to learn how to use the framework, but the fact that libGDX is a Java framework made this process easier, as Java was the programming language I at the moment had the most experience using.

## 15.3 Firebase

The online functionality of Fitogotchi was implemented using a platform called Firebase. Firebase is a platform by Google that provides many useful services for developers of applications, like crash reporting, real-time database, cloud storage, analytics service, remote configuration and authentication services (Google, 2017b).

The Firebase Real Time database was used to implement the leaderboard. This made it possible to have an online NoSQL database up and running fast, without the need to write any server code.

Secondly, the crash reporting functionality of Fireabse was implemented in the game, enabling monitoring of how often and why the game crashed. If severe problems occurred, they could be fixed and a patch could be sent to the participants. Analytics functionality was also implemented, to get useful data about how players used the app when playing it.

Remote configuration was used to make functionality that made it possible to remotely disable the game from working after the game playing period was over.

## 15.4 Google Fit

As mentioned in the introduction of this chapter, Fitogotchi needs to be able to track most of the participants everyday activities – at all times. In order to do this, health related data gathered by Google Fit was be used in the game. As discussed in Section 7.6.2, Google Fit tracks when users walk, run and bike in a background process whenever the user carry the phone. In addition to the health data Google Fit tracks, Google Fit also works like a hub gathering health related data generated by other applications on the phone.

Google Fit therefore address the two basic needs of the game: to gather health data from a variety of relevant physical activities and to gather it at all times. The health related data needed for Fitogotchi was retrieved through the APIs of Google Fit.

## 15.5 Summary of Chosen Technologies

Fitogotchi is a game concept that works well on smartphones. In combination with the health tracker Google Fit, Android smartphones address all the three needs described in the introduction of this chapter: they are portable and carried by most users throughout the entire day, many kinds of activities are automatically tracked by Google Fit and it all happens in the background without the need for users to remember to turn on anything. Moreover, it is done in a power efficient way, making it possible to track the physical activity during the entire day.

Furthermore, Firebase made it possible to implement the online functionality in Fitogotchi in a quick and reliable way.

# Chapter 16

## Game Development

In this chapter the development process of the game, the tools used to develop the game and a brief overview of the structure of the application.

### 16.1 Development Process

The development process started with a rough draft of the game concept described in Chapter 12. As Fitogotchi were a quite extensive concept, considering that the game had to be developed by only one person over a period of eight weeks, an open source code for a simple side scrolling platforming game was used foundation to start the development from. The useful classes of this source code were kept, while the rest were disposed.

Functionality of the game was then iteratively added in order of importance. The first step was make a module that handled the communication with the API's of Google Fit, so the desired data from Google Fit could be used in the game. Furthermore, the level system of the game was implemented and tested to get rid of bugs and make sure it worked as intended.

The next step was to start implementing the endless runner. The source code consisted of code for collision detection and physics that was appropriate for a platform game. The physics was modified to better fit the endless runner of Fitogotchi, and the controls of the Fitogotchi were implemented.

The next step was to make the game worlds in Fitogotchi. The layout of each of the five worlds were made, and the assets for each world was made by the developer. The worlds were tested and refined during during the development

process, as flaws were discovered. While working on the worlds, enemies, various types of obstacles and the dash boxes were implemented, in addition to adding new types of coins.

The game at this stage was now playable, and the next step was to implement the online functionality of the game. First, classes were made that handled the communication with the server, before the the database model for the leaderboard was made. Additionally, statistics tools and crash reporting were implemented in the game.

When this was done, a hint system was implemented to guide players in the right direction when they struggled, but also to give players advices on how to incorporate physical exercise in their everyday life. Furthermore, in-game explanations were added so players could press different menu elements to get explanations on how to play the game and how the level system worked.

The last step was to implement a kill switch that let me remotely shut down the game, so people could not play the game after the game testing period.

## **16.2 Development Tools**

The game was developed, as described in Section 15.2 using the libGDX framework. As the game was made for Android, Android Studio (as seen in Figure 16.1) was used as the development environment when developing the game.

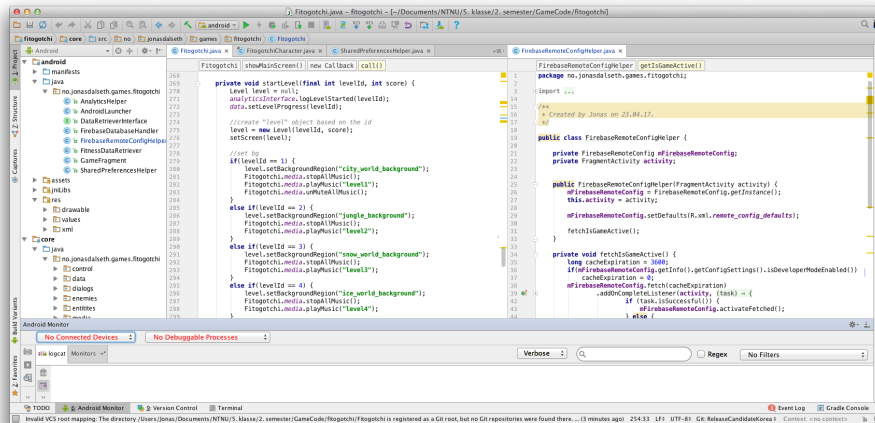


Figure 16.1: *Android Studio.*

I designed most of the graphical assets in the game myself from scratch. Affinity Designer, a vector graphics tool similar to Adobe Illustrator, were used to develop these assets (see Figure 16.2). I had close to no experience doing graphical designs before the work on Fitogotchi. Considerable time and effort were therefore put into learning the software and design techniques in order to be able to design the final design of Fitogotchi.

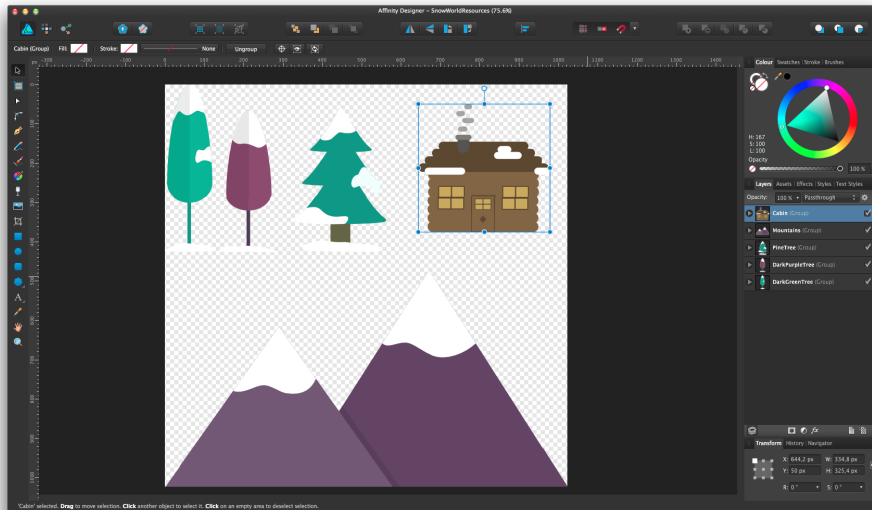


Figure 16.2: *Affinity Designer*.

The layout of the game worlds were made using a program called Tiled. Tiled is a map editor where game worlds and maps can be made in a grid based interface. The tmx-files from Tiled were then parsed in the game to construct the game worlds.

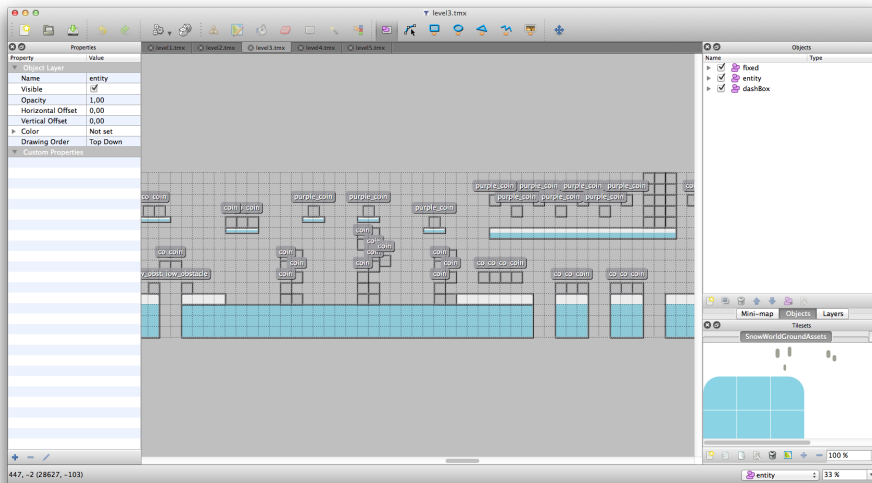


Figure 16.3: *Tiled*.

## 16.3 Game Architecture

The game consists of a client and a server. The server side of the system were mainly used to stored the leaderboards (one for Korea and one for Norway). It also notifies all the clients when a change was made in the leaderboard, and sent all the clients the updated leaderboard data.

The client side of the system contains the Android application. This was implemented using libGDX. As libGDX is cross platform framework, platform specific code could not be implemented in the core part of the project. Hence, the Android application consists of two main modules. One platform independent module, that can be reused if the game is ported to other platforms. This part consists of 45 classes and is the most extensive part of the game. This part contains of all the game logics.

Furthermore, platform dependent code were implemented in a separate Android module and accessed from the platform independent module using interfaces. The Android module contains seven classes, which are responsible for the communication with the server and the Google Fit API's, in addition to launching the libGDX game in an Android Activity. As the APIs that were used were Android APIs, all communication with the server went through the Android module and data was then forwarded to the platform independent module.





# Part V

## Research Methodology

In order to answer the research questions described in Chapter 3, the game was tested by participants from both Norway and Korea. Various methods were used to gather both qualitative and quantitative data that was needed to answer these questions.

This part will present the theories that was used to design the experiment, together with the methods used to gather data during the experiment. Furthermore a thorough description of how the experiment was conducted will be presented.



# Chapter 17

## Experiment Design

The following experiment was designed to give data that can be used to answer the research questions listed in Chapter 3. More details about the collected data and how the data were gathered will be described in Chapter 18. Furthermore, Chapter 20 describes in more details how the experiment was executed.

Before the experiment started, all participants were asked to install Google Fit on their personal smartphone and to keep it enabled during the entire experiment period. In this way, it was possible to get information about their physical activity level during the experiment. Details about the data gathered by Google Fit are described in Section 18.6.1. The experiment lasted for four weeks in total and consisted of three phases:

- **Phase 1 (duration: 1 week):** The participants live their lives as normal. During this week, Google Fit data are gathered to get an overview of the participants' regular activity level. Hence, their normal activity level can be compared with their activity level while they play the game in phase 2. In this way, the Google Fit data can be used to reason about the game's effect on the participants' activity level.
- **Phase 2 (duration: 2 weeks):** Fitogotchi is sent to the participants at the beginning of this phase and they play the game as much as they want the following two weeks. Only during this period the participants can play the game. At the end of this phase, the game is disabled to ensure that players stop playing the game. The Google Fit data gathered in this phase will be used to determine the effects the game had on players' physical activity level.

During the last days of this phase, some of the participants are in-

interviewed about the game and its perceived effects on their physical activity.

- **Phase 3 (duration: 1 week):** The third phase of the experiment is the same as phase 1 – players do not play the game, but Google Fit still tracks the activity level of the participants. The Google Fit data from the last week will be used to answer research question 6 – to determine whether the game has an effect on the participants' activity level also after they stopped playing the game.

When this phase is over, the participants will answer a survey about their experiences with the game. They will also submit their Google Fit data from the experiment period, using an Android application that automates this process.

# Chapter 18

## Data Collection Methods

During the experiment, data were gathered using four different methods. How the data were gathered will be explained in this chapter and a rationale for how this data are useful to answer the research questions formulated in Chapter 3 is presented.

By gathering data about the same phenomenon using different methods and data sources, data can be cross-validated in order to increase the *reliability* of the results. This relies on the different methods' strengths to compensate for another methods' weaknesses. Furthermore, by using different methods to study a phenomenon, the understanding of a matter can be enriched by seeing it from different perspectives that would otherwise not have been investigated (Jick, 1979; Denzin, 1978). This combination of different methods used to investigate one particular phenomenon is called *triangulation* (Denzin, 1978).

By *triangulating* the data from the data sources described in this chapter, the results of this research will be more reliable. Hopefully, studying the effects of Fitogotchi using different methods will also give us a richer understanding on the matter.

### 18.1 Data Categories

Data were collected to measure four desired categories of qualities in Fitogotchi: player enjoyment, the game's effect on players' motivation to exercise, the game's ability to affect the type of physical activity the player perform and whether the game could affect players' habits also after they stopped playing the game.

### 18.1.1 Player Enjoyment

Data about player's enjoyment of Fitogotchi were gathered, both from when they started playing the game and also when they had played the game for about two weeks. This was done in order to investigate how player enjoyment changes over time as the novelty wears off. This data is related to two of the research questions defined for this thesis:

*RQ1 How does this exergame affect players' enjoyment?*

*RQ2 How does this exergame affect players' enjoyment over time?*

### 18.1.2 Effects on Players' Motivation to Exercise

The effects Fitogotchi had on the players' motivation to exercise were investigated, hence data about their activity level during the experiment and their *perceived* motivation from the game were collected. This data lays the foundation for reasoning about two of the defined research questions:

*RQ3 How will this exergame affect the players' motivation to perform physical activity?*

*RQ4 How will this exergame affect the players' motivation to perform physical exercise over time?*

### 18.1.3 Influence on Type of Physical Activity

It was investigated to what extent the game was able to influence the type of physical exercise players performed, hence data on this matter were gathered. This data coincides with research question 5, defined in Section 3.1:

*RQ5 How does this exergame affect what kind of physical exercise the players perform?*

### 18.1.4 Does the Effects Last?

As the game aims to change players' everyday habits on physical exercise, it was desirable to investigate to what extent these habits were maintained after the players stopped playing the game. The data gathered on this matter enable reasoning about research question 6:

*RQ6 How will this exergame impact the players' activity levels after they stop playing the game?*

## 18.2 Questionnaire

A questionnaire was made to gather *quantitative data* about the game. It included questions asking about the participants' gender, age, habits on physical exercise and video games, how often participants played Fitogotchi, to what extent they perceived the game enjoyable and the wear-out effect of the game. Questions were also asked to uncover their thoughts on the impact the game have had on their physical activity level and to what extent they thought the game could have changed their habits and physical activity level also after they stopped playing the game.

The questionnaire contained 37 statements that the participants were asked to respond to what extent they agreed to them. The response alternatives were: strongly disagree, disagree, neutral, agree and strongly agree. The statements in the questionnaire are listed in Tables 18.1 to 18.5 and sorted on the categories defined in Section 18.1. The statement IDs are based on the order they were asked in the questionnaire (attached in Appendix A [English] and Appendix B [Korean]).

### Player Enjoyment

In order to get data about the players' perceived enjoyment of the game, the participants were presented with eighteen statements based on elements

*curiosity, fantasy, flow and rewards.* These metrics were used as they have been proven to be important for player enjoyment, as discussed in Chapter 8.

To measure how the players' enjoyment changed over time, some statements covering enjoyment were presented twice, but one covered the beginning of the test period and the other one covered the end. In this way, the participants' perceived enjoyment in the beginning could be compared to the perceived enjoyment in the end. Statements covering if the game ran out of new content were presented. Statement S17 and S18 are general statements about the players' perceived enjoyment of the game.

The statements related to player enjoyment are presented in Table 18.1.

ID	Statement
<b>S1</b>	I was curious on seeing how my Fitogotchi's appearance would change as I leveled up.
<b>S2</b>	In the beginning of the test period I enjoyed trying to reach new worlds in the game.
<b>S3</b>	In the end of the test period I enjoyed trying to reach new worlds in the game.
<b>S4</b>	I felt I was in control of my actions in the game (the controls where responsive and intuitive).
<b>S5</b>	The game was challenging, but not frustratingly hard.
<b>S6</b>	The game required my full concentration when I played.
<b>S7</b>	I felt I got better at playing the game, the more I played.
<b>S8</b>	I finished the last world of the game (the lava world) early in the test period.
<b>S9</b>	I felt I was able to make progress in the game during the entire testing period.
<b>S10</b>	I liked the universe and the character in the game.



<b>S11</b>	In the beginning of the test period I enjoyed trying to beat my personal best score.
<b>S12</b>	In the end of the test period I enjoyed trying to beat my personal best score.
<b>S13</b>	In the beginning of the test period I enjoyed beating the score of other players on the leaderboard.
<b>S14</b>	In the end of the test period I enjoyed beating the score of other players on the leaderboard.
<b>S15</b>	I enjoyed getting a good score more in Fitogotchi than in other games, because I had exercised to achieve this score.
<b>S16</b>	I enjoyed leveling up my character by performing physical exercise.
<b>S17</b>	In the beginning of the test period I enjoyed playing the game.
<b>S18</b>	In the end of the test period, I enjoyed playing the game.

Table 18.1: Statements related to player enjoyment.

Furthermore, the participants were asked to quantify how much they played the game separated between the first and second week of the experiment. A change in these numbers can give indications about how the participants enjoyed playing the game over time. These questions are displayed in Table 18.2.

ID	Question
Q1	About how many times did you play Fitogotchi the first week of the experiment?
Q2	On average, for how many minutes did you play Fitogotchi each time you played it the first week of the test period?
Q3	About how many times did you play Fitogotchi the second week of the experiment?
Q4	On average, for how many minutes did you play Fitogotchi each time you played it during the second week of the test period?

Table 18.2: Questions related to player enjoyment.

## Effects on Players Motivation to Exercise

Thirteen statements were added to the questionnaire in order to get an understanding of Fitogotchi’s ability to motivate the players to perform more physical exercise. The statements were focused on *rewards*, as rewards, as discussed in Chapter 8, are important for players’ motivation.

The participants were also asked to state whether they had performed the different kinds of exercises Fitogotchi supports, because they wanted to strengthen their character. Statement S29 is a general statement about the perceived effects the game had on their physical exercise during the test period. The questionnaire also presented two general statements, S27 and S28, about their perceived motivation to perform physical exercise – S27 covering the beginning of the test period, while S28 covered the end. The detailed statements related motivation to exercise are listed in Table 18.3.

ID	Statement
S19	My desire to get a better score than the other participants motivated me to perform more physical exercise.
S20	My desire to level up the different levels of the character motivated me to perform physical exercise.
S21	My desire to see how the characters' appearance would change when leveling it up motivated me to perform physical exercise.
S22	My desire to reach new worlds in the game motivated me to perform physical exercise.
S23	During the test period I walked more than normal because I wanted to increase my Fitogotchi's endurance level.
S24	During the test period I ran more than normal because I wanted to increase my Fitogotchi's dash level.
S25	During the test period I biked more than normal because I wanted to increase the Fitogotchi's regeneration level.
S26	I felt I was properly rewarded for the physical activity I performed.
S27	I was motivated by the game to perform physical exercise when I started playing the game.
S28	I was motivated by the game to perform physical activity at the end of the test period.
S29	Overall, my physical activity level increased during the test period because of the game.
S30	I enjoyed doing the physical exercise I performed when trying to level up the character.
S31	I got useful tips from the games hints that helped me perform more physical exercise in my everyday life.

Table 18.3: Statements related to Fitogotchi's effect on players' motivation to exercise.

## Influence on Type of Physical Exercise

In order to retrieve data about how the game had influenced the type of physical exercise the participants had performed during the test period, three statements related to which exercises the game had motivated the participants to perform were presented in the questionnaire. Additionally, two statements stating more directly that the players had performed multiple activities because of the game and if they perceived the *reward* for performing the different exercises as useful were presented. The last statement was a general statement about the game's influence on the type of exercise they had performed. These statements are displayed in Table 18.4.

ID	Statement
<b>S23</b>	During the test period I walked more than normal because I wanted to increase my Fitogotchi's endurance level.
<b>S24</b>	During the test period I ran more than normal because I wanted to increase my Fitogotchi's dash level.
<b>S25</b>	During the test period I biked more than normal because I wanted to increase the Fitogotchi's regeneration level.
<b>S35</b>	I performed two or more kinds of physical activities during the test period in order to develop different skills of the character.
<b>S36</b>	I felt that all the Fitogotchi's levels were useful in order to reach my goals in the game.
<b>S37</b>	The game sometimes had an influence on what kind of physical activity I performed during the test period.

Table 18.4: Statements related to Fitogotchi's influence on players type of physical exercise performed.

## Does the Effects Last?

Four statements were included in the questionnaire in order to give data about how the participants perceived the game to have changed their habits to the extent that they lasted after the game testing period of the experiment. A hint system, giving hints about how physical exercise could be incorporated into their everyday life, was implemented in the game, aiming to inspire participants to do small efforts to change their activity level. A statement covering the perceived efficiency of this system was included to get data about the efficiency of this. Furthermore, a statement covering the participants' perceived enjoyment of the physical exercises they had performed in the test period, but normally not did was added. If participants enjoyed exercises they normally not performed, there is a chance they will continue performing them.

The last two statements are general statements about the perceived effects the game had on the test subjects' activity level after the test period. These statements are listed in Table 18.5.

<b>ID</b>	<b>Statement</b>
<b>S31</b>	I got useful tips from the games hints that helped me perform more physical exercise in my everyday life.
<b>S32</b>	I enjoyed performing physical exercises that I normally do not do during the test period.
<b>S33</b>	The game has given me inspiration to perform more physical activity after the test period was over.
<b>S34</b>	I believe my physical activity level was higher the week after I stopped playing Fitogotchi than the week before I started playing Fitogotchi because the game has changed my physical activity habits.

Table 18.5: Statements related to lasting change in players habits on physical exercise.

## 18.3 Interview

In order to gather *qualitative data* about the game, some of the participants were asked to participate in *individual interviews*. The interviews were *semi-structured*, as opposed to *unstructured interviews*, a list of questions that acted like a guideline for topics that should be covered during the interview was made on beforehand and used to make sure that necessary topics were covered. These topics included how players enjoyed playing the game, if and how the game had affected their physical activity level and what they liked and disliked about the game. They were also asked how they perceived the enjoyment of the game and their motivation to perform physical exercise had changed during the test period.

Unlike *structured interviews*, some questions were open ended and could be answered in different ways. The questions were also formulated to avoid short answers like yes and no (Hove and Anda, 2005). The participants were never interrupted while talking or answering questions, even when they were talking about things that were not initially on the agenda. In this way, in-depth information about the participants' experiences and opinions on the topics were uncovered and topics the researcher had not thought of was brought up into the light.

The interviews were recorded and later transcribed so the researcher did not need to take notes during the interview. In this way, the interviewee was in focus and the conversation became more natural.

## 18.4 Observation

*Overt observations* were conducted on some of the participants in order to gather qualitative data about the way they played the game, to find out if they understood how the game worked and to get an understanding on how they felt when playing the game (Oates, 2006).

The *concurrent thinking aloud protocol* was used in order to get information about what the participants were thinking while playing the game (U.S. De-

partment of Health & Human Services, 2017). While the participants played the game, the researcher noted noteworthy observations. If the participant agreed to being filmed while playing the game, their face and the screen was filmed while they played, so the researcher could extract more data about the play session later.

After participants had played the game, they were asked about things that happened during the playing session, a technique called *retrospective probing* (U.S. Department of Health & Human Services, 2017).

## 18.5 Game Statistics

The game gathered statistics about the participants' usage of the game. This data included:

- The number of unique daily, weekly and monthly users.
- The number of times each user started a session of the endless runner in Fitogotchi. A session is defined as every time the game is started after being idle for 30 minutes or more.
- How long the players played the game each time they opened it.
- How many times each world was played.
- How many times the players started a run in the endless runner.

To gather this data, the Analytics SDK in Firebase was used. Firebase Analytics gather some basic statistics about the usage of the application automatically when implemented in the Android project, including the first two bullet points in the above list. The rest of the statistics was implemented manually in the code of the game by making custom events that triggered in specific parts of the code (Google, 2017a).

In order to retrieve detailed statistics about the game, the data had to be Google's BigQuery platform. This was done by linking the Firebase project

to BigQuery, then the analytics data were sent to the BigQuery platform on a daily basis. It was not possible to transfer data from previous days to BigQuery.

As it was not discovered before the fourth day of the test period in the Norwegian experiment that the Analytics data had to be sent to BigQuery in order to access detailed statistics, the analytics data for these days were lost. As this data were intended to be used to reason about the long term enjoyment of the game, the rest of the data were left unusable as it was no more possible to compare data from the beginning and the end of the test period. This data was therefore disposed.

Fortunately, this problem was discovered before the Korean game testing period started, hence this data were still usable.

## 18.6 Google Fit Data

As discussed in Section 7.6.2, Google Fit tracks the users' physical activity as long as they bring their smartphone. As people often tend to carry their phone wherever they go, activity data from Google Fit can give an indication of people's activity level.

Since Fitogotchi used the API's of Google Fit to determine users' activity level to level up the Fitogotchi, the participants of the experiment already had to install Google Fit to participate. This opened a golden opportunity to gather and analyze Google Fit data to determine the impact Fitogotchi had on the participants' activity levels.

### 18.6.1 The Google Fit Data that were Gathered

The Google Fit data that were gathered were the following:

- *Time spent walking* every day during the experiment period.



- *Time spent running* every day during the experiment period.
- *Time spent biking* every day during the experiment period.
- Google Fit's estimation on *energy expenditure* for every day during the experiment period.

## 18.6.2 How the Google Fit Data were Gathered

To make the data collecting process less prone to human errors and to make it quick and easy to gather the participants' Google Fit data while ensuring the participants anonymity, an Android application was made to collect the Google Fit data.

The application extracted the data mentioned in Section 18.6.1 in the time-frame the experiment lasted, using the Google Fit history API (Google, 2017c). The fitness data were sent to a server where they were accessible for the researcher. The files were stamped with a randomly generated, unique participant number that every participant got by the Fitogotchi game when the test period was over. Participants also entered this number when answering the questionnaire, but the data was not linked to any identifying information about the participant such as name or personal identification number, hence the data was anonymously gathered.

Figures 18.1 and 18.2 show the steps the users went through in the data collection application.

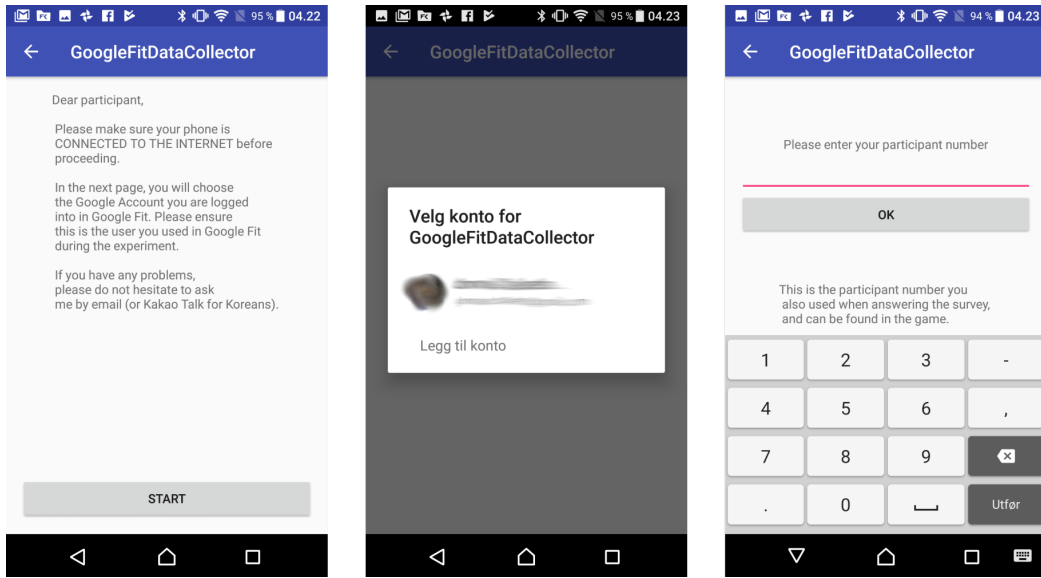


Figure 18.1: *The first 3 steps in the Google Fit data collector application.*

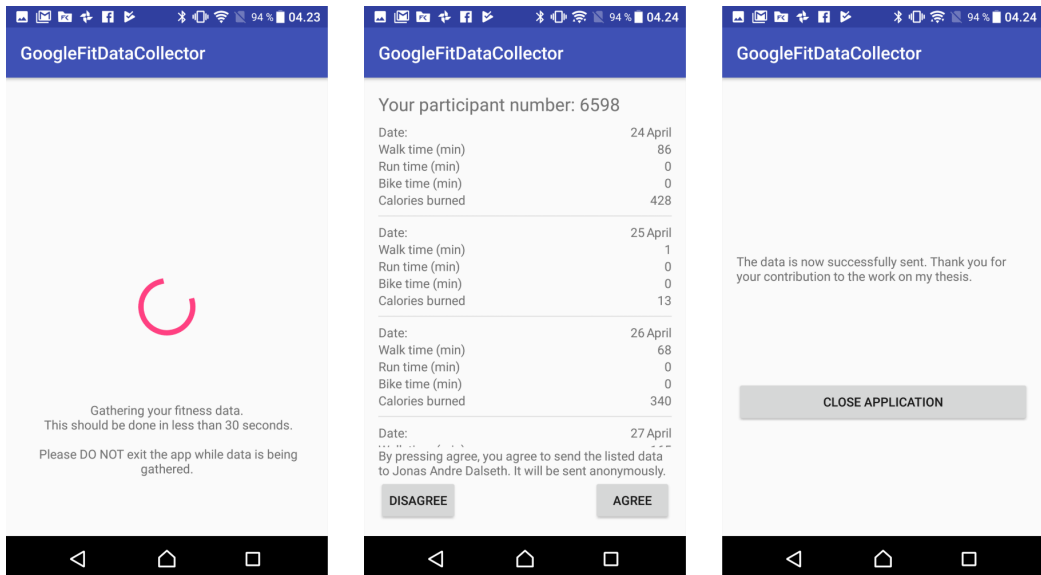


Figure 18.2: *The last 3 steps in the Google Fit data collector application.*

It should also be mentioned that the quality of Google Fit data has its limitations. These are discussed in more detail in Section 21.3.

## 18.7 Ethics

As this experiment included user testing, it is important to keep the participants aware of what data are gathered about them and how their data will be treated and presented in the final publication. Participants, both in Norway and Korea, therefore received a contract informing them about the purpose of the study, the experiment procedure, the data that would be gathered from them and how their data would be used in this research. As Koreans were given a reward for participating, the requirements for getting this reward were also described.

Furthermore, the research is approved by Konkuk University's ethics committee. The committee has reviewed the research methods and the processes of this research and confirmed that the participants' privacy is ensured. The certificate from this committee is attached in Appendix K.

In Norway, there are two instances that were considered necessary to apply for: Norwegian Centre for Research Data (NSD) and Regional Committees for Medical And Health Research Ethics (REC).

As the data that were gathered in this experiment were anonymous, there was no need to apply to NSD.

An email was sent to REC, containing a description of the experiment procedure and the data that would be gathered, to ask if this research needed to be reported to them. According to the reply, only projects aiming to acquire new knowledge about health and diseases were required to report their research to them. As this project aims to research software, it was according to them, not necessary to report this research.



# Chapter 19

## Preliminary Experiments

In order to test the experiment design and uncover potential flaws of the design, two short preliminary experiments were conducted before the final experiment was carried out. These pilot experiments were conducted in Korea. As it was not possible to test a full length experiment, the pilot experiments were shortened down to four days each instead of the full experiments' four weeks, where each day in the pilot experiment was equivalent to one week in the final experiment.

### 19.1 Alpha Experiment

The first preliminary experiment was conducted on a handful of people that had a relation to the same lab as the researcher worked on. The participants were the day before the experiment started instructed to install Google Fit on their smart phones.

Then, at the end of the first day of the experiment, participants were sent an unfinished version of Fitogotchi together with instructions on how to install it. These instructions were sent through the Kakao Talk messaging application described in Section 20.3 and were written in English. In the same message they were also told to install the game immediately.

During the third day of the experiment, it turned out that almost nobody had installed either Google Fit or Fitogotchi. Conversations with the participants revealed that many of them had not even read the messages that were sent to them, as they were written in English. As most participants had not done as instructed, a decision was made to stop the first pilot experiment on day

three.

## 19.2 Beta Experiment

In total there were 15 participants participating in the second preliminary experiment. They were all people working on the same lab as the researcher, and knew the researcher personally. Most participants now succeeded on performing all three phases of the experiment. At the experiment's end, the participants answered a draft of the questionnaire that was described in Section 18.2. They also sent their Google Fit data for the four days the preliminary experiment lasted. The Google Fit data were in this beta experiment written down manually in a text file by each participant and sent manually and anonymously by each participant using a service called dropitto.me, that allows people to anonymously send files to a folder stored in the cloud (dropittome, 2017).

## 19.3 Lessons Learned from the Preliminary Experiments

Both the alpha and beta experiment were useful to find flaws in the initial experiment design. The alpha experiment highlighted some of the challenges that appeared when doing research outside of the researcher's home country. It was made clear that information given to the participants in Korea should be given in Korean, in order to make more participants read and understand the messages they receive. Furthermore, participants should be asked to send a confirmation to the researcher when they have performed instructions given to them.

During the beta experiment, the process of manually writing down the Fitness data for mere four days the experiment lasted, turned out to be a pretty comprehensive process for the participants, hence a new method had to be found to gather this data. In the final experiment, this was done by developing the Android application that is described in Section 18.6.2, which automates

this process.

Data from the preliminary experiments were also used to make improvements to the final questionnaire.





# Chapter 20

## Experiment Execution

In this chapter, details about the practical execution of the experiment are described. The experiment was conducted both in Norway and Korea. Even though the experiment procedure was the same in both countries, the experiment were conducted separately. Due to differences in these two countries and the fact that the researcher was in South Korea at the time the experiments were performed, some practicalities were done differently between these two countries. These differences will also be explained here.

Both the experiment conducted in Norway and Korea were performed as described in Chapter 17. The experiment conducted in Norway started the 28th of April and ended the 25th of May. The experiment in Korea lasted from the 2nd of May until the 29th of May.

### 20.1 Incentives for Participation

In Norway, the test subjects received no reward for participating in the experiment.

The Korean participants, on the other hand, received a gift card worth 10 000 KRW ( $\approx 9$  USD [27.07.2017]) if they participated in all the steps of the experiment. The detailed conditions that were required to acquire this coupon were stated in the subject agreement contract the participants signed before the experiment started (found in Appendix G [Korean]).

## 20.2 Participant Recruitment

Participants were gathered in different ways in Norway and in Korea. Both the recruitment process in Norway and Korea will be described here.

### Norway

The participants in Norway were gathered by posting information about the research and the experiment on different Facebook groups, in addition to contacting friends and acquaintances to ask if they wanted to participate. Additionally, the researcher's family recruited co-workers and classmates to participate.

For the interviews, three men and three female participants were selected to be interviewed.

### South Korea

In Korea, participants were gathered by posting a message on a group for the students at Konkuk University, on a social network called 에브리타임 (Everytime). The message included brief information about the experiment, the requirements for participating and the reward they received at the end of the experiment. It was advertised that players could play a game that encouraged players to exercise, in order to attract attention to players who did not want to participate just because of the reward. None of the Korean participants knew the researcher personally.

Four male and four female test subjects were selected to participate in observations and an interview.

## 20.3 Communication with the Participants

Due to the researcher being in Korea when the experiment was conducted and commonly used communication tools in Norway and Korea differ, communication with the participants were done differently in Norway and Korea.

### Norway

Communication with the Norwegian participants were done mainly using email. Some of the participants were friends with the researcher on Facebook before the experiment, and they were notified there when an email was sent to them. Instructions on how to set up Google Fit were sent to the participants by email before the experiment started, and participants were asked to report back to the researcher when they had installed and set up the application correctly. This instruction sheet is attached in Appendix J (Norwegian).

When the game testing phase of the experiment started, the game was distributed by sending the APK-file to the participants by email.

### South Korea

In Korea, most of the communication with the participants were done using an instant messaging application called Kakao Talk (Corp., 2017). As most Koreans use this messaging application in their everyday life, this was convenient to distribute information to the participants. The communication with the participants was easier and quicker in Korea than in Norway. This was due to the fact that the messages sent at the instant messaging application were read quicker and more participants responded to the messages sent, compared to the emails sent in Norway.

Before the experiment, the participants were asked to come to the researcher's lab to sign the subject agreement contract. When they signed the contract, they also got help to set up the Google Fit application correctly. This was in

order to decrease the risk of erroneous Google Fit data or errors leading to Google Fit data not being collected at all.

The game was distributed to the participants sending the APK-file in a Kakao Talk message.

## 20.4 Data Collection

A selection of participants were interviewed in the end of phase 2 of the experiment, described in Chapter 17, in both countries. Additionally, observations of players playing the game were conducted in Korea. As the researcher was in Korea at the time of the experiment, the geographical distance to Norway made it hard to conduct observations in Norway, hence it was not considered to be worth the hassle. In the end of the experiment, the participants also answered a survey. In Norway, this survey was given in English, in Korea it was given in Korean as most of the Korean participants were not fluent in English.

### Norway

In Norway, as mentioned in Section 20.2, six participants were interviewed. The interviews were conducted as described in Section 18.3, using voice chat services such as Skype and Facebook, based on the participants' preference. All the interviews were conducted in the participants' and researcher's common native language, Norwegian. The interviews lasted from 25 to 35 minutes. Figure 20.1 shows a re-enactment of how the interviews with the Norwegians were performed.



Figure 20.1: *Re-enactment of Norwegian interview.*

## Korea

In Korea, eight participants were interviewed and observed playing the game. The observations and the interview together lasted from 35 to 60 minutes. The observations were performed first, before the *retrospective probing* was conducted as a fluent transition to the interview.

A translation service was offered to the participants who felt they were not able to express themselves properly in English. This was a necessity as many of the Koreans had trouble expressing themselves in English. By keeping the conversations in the participants' native language, they were able to express themselves more precisely and give richer explanations on the matters discussed. Marshall and While also argue that conducting interviews in the informant's native language, gives more reliable and valid data than if conducted in the participant's second language (Marshall and While, 1994).

Seven out of eight participants used this translation service.

The observation and interview procedures were explained in detail to the translator before the interviews were conducted. The questions and topics that were discussed during the interviews were also reviewed together with the translator on beforehand, to streamline the interviews and reduce the probability of misconceptions while talking to the test subjects.

The observations were conducted according to the procedure described in Section 18.4. A re-enactment of the observations is shown in Figure 20.2. If the participant agreed to be filmed while playing the game, a smartphone was used to film the participant's facial expression, and a camera on a tripod filmed the screen on the participant's smartphone. The smartphone was put discretely on the table as shown in the figure, in order not to take the focus of the participant. These videos were later analyzed to get information about details that might have been overlooked. The researcher took notes while observing the participants. These notes were used to help the researcher remember topics that were interesting to discuss during the retrospective probing, but also as a mean to save data about the observation.

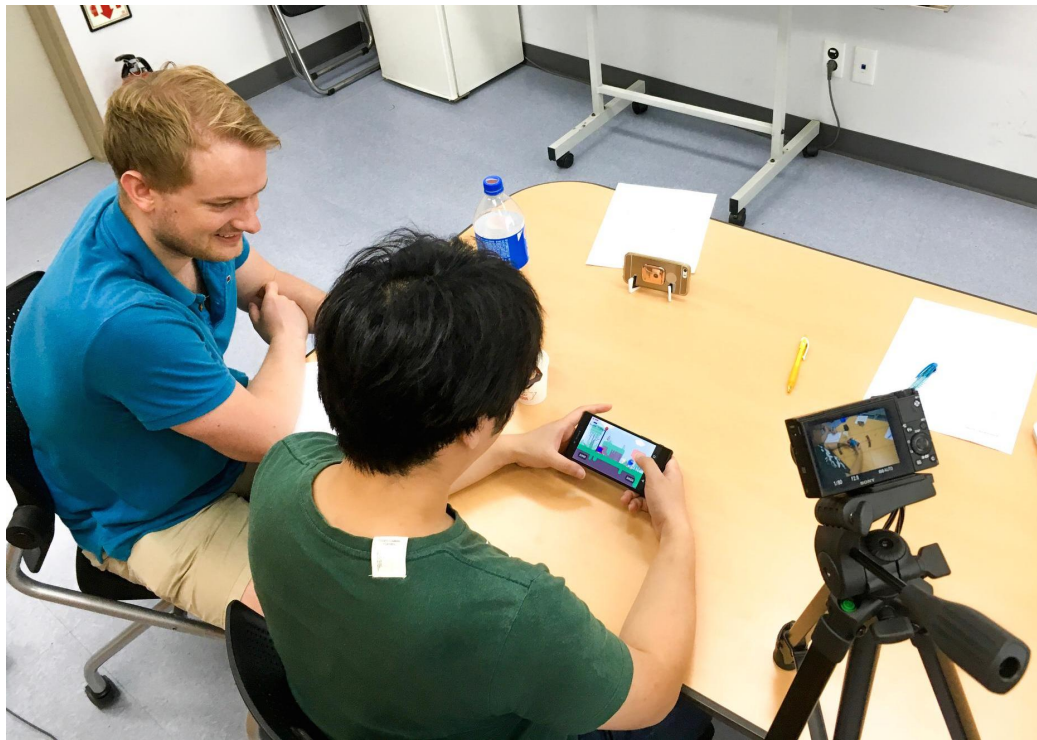


Figure 20.2: *Re-enactment of the observations performed in Korea.*

During the interview, the researcher asked questions in English that were then translated to Korean by the translator. Their response was then translated to English, so the researcher could understand their response and ask follow-up questions. Figure 20.3 shows a re-enactment of the interviews conducted in Korea, where the researcher is on the left side, the translator in the middle and the interviewee on the left in the picture.



Figure 20.3: *Re-enactment of Korean interview.*



# Chapter 21

## Threats to Validity

### 21.1 Familiarity Bias

As participants in Norway mainly consisted of friends and acquaintances of the researcher, as well as their friends and acquaintances, there is a chance that they, since they know the developer of Fitogotchi, are inclined to give more positive feedback about the game than they otherwise would have done. In order to minimize this effect, participants were told before answering the survey and being interviewed that they should be as honest as possible, as giving dishonest answers would harm the research. Even though this effort to minimize this effect was put in place, it is still possible that some participants' answers were affected by the fact that some of them knew the researcher.

### 21.2 Translation of Data

Translation of data material from one language to another, poses many challenges hence the data is prone to loss of quality in translation. Cultural norms often affect how a matter is understood and interpreted. Failing to understand these common perceptions in a foreign culture can lead to misinterpretation of data (Twinn, 1997). Furthermore, words from one language might be hard, if not impossible, to translate directly from one language to another, which is a problem that can lead to decreased precision in translated data (van Nes et al., 2010).

Furthermore, Temple and Young argue that translators also work as analysts and cultural brokers, as they will always make assumptions on participants'

opinion based on their statements, in the translation process (Temple and Young, 2004).

Different kinds of material, including the Korean questionnaire, the transcripts of the Korean interviews and the interviews in Korea were translated by a translator that was not the researcher. This person was not a translator by profession, but a local friend of the researcher. Her native language was Korean, but she was also fluent in English, both orally and written.

She did not have insight into the field of study, and hence it was possible that misinterpretation of questions in the survey or the researchers' questions during the interviews could occur. Measures were taken in order to counter these threats. The questionnaire was translated from English to Korean together with the researcher, so possible translations could be discussed to minimize the risk of misinterpretations (van Nes et al., 2010).

Furthermore, as explained in Section 20.4, the interview procedure and topics that were discussed during the interviews, were reviewed and explained to the translator on beforehand, in order to reduce the possibility of misconceptions (van Nes et al., 2010). Additionally, the same translator was used for all the translation work, as Twinn argues that this maximizes the reliability and consistency of the translated data (Twinn, 1997).

### 21.3 The Quality of Google Fit data

While not much research is done on the exact precision of the data gathered by Google Fit, it is clear that the data can not be assumed to be entirely correct (Mahoney, 2015). Sensors and the algorithms determining the physical activity level of the users are inaccurate and Google Fit data should only be treated as an *estimate* of the users' activity levels.

Furthermore, the factors that determines people's physical activity level is many, hence factors not related to the test subjects playing the game affects the participants physical activity level. Additionally, data are not registered when the test subjects does not bring their phone with them, which also affects the data output of Google Fit.

It is hard to avoid any of the mentioned inaccuracies, hence the Google Fit data gathered in this experiment should be analyzed with skepticism. The Google Fit data should not be used to draw conclusion alone, but can be a useful when triangulated with the other data.

In an effort to uncover potential major flaws in the participants' Google Fit data, the participants were asked if they perceived Google Fit to report their activity level to be too high, too low or correct.



# Part VI

## Results

In this part, the results from the experiment will be presented. The results from the experiment conducted in Norway will be presented first. Then the results from the experiment conducted in Korea will be introduced, before data from the questionnaire in both countries will be presented as a whole.



# Chapter 22

## Results – Norway

In this chapter, the results of the experiment conducted in Norway is presented.

### 22.1 Test Population

By the beginning of the experiment, 28 participants in Norway were recruited. Out of these, 24 participants answered the questionnaire described in Chapter 18.2. In this questionnaire, there was a question asking the participants if they felt that they played the game enough to form an opinion about the game. Three of the participants answered no on this question and their data will therefore not be used.

Hence, data from a total of 21 participants from the Norwegian experiments were used in the analysis of the game, whereas 14 of the participants were men and 7 were female as illustrated in Figure 22.1.

Out of these 21 participants, 13 of the participants were students and 8 of them were workers, meaning that 61.9% of the test subjects were students, where one of the students was a student in high school.

## Gender Distribution – Norway

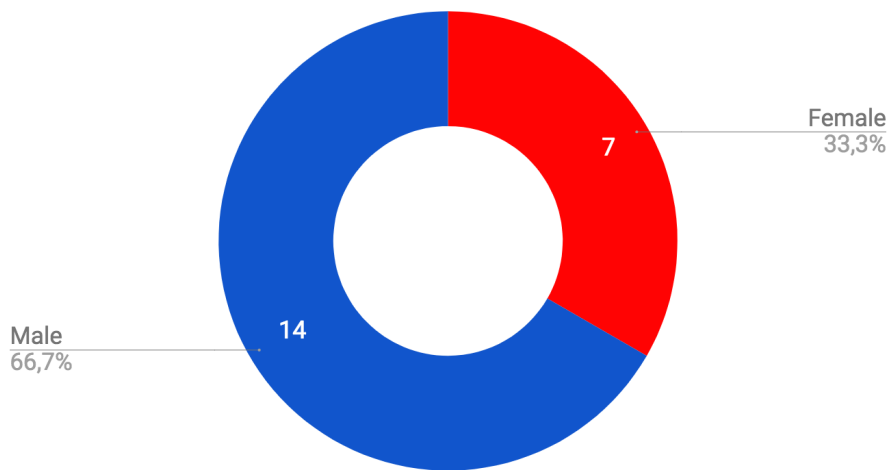


Figure 22.1: *Gender distribution among Norwegian participants.*

As Figure 22.2 shows, most of the participants are in the age range 23-25 years old, a results of the fact that many of the recruited participants are students.

## Age Distribution – Norway

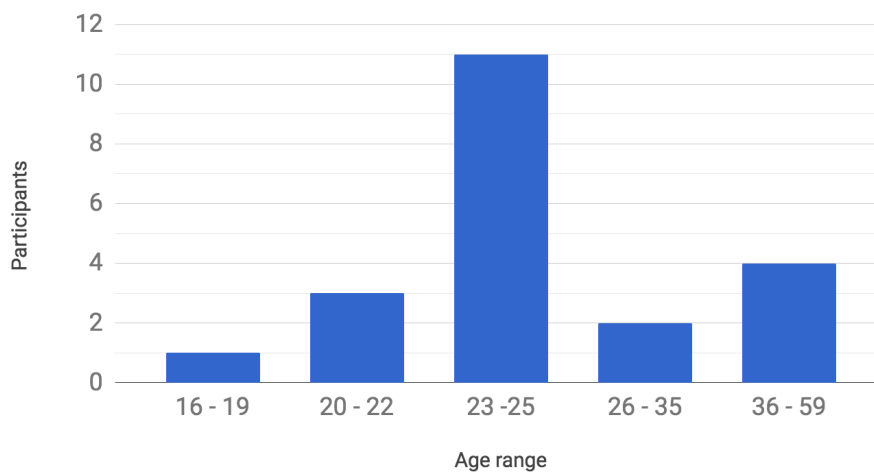


Figure 22.2: *Age distribution among Norwegian participants.*



Figure 22.3 shows how much the Norwegian participants normally play video games per week, not including games on the smartphone. As the figure shows, almost half the test subjects normally do not play video games at all. 23.8% of the participants play more than 1 hours a day on average, while 28.6% play the game between 1-6 hours every day.

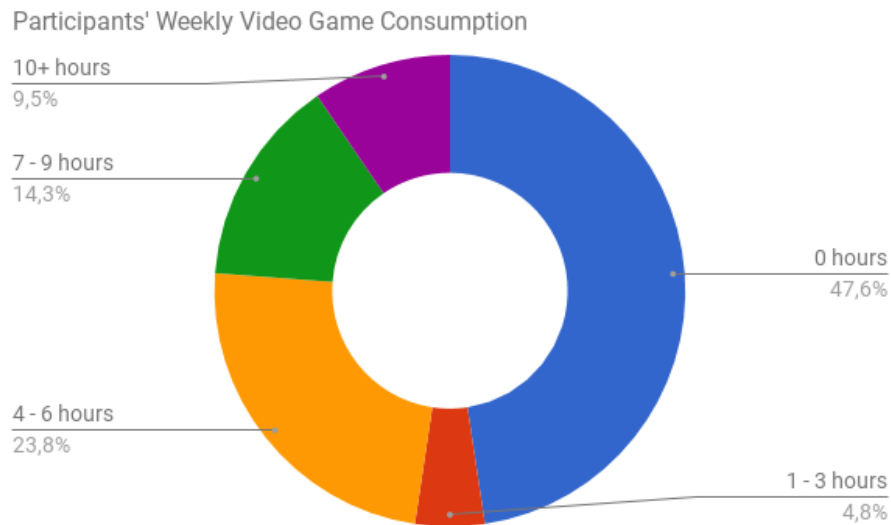


Figure 22.3: *The Norwegian participants' normal video game consumption (excluding smartphone games).*

In general, the Norwegian participants play smart phone games less than they play video games. Figure 22.4 shows that nobody plays smartphone games for more than 3 hours per week. Furthermore, 52.4% of the participants do not normally play games on their phone at all. The remaining 47.6% reports to play smartphone games on average for about 1 - 3 hours per week.

Participants' Weekly Smartphone Game Consumption



Figure 22.4: *The Norwegian participants' normal smartphone game consumption.*

Figure 22.5 shows how much the participants normally exercise. Most participants are quite active and only 14.3% of the participants reports that they do not normally exercise.

Participants' Weekly Time Spent Performing Physical Activity

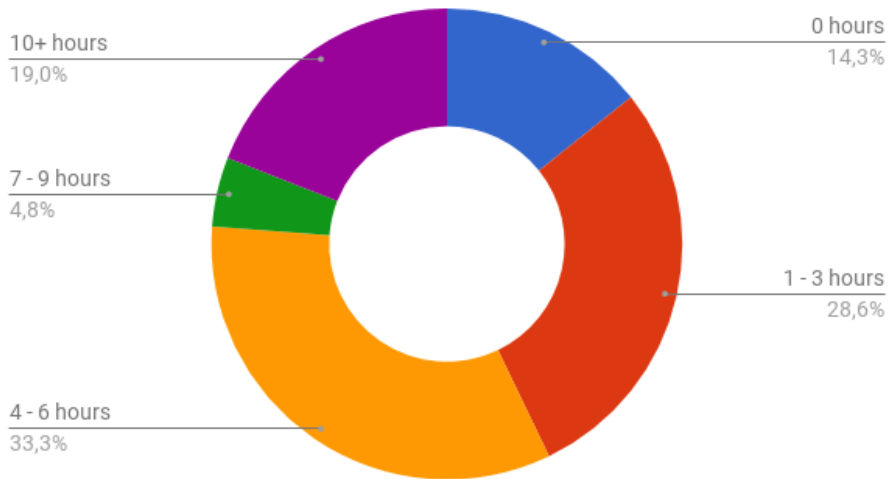


Figure 22.5: *The Norwegian participants' time spent performing physical exercise per week.*

Table 22.1 lists the activities players reported to normally do in the questionnaire, showing how many of the test subjects that performed each activity. It indicates that the activities that are implemented in Fitogotchi are the most popular physical activities among the test subjects.

Activity Type	Percentage of Participants Performing Activity
Walking	57.1%
Running	47.6%
Biking	9.5%
Strength exercise	52.3%
Other	28.6%

Table 22.1: The test subjects' regularly performed physical activities.

## 22.2 Enjoyment

In this section, data giving information about player enjoyment are presented.

### 22.2.1 Questionnaire

The statements in *all the tables in this chapter* presenting the results from the questionnaire are shortened to fit better into the tables. Furthermore, in the questionnaire, participants responded to each statement using either of the five options :*strongly disagree, disagree, neutral, agree, strongly agree*. To simplify the analysis, strongly disagree and disagree has been grouped together. The same has been done to agree and strongly agree. The original statements and the detailed distribution of the answers can be found in Appendix C.

When calculating the distribution of the answers from the questionnaire, the percentage of participants that disagreed was calculated and then rounded to the nearest decimal in one decimal place. This was also done for participants that answered neutral and agree. As each response was rounded separately, the total of all the responses from one question can range from 99.9% to 100.1%, hence not necessarily exactly 100%. This applies for *all tables* in this chapter that present the results from the statements in the questionnaire.

Table 22.2 lists the results of the statements in the questionnaire that were related to player enjoyment. In general, the statements related to flow, S4, S5, S6 and S7 were rated high among the participants. The results also indicate a small decrease in player enjoyment over time.

<b>ID</b>	<b>Statement</b>	<b>D</b>	<b>N</b>	<b>A</b>
<b>S1</b>	I was curious on seeing how my Fito-gotchi's appearance would change.	4.8%	14.3%	81.0%
<b>S2</b>	In the beginning I enjoyed reaching new worlds.	9.5%	4.8%	85.7%
<b>S3</b>	In the end I enjoyed reaching new worlds.	19.0%	9.5%	71.4%
<b>S4</b>	I was in control of my actions in the game.	0.0%	28.6%	71.4%
<b>S5</b>	The game was challenging, but not frustratingly hard.	9.5%	4.8%	85.7%
<b>S6</b>	The game required my full concentration.	9.5%	14.3%	76.2%
<b>S7</b>	I got better at playing the game, the more I played.	4.8%	0.0%	95.2%
<b>S8</b>	I finished the last game world early.	90.5%	4.8%	4.8%
<b>S9</b>	I was able to make progress during the entire test period.	23.8%	9.5%	66.7%
<b>S10</b>	I liked the universe and the character in the game.	4.8%	33.3%	61.9%
<b>S11</b>	In the beginning I enjoyed beating my high score.	0.0%	9.5%	90.5%

<b>S12</b>	In the end I enjoyed beating my high score.	9.5%	4.8%	85.7%
<b>S13</b>	In the beginning I enjoyed beating other players' score.	0.0%	9.5%	90.5%
<b>S14</b>	In the end I enjoyed beating other players' score.	9.5%	9.5%	81.0%
<b>S15</b>	I enjoyed getting a good score more in Fitogotchi, because I had exercised to achieve this score.	33.3%	28.6%	38.1%
<b>S16</b>	I enjoyed leveling up my character by exercising.	9.5%	14.3%	76.2%
<b>S17</b>	In the beginning I enjoyed playing the game.	4.8%	28.6%	66.7%
<b>S18</b>	In the end I enjoyed playing the game.	9.5%	28.6%	61.9%

Table 22.2: The results from statements related to player enjoyment.

The results from question Q1 and Q3 (see Table 22.3) are visualized in Figure 22.6 and show the number of times the participants reported that they played the game for each of the two weeks the game testing lasted. During the first week, each player played the game on average 12.1 times. This number decreased to 10.7 times in the second week.

ID	Question
Q1	About how many times did you play Fitogotchi the first week of the experiment?
Q2	On average, for how many minutes did you play Fitogotchi each time you played it the first week of the test period?
Q3	About how many times did you play Fitogotchi the second week of the experiment?
Q4	On average, for how many minutes did you play Fitogotchi each time you played it during the second week of the test period?

Table 22.3: Questions related to player enjoyment.

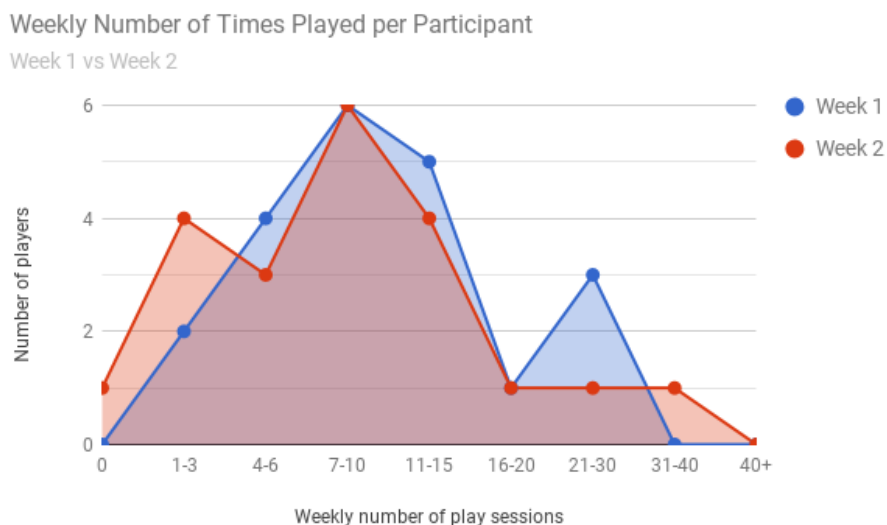


Figure 22.6: Reported number of times the game was played during the two weeks in the experiment.

Figure 22.7 visualizes the results of question Q2 and Q4. The results from these questions indicate that players reportedly played the game on average 8.7 minutes every time they played the game during the first week of the experiment. This number decreased to 7.1 minutes the second week.

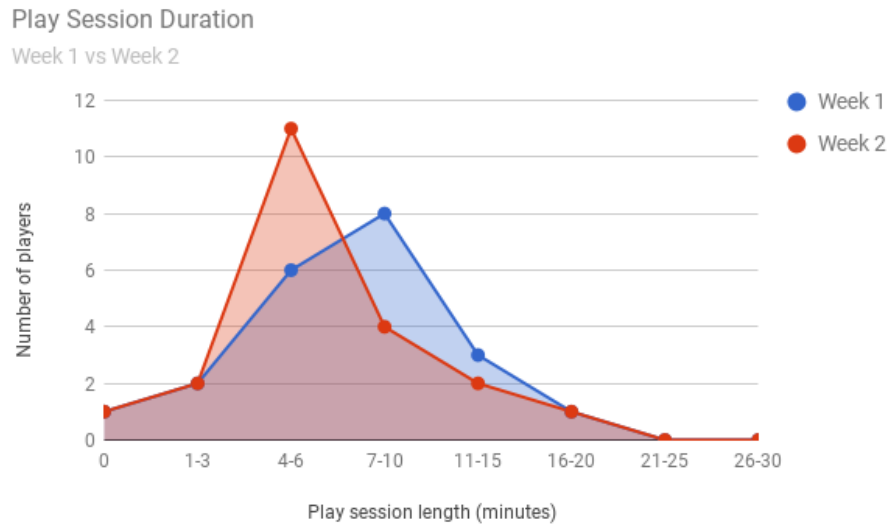


Figure 22.7: The average duration the participants reported they had played the game each time they played.

In the end of the questionnaire, the participants were asked if they had additional feedback to give. Some of the comments related to the test subjects' enjoyment of the game are listed below:

- *“I did not play the game for very long as I got tired of starting at the beginning every time I played.”*
- *I really enjoyed taking part in this project, especially because the overall design of the game was strong (music, art style, gameplay).”*
- *“Upgrade quality, looks a bit old.”*
- *“Think my answers speak for my opinions on the game. I really enjoyed playing it, and would love to see other games build on this type of leveling etc.”*
- *“I sometimes felt that doing exercise was the only way of doing progress in the game, so that becoming good in the game wasn't a point. Therefore I only played it for a short time when I played, because I felt like there was no point in continuing before I had done more exercise.”*

- *“The biggest motivation was to compete against those who were about as active as myself. If the game grows big, players should be divided into groups with players about as active as yourself. In this way, it is possible to reach the first place of the leaderboard if you make an effort.”*
- *“I think this does not appeal to me as I am not interested in games. On the other side, the game was quite captivating as I understood the concept. So maybe the test period was too short? In addition, work and children activities occupied my time during the test period.”*
- *“Fun game, and interesting idea and concept.”*
- *“This was fun, I hope you will activate the game again! :)”*
- *“Looking forward to when the game comes out.”*

### 22.2.2 Interview

Overall, during the interviews, it was clear that the interviewees had enjoyed playing the game. Among the six Norwegian interviewees, five of them said they had really enjoyed playing the game and most of them had played the game almost every day during the experiment. All the participants mentioned the *the leaderboard* as an important factor of the game, and they enjoyed trying to beat other players that were close to them on the leaderboard. But some of the participants said they later in the test period were demotivated when they started to fall behind the lead, suggesting that in a final game with more players, players should be grouped together with people whose characters are about equally as strong as theirs.

Three out of the six interviewees mentioned that they really wanted to find the secret cave in the jungle world. Just two of these were able to find the secret cave, but the last one had tried hard to find it while he played, as he had seen in the in-game hints that there was a secret cave in the jungle.

In fact, reaching new worlds was considered to be one of the more enjoyable factors of the game, and being able to reach new worlds was for one of



the interviewees the main motivation for leveling up his Fitogotchi. Among the five other participants, reaching new worlds was the second most important motivational factor, just slightly behind increasing their score on the leaderboard.

*“I think it was fun that the green coins rose in value as you gathered many of them consecutively.”* one participant stated. Another participant did not understand that the green coins increased in value as she gathered many of them consecutively before the end, but when she noticed, it was one of the things she liked the most about the game as she was able to climb all the way to the top of the leaderboard, as she focused on collecting these.

All of the interviewees also expressed that they liked how their physical activity affects their character’s levels. Many of the participants felt that this system was new and refreshing, compared to other games they had played. One of the interviewees, that was not used to playing video games, said that the game was *“cooler than other games, as I feel I have a reason for playing. [...] this is much better, as I actually have to do something physical myself.”* Some other participants also mentioned that as they regularly walk, the Fitogotchi’s endurance level was steadily increasing during the test period, enabling players to reach further in the worlds most of the times they played Fitogotchi.

But the level system was not without its flaws. One participant mentioned that the system was too simple and wanted more variety in the way the character could be leveled up, including implementation of different daily goals that varied from day to day, and then the game could reward players who completed these goals with experience points that could be used to level up the character.

Another participant was disappointed that the Fitogotchi’s regeneration level had to be leveled up by biking, as he did not own a bike. He therefore suggested that it should be possible for players to choose from a pool of many physical activities that you liked doing.

Of other negative sides of the game, two of the interviewees mentioned that they were quite tired of playing the first world over and over again. Another participant though disagreed on this and said he *“always tried to optimize*

*how he played the first level*” so he could gather as many coins as possible. Another player also stated that the worlds after the first level, which are twice as long as the first level, were too long. And as he stated he started wondering *”where is world 3?”*.

It turned out that just one out of the six interviewees thought Fitogotchi was less enjoyable over time. *”In the beginning it was quite fun to play, but in the long run I ran out of things to do.”* this participant stated. He had played the game a lot the first days of the test period, but got bored after playing it for four days.

Three participants said the game was just as enjoyable to play in the end as it was when they started. *”I think the entertainment value of the game has been quite stable during the test period, as the character just gets better and better all the time. And it also really helps that there is a leaderboard in the game, which has a big impact on how fun it is to play the game, cause then you always have a goal to beat someone and become the best.”* Another participant had played the game four to five times every day during the test period, stating that she simply thought the game was quite fun.

The last two participants even stated that the game was more fun to play the more they played it. One participant said: *”The game was more fun, the later in the test period it was, as I could make progress all the time. In the beginning it was not possible to reach far. The Fitogotchi had so little life in the beginning, but it increased quite fast as I performed physical activity. [...] And later, other players also started to appear on the leaderboard, and then it was some competition also.”* Another participant argued that she could gradually increase the score during the entire test period, motivating her to play the game again and again during the experiment.

## **22.3 Effects on Players’ Motivation to Exercise**

This section presents the data that give insight into Fitogotchi’s ability to affect the test subjects’ motivation to perform physical activity.

### 22.3.1 Questionnaire

The results from the statements in the questionnaire related to the game's ability to motivate players to perform physical exercise, are displayed in Table 22.4. According to statement S27, 47.6% of the participants *perceived* to be motivated by Fitogotchi to perform physical exercise in the beginning of the experiment. This number decreased to 42.9% in the end of the test period, according to statement S28.

ID	Statement	D	N	A
S19	My desire to get a better score than the other participants motivated me to exercise.	28.6%	23.8%	47.6%
S20	My desire to level up the levels of the character motivated me to exercise.	9.5%	23.8%	66.7%
S21	My desire to see how the characters' appearance would change when leveling up motivated me to exercise.	23.8%	38.1%	38.1%
S22	My desire to reach new worlds motivated me to exercise.	28.6%	28.6%	42.9%
S23	I walked more because I wanted to increase the endurance level.	23.8%	19.0%	57.1%
S24	I ran more because I wanted to increase the dash level.	47.6%	28.6%	23.8%
S25	I biked more because I wanted to increase the regeneration level.	57.1%	19.0%	23.8%
S26	I was properly rewarded for the exercise I performed.	14.3%	9.5%	76.2%
S27	I was motivated to perform exercise when I started playing the game.	23.8%	28.6%	47.6%
S28	I was motivated to perform exercise at the end of the test period.	23.8%	33.3%	42.9%

<b>S29</b>	My physical activity level increased because of the game.	33.3%	19.0%	47.6%
<b>S30</b>	I enjoyed doing the exercise I performed when playing the game.	23.8%	9.5%	66.7%
<b>S31</b>	I got useful tips from the game that helped me do more exercise in my everyday life.	28.6%	42.9%	28.6%

Table 22.4: The results from statements related to the game’s ability to motivate players to exercise.

In the feedback section in the end of the questionnaire, one participant commented: *“Overall a neat little game. I was generally using the game to check how active I had been, rather than the game driving me to perform more exercise.”*

### 22.3.2 Fitness Data

The fitness data collected using the Google Fit data collection application, described in Section 18.6.2, give information about the physical activity level of the participants during the experiment.

In the questionnaire, the participants were asked if they had registered data manually in the Google Fit application, in order to uncover players that had tried to cheat in the game by adding data to Google Fit. As the data of these players will be show that they have performed more physical activity than they have actually done, their fitness data are not included here. Hence, the fitness data presented here consists of data from 10 participants.

Figure 22.8 shows the average weekly walk time per participant during the test period.

Average Weekly Walk Time Per Participant

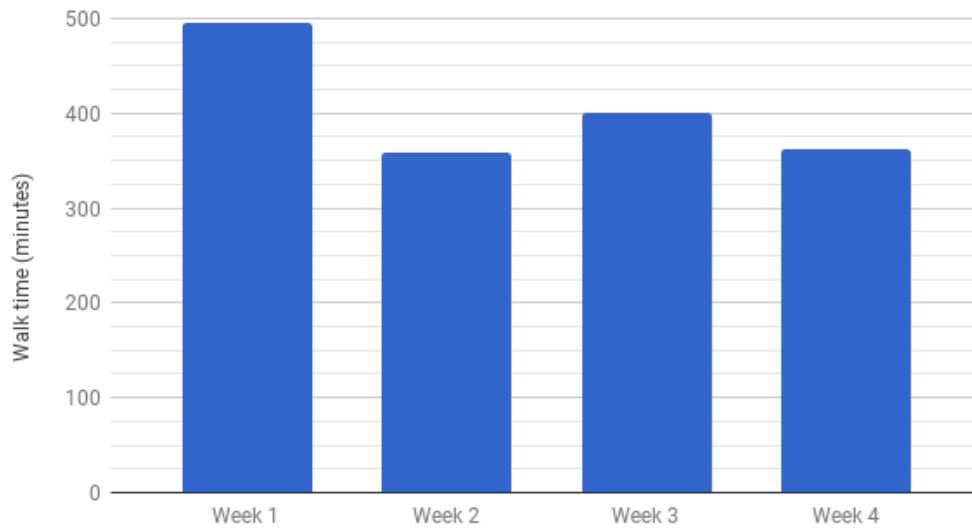


Figure 22.8: Average weekly walk time per participant.

The average weekly run time per participant is displayed in Figure 22.9.

Average Weekly Run Time Per Participant

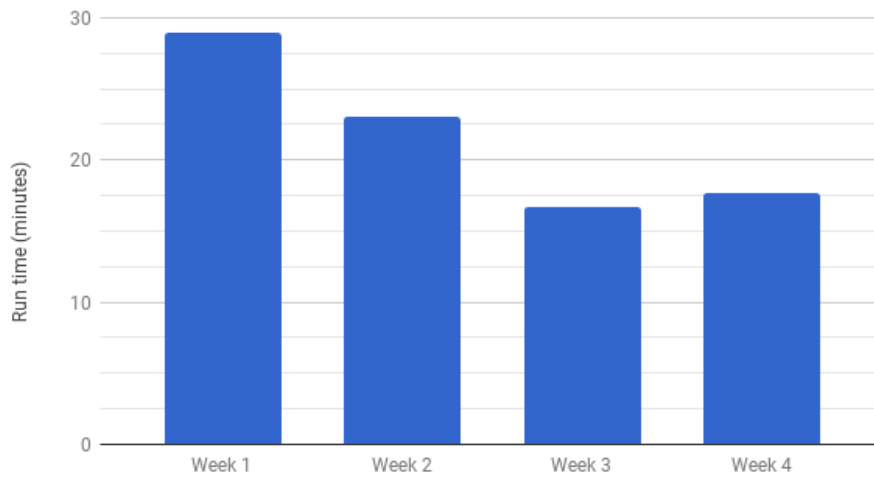


Figure 22.9: Average weekly run time per participant.

Figure 22.10 visualizes the average weekly bike time per participant.

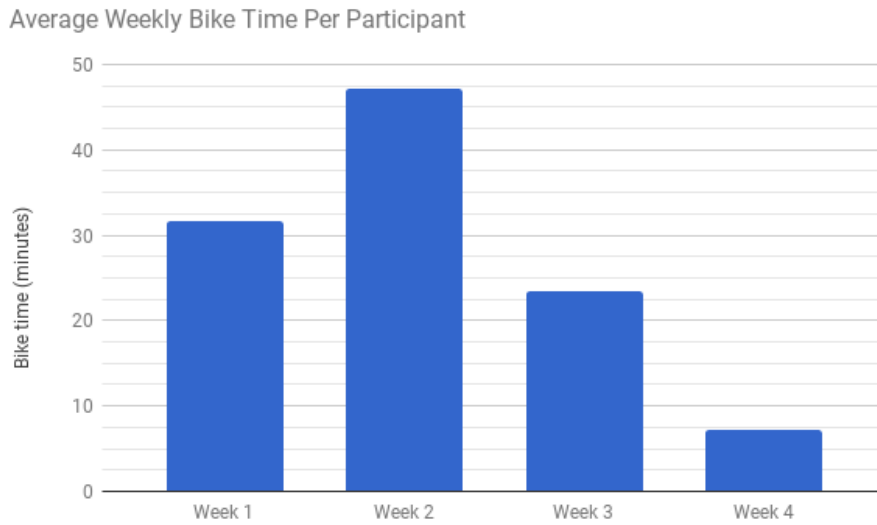


Figure 22.10: *Average weekly bike time per participant.*

The average total weekly activity time per participant is showed in Figure 22.11.

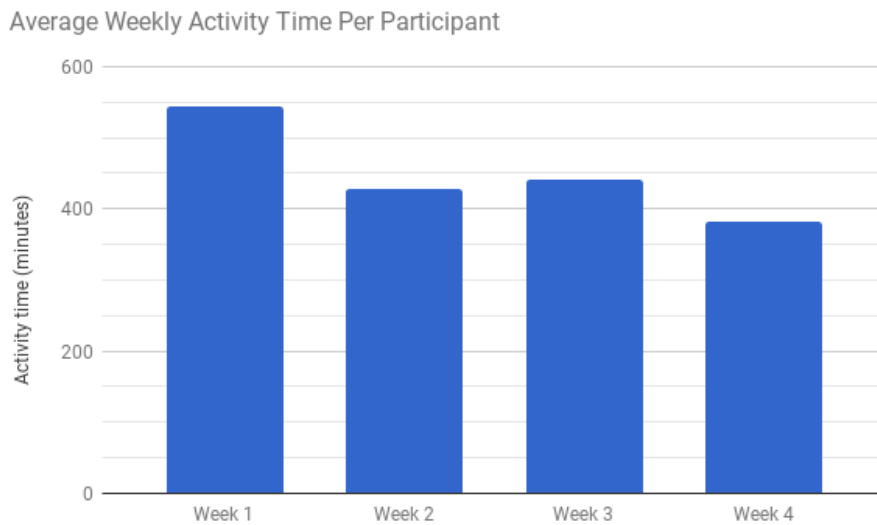


Figure 22.11: *Average weekly activity time per participant.*

Figure 22.12 visualizes the average active energy expenditure among all the participants in the experiment performed in Norway. Active calorie expenditure is defined as the calories the body burns due to physical activity and not the basal metabolic rate. Basal metabolic rate is the rate at which the body at rest expends energy to keep it functioning (Wikipedia, 2017).

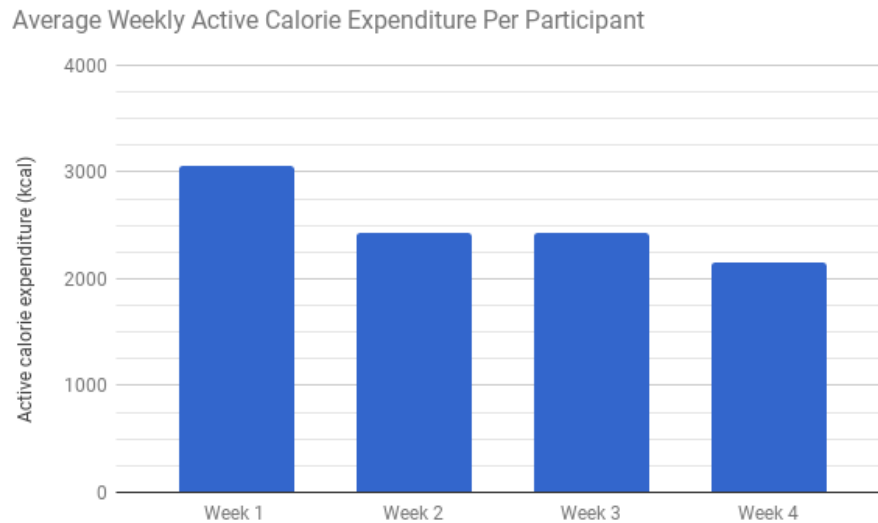


Figure 22.12: Average active calorie expenditure among all the Norwegian participants.

All the Google Fit data show a steady decline in the activity level of the participants. It is unlikely that the game has made participants perform less physical activity. Many of the participants were students and the experiment was conducted during the exam period in Norway. As students often find less time to exercise in the exam period, this is likely the reason for this decline.

### 22.3.3 Interview

The extent to which the game was able to motivate each participants, varied among the interviewed participants. Two participants thought the game did not have an impact on their physical activity during the test period at all. One of the participants had performed a lot of physical activity the first weekend

with the purpose of leveling up his Fitogotchi, but as he got tired of playing the game, he lost his motivation to exercise. The three other interviewees, did not go out to exercise just to level up the character, but had performed extra physical activity sometimes when they performed their everyday activities.

*“When I went for a walk, one day I wore sports wear so I could run once in a while to level up my character. Additionally, I walked detours to the grocery store and made sure I had walked a few steps every day.”* one participant mentioned. Another participant stated that she had *“[...] walked a few extra rounds in the office to get more steps during the day.”* to improve her character. She also mentioned that she had been more conscious on walking during her everyday life in the test period.

The last participant stating the game might have affected his physical activity level said that he really liked the character development system, and thought he would have spent a lot of time developing his character if he had more time during the test period. As he had been busy during the experiment, he did not have the time to go out to exercise just for the purpose of leveling up the character, but he had walked detours on his way to work and went biking to the train on his way to work instead of walking, in order to level up his character’s regeneration level.

*“First and foremost, the leaderboard is the main motivational factor, and not that far below comes to reach further in the game’s worlds. Then seeing the character’s appearance change has been more like a bonus.”* one of the participants answered when he was asked what factors of the game that had motivated him most to exercise. This was a common conception among the interviewees as five out the six interviewees ranked the leaderboard as the main motivational factor, and reaching new worlds in the game as the second most important. The remaining participant said that reaching new worlds in the game was the main motivational factor, just above trying to climb the leaderboard. Nobody mentioned seeing their character evolve as a major factor for motivation to exercise.

Some of the participants also said that showing other players that they had performed more physical exercise than them was an extra motivational factor for getting a high score in Fitogotchi compared to other games. Participants that were high on the leaderboard also said that it felt good to be high on



the leaderboard, cause they themselves felt good because they felt they had performed more physical activity relative to the other participants.

Although most of the participants stated that they enjoyed the level system in the game, one participant stated that the level system was too simple and monotonous in the long run, suggesting that the game should implement daily challenges and subgoals that could give a boost to the character's levels. By adding functionality like this, she stated, Fitogotchi would motivate her far more than the current level system did for her.

Among the four participants stating that the game motivated them to improve their physical activity habits (see Section 22.3.3), only one of the participants meant that the game's effect on his motivation decreased during the period. This decrease was due to him being tired of playing the game. An additional factor was that, as his character reached higher levels, the activity time requirement for reaching the next level got very high, and walking for two hours straight without any subgoals along the way was not motivating.

The remaining three participants stated that the motivation was about constant during the entire test period. One of these participants said that he always strived to be in the top three on the leaderboard, giving him motivation to perform physical activity during the entire period. The other two participants were motivated to improve their character, simply because they still enjoyed playing the game and wanted to make continuous effort to climb the leaderboard and reach new worlds.

## **22.4 Influence on Type of Physical Activity**

This section presents the data gathered from the experiment that can be used to reason about Fitogotchi's ability to influence the type of physical activity the players perform while playing the game.

### 22.4.1 Questionnaire

The results from the statements related to what type of physical activity the players performed while playing the game are displayed in Table 22.5.

42.9% of the participants agreed to statement S37, indicating that the game has had an impact on what kind of physical activity almost half of the participants sometimes have performed.

ID	Statement	D	N	A
S23	I walked more because I wanted to increase the endurance level.	23.8%	19.0%	57.1%
S24	I ran more because I wanted to increase the dash level.	47.6%	28.6%	23.8%
S25	I biked more because I wanted to increase the regeneration level.	57.1%	19.0%	23.8%
S35	I did two or more kinds of activities to develop different character skills.	28.6%	19.0%	52.4%
S36	All the Fitogotchi's levels were useful.	23.8%	14.3%	61.9%
S37	The game sometimes influenced what kind of physical activity I performed.	38.1%	19.0%	42.9%

Table 22.5: The results from statements related to the game effects on players' type of physical activity.

In the feedback section of the questionnaire, one participant wrote: *“Some strength exercise were just swapped out in advantage of running to make it count in the game.”*

## 22.4.2 Interview

During the interview, two out of the six interviewees perceived the game to be a factor that had changed the type of activity they had performed during the test period. “*It (the game) has made me bike to the train station, instead of walking*”, one participant said, mentioning that leveling up different stats of the character was the motivation to do so. The other participant said that when she went for a walk, she wore workout clothes a few times during the test period so she could run once in a while to develop her Fitogotchi’s dash level.

The rest of the participants stated that they had kept doing the same exercises that they normally do.

## 22.5 Does the Effects Last?

In this section, the data giving insight into whether or not players keep potentially changed habits related to physical exercise even after they stop playing the game are presented.

### 22.5.1 Questionnaire

The participants’ response to the statements in the questionnaire related to the “after effects” of the game is displayed in Table 22.6.

ID	Statement	D	N	A
S31	I got useful tips from the game that helped me do more exercise in my everyday life.	28.6%	42.9%	28.6%
S32	I enjoyed performing activities that I normally do not do during the test period.	38.1%	38.1%	23.8%
S33	The game inspired me to perform more exercise after the test period was over.	57.1%	23.8%	19.0%

<b>S34</b>	My physical activity level was higher the week after I played the game than the week before the test period, because of the game’s effect on my habits.	61.9%	14.3%	23.8%
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Table 22.6: The results from statements related to the after effects of the game.

### 22.5.2 Interview

The game showed the players hints when they died, some of them giving advices on how to incorporate more physical activity into their everyday life. Four out of the six interviewees stated they had read them most of the time, one participant commented: *“I was almost forced to read them, as you had implemented a seven second delay or so before you could click past them.”*

Only one out of the six interviewees stated that they followed any of the hints related to physical activity. She had not followed the hints directly, but the hints made her more conscious on how she could increase the step count during the day. Because of this, she had some extra breaks during work to walk a little extra to increase her Fitogotchi’s endurance level. Nonetheless, this was not believed to last when the game was shut down.

The same applied for the rest of the participants as no one thought their activity level would be maintained when the access to the game was locked. One participant explained that the main factor that motivated him to perform physical exercise was to compete against other players, but when the game shuts down there will be nobody to beat.

### 22.5.3 Fitness Data

According to Figures 22.8 to 22.12, the activity level did steadily decrease every week during the experiment period, hence the participants’ activity levels were generally higher in the first week than in the fourth week of the experiment.

# Chapter 23

## Results – Korea

In this chapter, the results of the experiment that was conducted in Korea are presented.

### 23.1 Test Population

Initially, the test population in the Korean experiment consisted of 28 people that had signed the subject agreement contract and installed Google Fit. Out of these, 24 participants installed the game and 23 participants answered the questionnaire. Out of the participants that answered the questionnaire, one participant answered that he had not played the game enough to form an opinion about the game, leaving usable data from 22 of the participants. In the Korean test population it was an overweight of women, with 13 female participants and 9 male, as illustrated in Figure 23.1.

## Gender Distribution – Korea

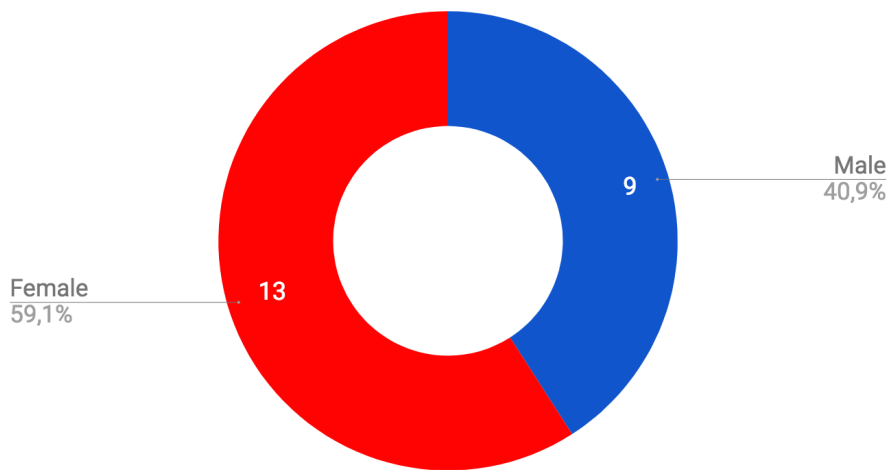


Figure 23.1: Gender distribution among Korean participants.

As the Korean participants were gathered exclusively among the students in Konkuk University, their age range is quite narrow compared to the Norwegian test population presented in Section 22.1, as shown in Figure 23.2.

## Age Distribution – Korea

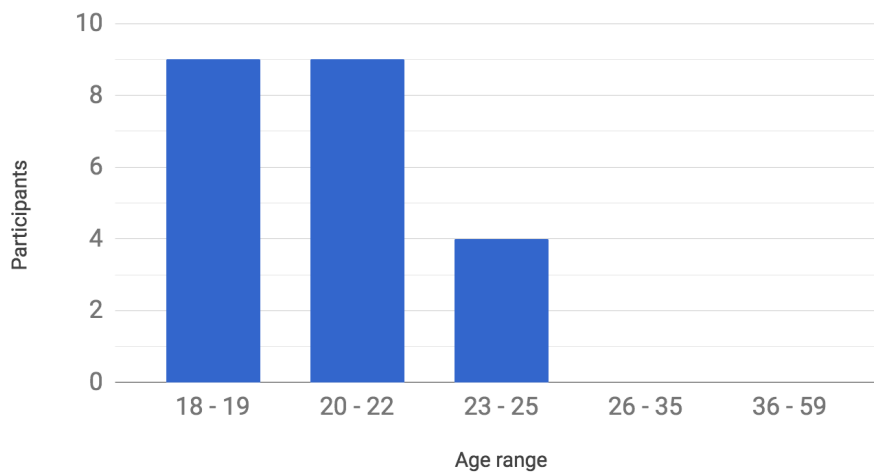


Figure 23.2: Age distribution among Korean participants.

Figure 23.3 shows that almost half the Korean test population normally never play video games. About one fifth of the population plays video games between 1 - 3 hours, while on the other end of the scale, 18.6% of the Korean test subjects play video games on average one hour a day or more.

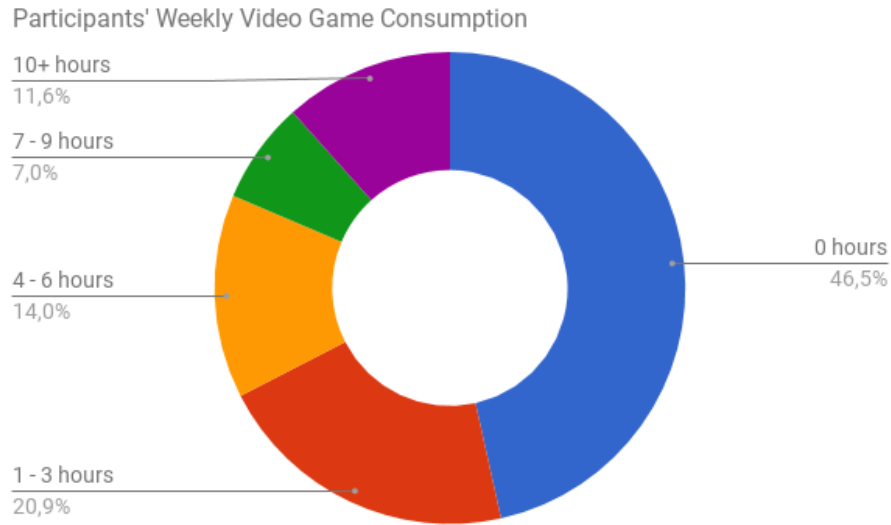


Figure 23.3: *Korean participants' normal video game consumption (excluding smartphone games).*

Figure 23.4 displays the Korean participants' reported time normally playing smartphone games per week and shows that 37.2% of them do not normally play games on their phones. 41.9% of the participants play 1 - 3 hours a week, while 20.9% of the participants normally play games on their phones for 4 hours or more per week.

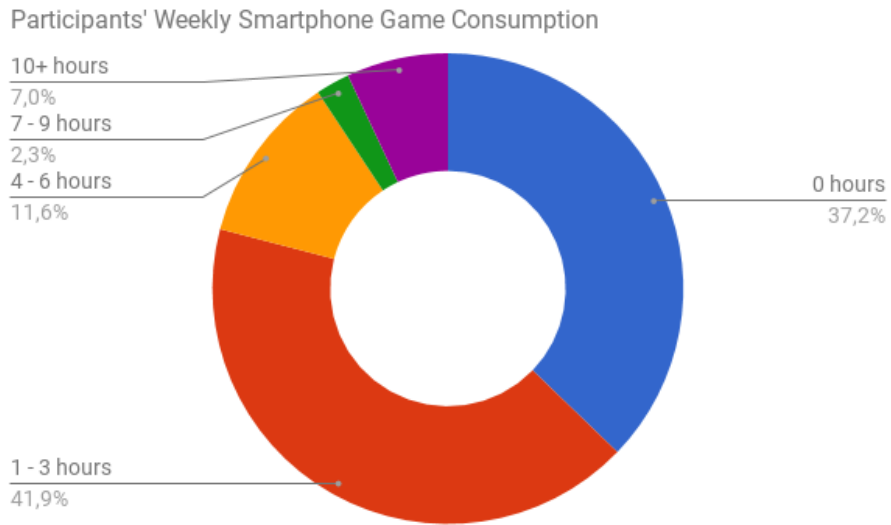


Figure 23.4: *Korean participants' normal smartphone game consumption.*

The participants' normal physical activity habits are displayed in Figure 23.5 and shows that 72.6% of the participants normally perform physical activity regularly. The majority of these perform physical activity for about 1 - 3 hours a week, and 4.5% of the test subjects perform physical exercise on average one hour or more per day.



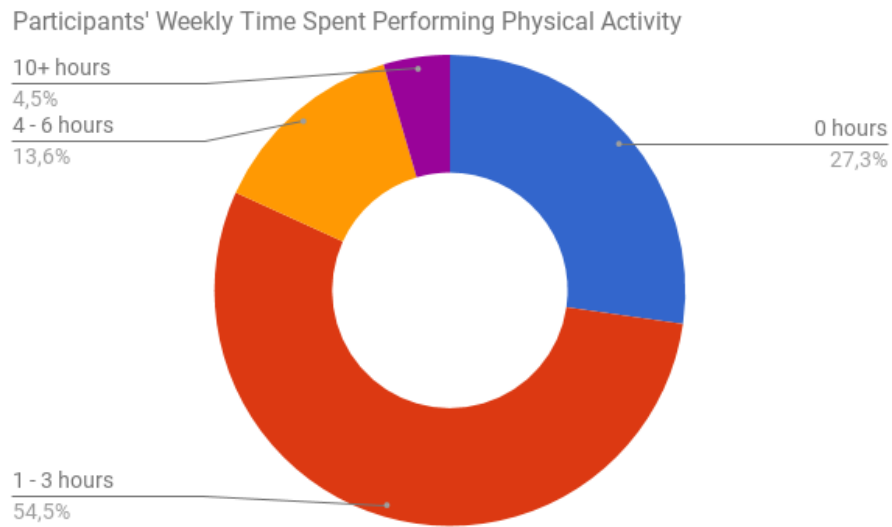


Figure 23.5: *The Korean participants' time spent on performing physical exercise per week.*

Table 23.1 shows the kind of physical activity the participants stated in the questionnaire that they normally do perform.

Activity Type	Percentage of Participants Performing Activity
Walking	59.1%
Running	22.7%
Strength exercise	13.6%
Biking	13.6%
Dancing	9.1%
Other	9.1%

Table 23.1: The test subjects' regularly performed physical activities.

## 23.2 Player Enjoyment

In this section, the data that can give indications about players' enjoyment of the game will be presented.

### 23.2.1 Questionnaire

The statements in *all the tables in this chapter* presenting the results from the questionnaire are shortened to fit better into the tables. Furthermore, in the questionnaire, participants responded to each statement using either of the five options: *strongly disagree*, *disagree*, *neutral*, *agree*, *strongly agree*. To simplify the analysis, strongly disagree and disagree have been grouped together. The same has been done to agree and strongly agree. The original statements and the detailed distribution of the answers can be found in Appendix D.

When calculating the distribution of the answers from the questionnaire, the percentage of participants that disagreed was calculated and then rounded to the nearest decimal in one decimal place. This was also done for participants that answered neutral and agree. As each response was rounded separately, the total of all the responses from one question can range from 99.9% to 100.1%, hence not necessarily exactly 100%. This applies for *all tables* in this chapter that present the results from the statements in the questionnaire.

Table 23.2 displays the test subjects' response to the statements in the questionnaire related to player enjoyment. Data from this table show that about 80% of the participants perceived the game to be enjoyable in the beginning, but the data indicate a trend that all metrics on enjoyability seem to decrease during the test period.

ID	Statement	D	N	A
S1	I was curious on seeing how my Fito-gotchi's appearance would change.	0.0%	31.8%	68.2%
S2	In the beginning I enjoyed reaching new worlds.	0.0%	9.1%	90.9%

<b>S3</b>	In the end I enjoyed reaching new worlds.	0.0%	22.7%	77.3%
<b>S4</b>	I was in control of my actions in the game.	4.5%	22.7%	72.7%
<b>S5</b>	The game was challenging, but not frustratingly hard.	4.5%	9.1%	86.4%
<b>S6</b>	The game required my full concentration.	9.1%	18.2%	72.7%
<b>S7</b>	I got better at playing the game, the more I played.	4.5%	18.2%	77.3%
<b>S8</b>	I finished the last game world early.	95.5%	0.0%	4.5%
<b>S9</b>	I was able to make progress during the entire test period.	9.1%	22.7%	68.2%
<b>S10</b>	I liked the universe and the character in the game.	9.1%	50.0%	40.9%
<b>S11</b>	In the beginning I enjoyed beating my high score.	0.0%	4.5%	95.5%
<b>S12</b>	In the end I enjoyed beating my high score.	9.1%	9.1%	81.8%
<b>S13</b>	In the beginning I enjoyed beating other players' score.	0.0%	9.1%	90.9%
<b>S14</b>	In the end I enjoyed beating other players' score.	18.2%	9.1%	72.7%
<b>S15</b>	I enjoyed getting a good score more in Fitogotchi, because I had exercised to achieve this score.	9.1%	50.0%	40.9%
<b>S16</b>	I enjoyed leveling up my character by exercising.	4.5%	27.3%	68.2%
<b>S17</b>	In the beginning I enjoyed playing the game.	4.5%	13.6%	81.8%
<b>S18</b>	In the end I enjoyed playing the game.	9.1%	36.4%	54.5%

Table 23.2: The results from statements related to player enjoyment.

Table 23.3 shows the questions that were asked in the questionnaire related to player enjoyment over time.

ID	Question
Q1	About how many times did you play Fitogotchi the first week of the experiment?
Q2	On average, for how many minutes did you play Fitogotchi each time you played it the first week of the test period?
Q3	About how many times did you play Fitogotchi the second week of the experiment?
Q4	On average, for how many minutes did you play Fitogotchi each time you played it during the second week of the test period?

Table 23.3: Questions related to player enjoyment.

The results from question Q1 and Q3 in Table 23.3 are illustrated in Figure 23.6. During the first week of the experiment, the average player played 15.6 times the first week and 13.8 times the second week of the experiment.

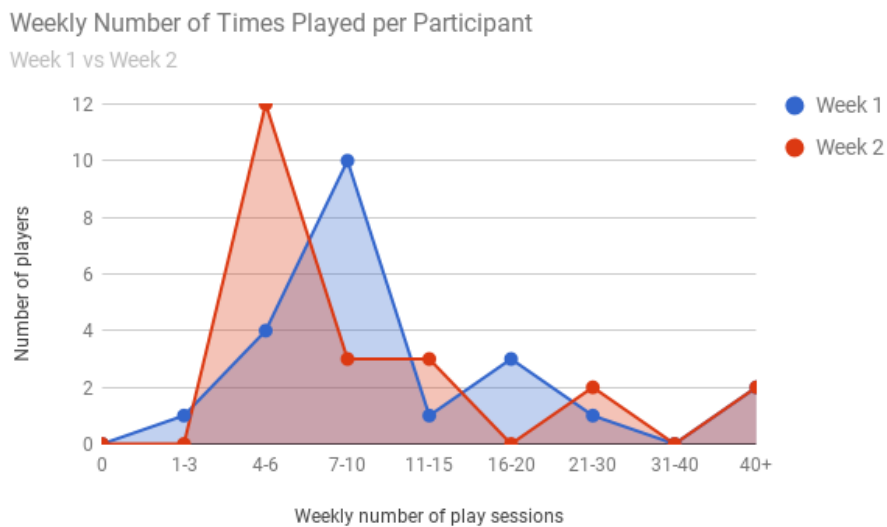


Figure 23.6: Reported number of times the game was played during the two weeks in the experiment.

Figure 23.7 displays the results from question Q2 and Q4 in Table 23.3, hence comparing the average play session length for the participants in week one and two of the experiment. On average, players reported to have played the game 14.1 minutes every time they played during the first week, and 13.31 minutes during the second week of the experiment.

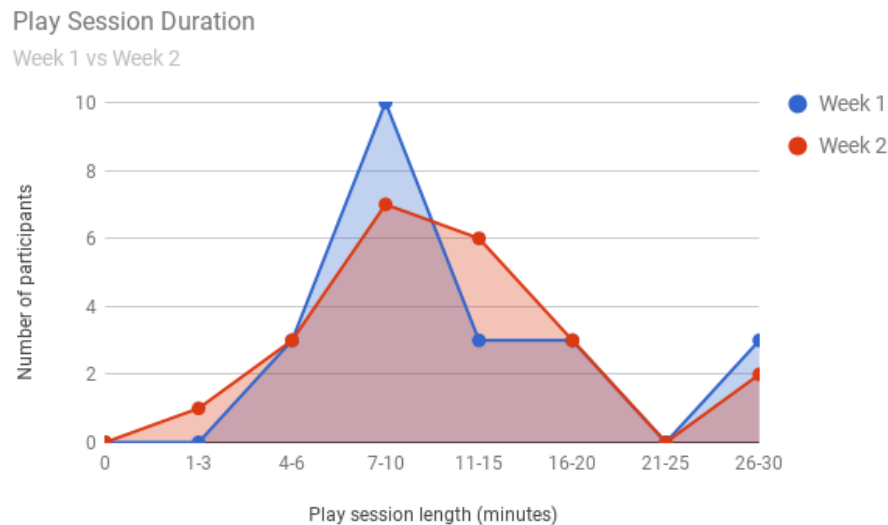


Figure 23.7: The average duration the participants reported they had played the game each time they played.

Some participants gave feedback related to their perceived enjoyment of the game in the questionnaire, which are presented in the list below:

- *“It would be great if it was possible to choose among different characters.”*
- *“The design of each background was pretty and the music was really cool. Once I also showed this game to other people, and many of them actually said the music was cool. I liked the feeling of hitting enemies and dashing into the bricks.”*
- *“The thing that can be improved the most is the character. I think the character is not attractive at all. The fact that the character changes as we level up was interesting, but it was hard for me to have expectations*

*for the appearance change of the character because the character was not pretty nor cute.”*

- *“It was really fun to play the game. I think it would be better if I could level up another stat of the character by having weekly quests including walking, running, and biking. I have not done any other exercise other than walking, so dash level and regeneration level were level 1. If this is changed, then I think it would be even more fun to play the game.”*
- *“The design of the game is so shitty.”*

### **23.2.2 Game Statistics**

The statistics from the game give information about how many players who played the game during the period, for how long the average player played the game during the period and how often they played the game.

Figure 23.8 shows how many unique players who played the game in Korea per day. In total 22 participants played the game in Korea. There were on average 17.3 unique participants playing the game per day the first week the test period. The same number decreased to 13.6 the second week.

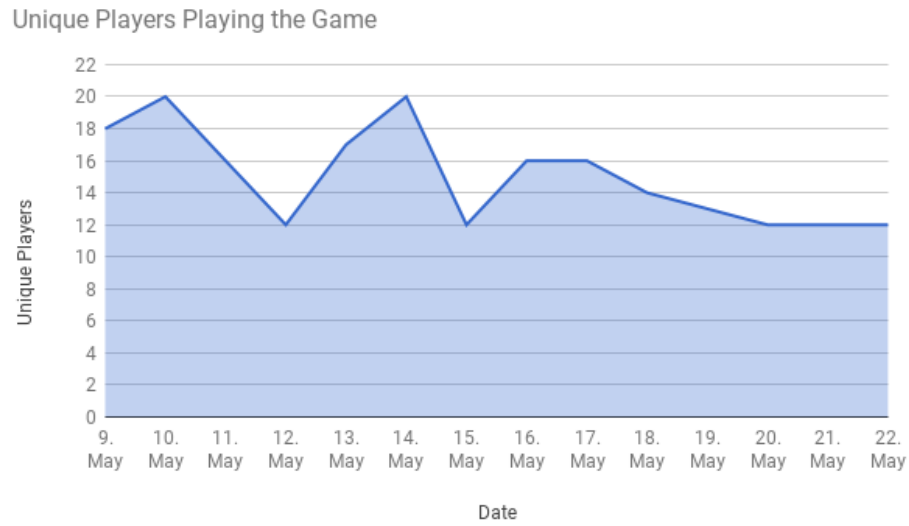


Figure 23.8: *Unique players per day.*

Figure 23.9 shows the average play duration for the players who played the game on the respective dates. The average daily play time for the active players the first week was 11 minutes and 39 seconds, and 11 minutes and 46 seconds for the last week of the experiment.

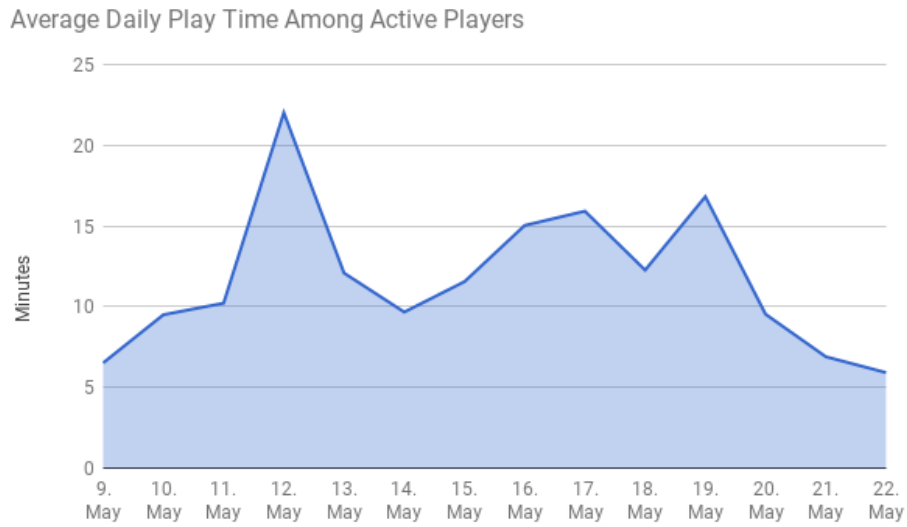


Figure 23.9: Average daily play time among active players.

Among all the players, also including those who did not play the game on the respective days, the average player played the game for 8 minutes and 36 seconds the first week and 7 minutes and 30 seconds the last seven days of the test period.



Average Daily Play Time Among All Players

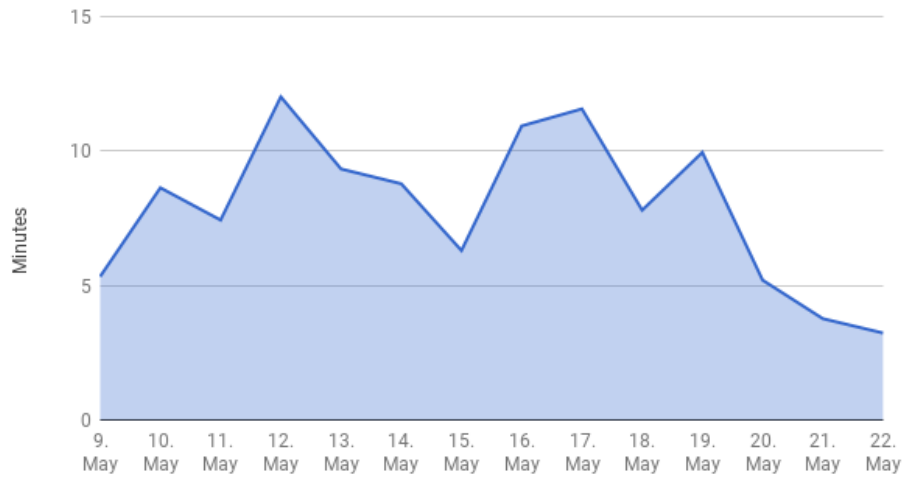


Figure 23.10: Average daily play time among all players.

Figure 23.11 gives information about how many sessions that have been started every day. One session is defined as every time the game is started after being idle for 30 minutes or more.

Session Starts

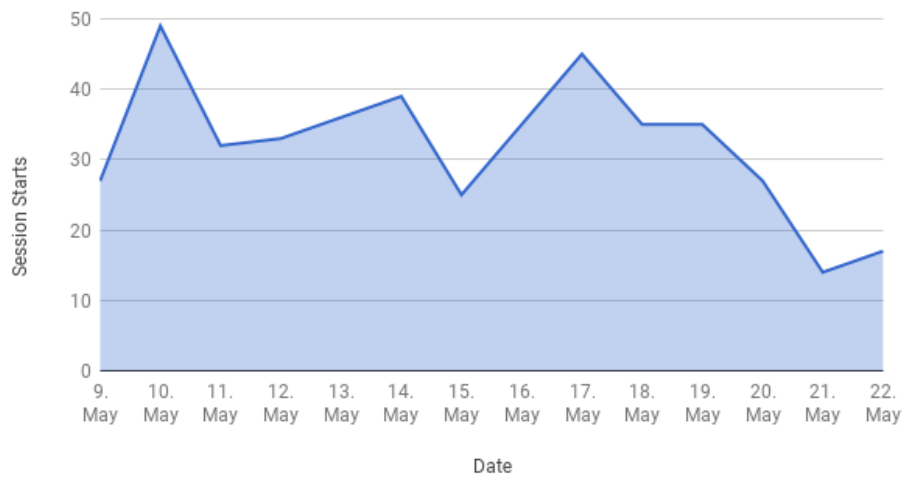


Figure 23.11: Session starts.

The average number of sessions per player who played the game on the respective days are shown in Figure 23.12. The average active player opened Fitogotchi 2.1 times per day the first week and 2.2 times per day the second week.

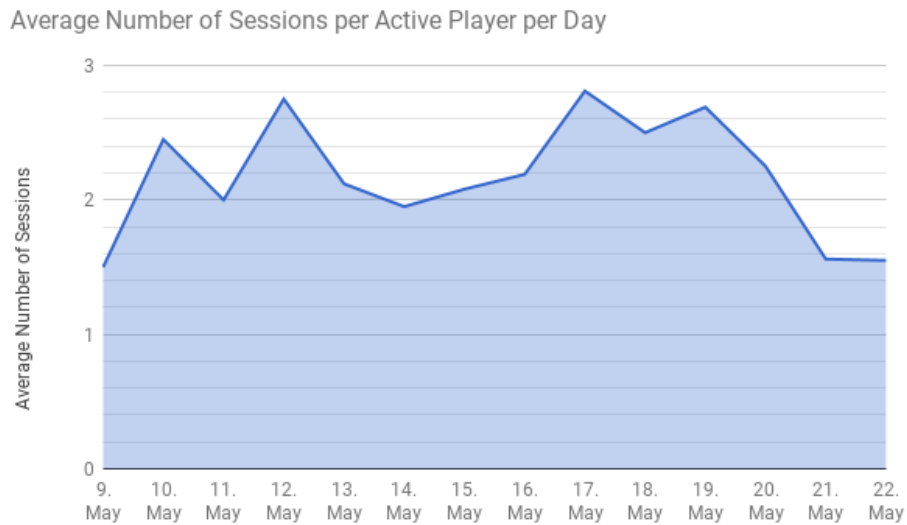


Figure 23.12: Average number of sessions per active players.

Figure 23.13 shows how many times active players played the endless runner of the game on the respective dates.

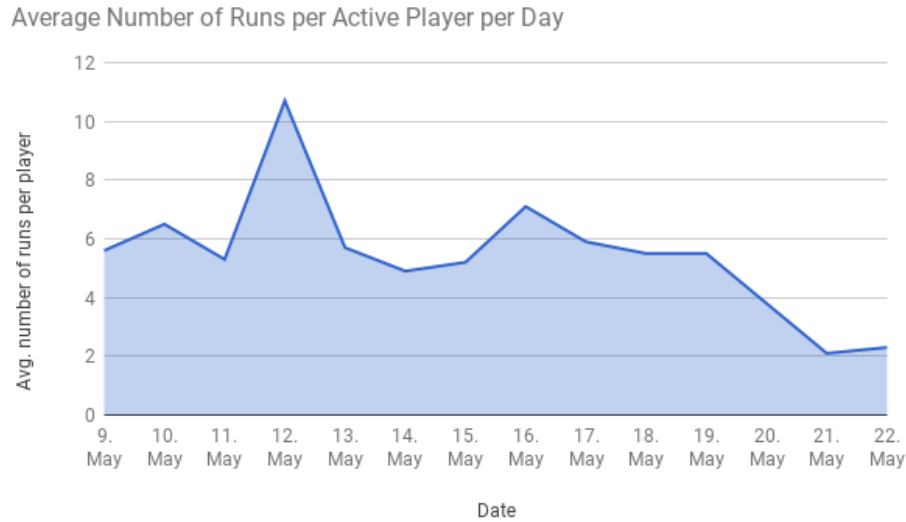


Figure 23.13: Average number of runs among active players.

### 23.2.3 Observation

The observed players were all very concentrated when playing the game. They were also clearly engaged in the game, as they showed disappointment as they hit obstacles and enemies or died, and smiled and sometimes cheered when they were able to get past hard sections in the game worlds without getting hurt.

Some of the players had played the game a lot during the test period, and were able find all the secret passages, avoid obstacles and kill enemies without getting hit. Other, less experienced players thought the first two worlds were still challenging and found it hard to reach alternative paths that were intended to require some practice to reach.

The participants seemed like they had understood how to play the game, but one of the players had not understood that she could hold the dash button to “fly”.

All the players were able to reach the second world, while half the players were also able to reach the third world. Only one participant was able to

reach world 4, but no one made it to world 5, which is the last world, even though one of them had made it before.

Only one of the participants played the game with the sound turned on during the observation. One of the participants mentioned that she normally played the game with the sound effects on, but with her own music instead of the music in the game, as this was how she normally played games on her phone.

Six out of the eight observed participants got a new high score when they played the game during the experiment, and most of them were cheering when they realized that. One participant was excited to show the researcher how he had climbed the leaderboard after he had beaten his own high score.

Some of the participants got the new high score on the first run, but two of the participants wanted to play again after they died the first time. One of these participants got a high score at the second trial and was cheering and smiling when the new high score label popped up on the screen. The other participant died on the same place as she had died the first time, and wanted to try a third time where she also got a new high score.

One of the participants leveled up her character when she started the game, cheering “*Yeah, I leveled up!*”, and was clearly enthusiastic to play the game during the observation to see how far she could reach with her improved Fitogotchi.

The frame rate of the game was on most phones good, but on older devices or some cheaper models, the frame rate of the game was low, on some phones even to the extent that it made the game harder to play. Three of the participants were affected by this, but only one participant mentioned it as a problem.

#### **23.2.4 Interview**

Seven out of the eight interviewees said they enjoyed playing the game and had played the game on average multiple times a day during the test period, most of them reporting to have played the game on average between 1 - 5

times a day. *“I go to school by subway, and I think I played it at least 3 times per day, mostly when I was taking subway on the way to school. And I think I played for about 10 minutes per day in total I guess.”* a participant said when he was asked about how often he had played the game during the test period. The interviewee that had played the game the most during the test period had lost count of how much he had played it: *“I played so much that I can’t really tell how much I played. I played Fitogotchi whenever I had spare time. And I felt like the player on the top of the leaderboard and I have been competing each other throughout the experiment period. I felt like we were on a similar level, and the gap between him and me has not been very big. When I saw that his score was only a few thousands higher than mine at lunch, then I tried to perform exercise during the day and catch up with him at night. I think he did the same too. He and I kept turning each other over and over. I guess we have been racing each other.”*

The participants mentioned various different things that they like about the game. *“I think this level system is very creative. Unlike most other games, I actually have to perform physical exercise to level up, which almost makes the health level of the character in this game as my health level. I felt like I was in a more intimate relationship with the character than in other games.”* one participant said. Many other interviewees also commented that they liked the level system in the game involving physical activity. Later in the interview he also said: *“Stepping on the mushroom was fun. And that I could dash through the bricks.”*. Another participant also mentioned that *“While doing exercise, I know both that the character will increase and that it’s good for my health, so I think I felt more enjoyment and accomplishment than just playing the game or just doing exercise only.”*

One of the interviewees also mentioned that she liked the Fitogotchi’s dash move. Furthermore, another participant stated that *“[...] it was really interesting to experience new worlds [...]”*, before she added that she really liked the leaderboard, and that she really liked to beat other players on the leaderboard, which turned out to be a general perception among all the participants. Additionally, the thrill of trying to catch the green coins was mentioned to be contributing to the perceived enjoyment of the game.

Among the interviewees, four of them stated that the game was more fun to play in the end of the test period, due to the fact that they were always able to

make progress in the game as their character got stronger. Two participants stated that the entertainment value was stable during the test period, because of the same reasons.

Two participants thought the game was less enjoyable in the end. This was because they perceived the game to be repetitive, especially for experienced players, as players were forced to start from the beginning and play the first worlds every time they played. This felt a little unnecessary as the first two levels did not pose a big challenge as their skills increased. It was also mentioned that, as they did not like to run or bike, they felt hindered by the game to make progress as they did not level up the Fitogotchi's dash and regeneration level.

Among other factors players perceived to be negative for the game, was the design, although the participants did not agree on this matter. Some interviewees stated they thought the game looked old-fashioned and ugly, other players expressed that they liked the design. Some participants also wanted to be able to choose from a selection of different characters when they started to play the game, so players could relate more to their character and feel it was more personal.

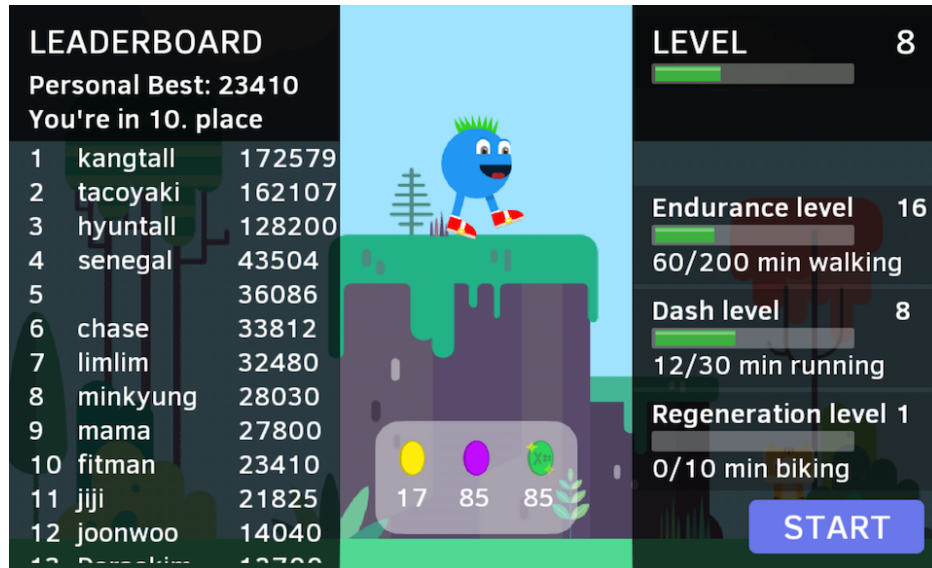


Figure 23.14: On the left: The leaderboard in Korea at the end of the test period.

In the leaderboard in Korea, there were three players that played the game a lot, hence their scores were way higher than the rest, as shown in the screenshot of the leaderboard at the end of the period in Figure 23.14. Many of the interviewees stated that the fact that the top three players were so far ahead of themselves, made them lose motivation to compete in the leaderboard as it seemed like an impossible task to reach the top anyway. The participants suggested regular resets of the leaderboard and character stats or dividing players into different “leagues” so players could compete against players that were at about about the same level as themselves.

One participant also mentioned that the game was hard to understand as it was in English and not Korean, and another participant experienced low frame rate on her phone in some of the worlds.

Overall, the overall perception of the Korean interviewees was that the game was *enjoyable* to play. Competing against other players on the *leaderboard* was ranked as the most enjoyable part of the game by most of the interviewees, just ahead of *reaching new worlds*. Some players also liked the Fito-gotchi’s dash move and dashing through the dash boxes. The level system was also perceived to be interesting, and participant felt more closely related to the character, as the health of his character and his own health were related. Another participant said he enjoyed playing the game more because the game combined fun with the health effects of physical exercise.

Many participants mentioned that it felt impossible to beat the top three players on the leaderboard, as their scores were very high, suggesting that players should be grouped with players with similar skills. The fact that players have to start from world 1 every time they played, made the game *repetitive* for some players, while players who did not like running or biking felt restricted by the game’s mechanics to make progress. Some participants were not impressed by the graphical design of the game and one participant sometimes struggled to understand the game, as it was in English.

## 23.3 Effects on Players' Motivation to Exercise

In this section, data that can give indications about the game's ability to motivate players to perform physical exercise are presented.

### 23.3.1 Questionnaire

Table 23.4 shows the response on the statements in the questionnaire related to the game's ability to motivate players to perform physical exercise.

Initially, 59.1% players perceived the game to be motivational in the beginning according to statement S27, but this number decreased to 27.3% in the end of the period according to the feedback on statement S28.

ID	Statement	D	N	A
S19	My desire to get a better score than the other participants motivated me to exercise.	9.1%	27.3%	63.6%
S20	My desire to level up the levels of the character motivated me to exercise.	18.2%	31.8%	50.0%
S21	My desire to see how the characters' appearance would change when leveling up motivated me to exercise.	9.1%	45.5%	45.5%
S22	My desire to reach new worlds motivated me to exercise.	13.6%	31.8%	54.5%
S23	I walked more because I wanted to increase the endurance level.	0.0%	31.8%	68.2%
S24	I ran more because I wanted to increase the dash level.	31.8%	40.9%	27.3%



<b>S25</b>	I biked more because I wanted to increase the regeneration level.	54.5%	31.8%	13.6%
<b>S26</b>	I was properly rewarded for the exercise I performed.	0.0%	40.9%	59.1%
<b>S27</b>	I was motivated to perform exercise when I started playing the game.	9.1%	31.8%	59.1%
<b>S28</b>	I was motivated to perform exercise at the end of the test period.	13.6%	59.1%	27.3%
<b>S29</b>	My physical activity level increased because of the game.	13.6%	50.0%	36.4%
<b>S30</b>	I enjoyed doing the exercise I performed when playing the game.	9.1%	31.8%	59.1%
<b>S31</b>	I got useful tips from the game that helped me do more exercise in my everyday life.	31.8%	40.9%	27.3%

Table 23.4: The results from statements related to the motivation to perform exercise.

In the feedback section of the questionnaire, one participant gave her opinion related to the game’s impact on her motivation to exercise:

*“When I just started playing the game, I felt the game was less fun because the character died so easily. I waited until the character leveled up naturally through the physical exercise that I perform in daily life rather than getting motivation to perform more physical exercise. As I could level up so slowly because of that, I played the game less during the first week. But as time passed, the game was more fun to play, since I could see the appearance of the character change, and could also reach the new levels. In this regard, I think this game can make people feel like “Oh, maybe I can just walk or run a little bit as I normally do, then I can still have progress in the game.”, which may not be effective in giving people motivation to perform more exercise. For me, I think I will not do any extra exercise even though I play this game again in the future.”*

### 23.3.2 Fitness Data

This section presents all the fitness data gathered from Google Fit, that are relevant to reason about the game’s ability to motivate the test subjects to exercise.

In the questionnaire, the participants were asked if they had registered data manually in the Google Fit application, in order to uncover players that had tried to cheat in the game by adding data to Google Fit. As the data of these players will be show that they have performed more physical activity than they have actually done, their fitness data are not included here. Hence, the fitness data presented here consists of data from 16 participants.

Figure 23.15 displays the average walk time among all the participants who submitted valid Google Fit data in Korea. As the figure shows, the test subjects walked on average more in week 2 - 4 of the experiment, with the peak being in week 3.

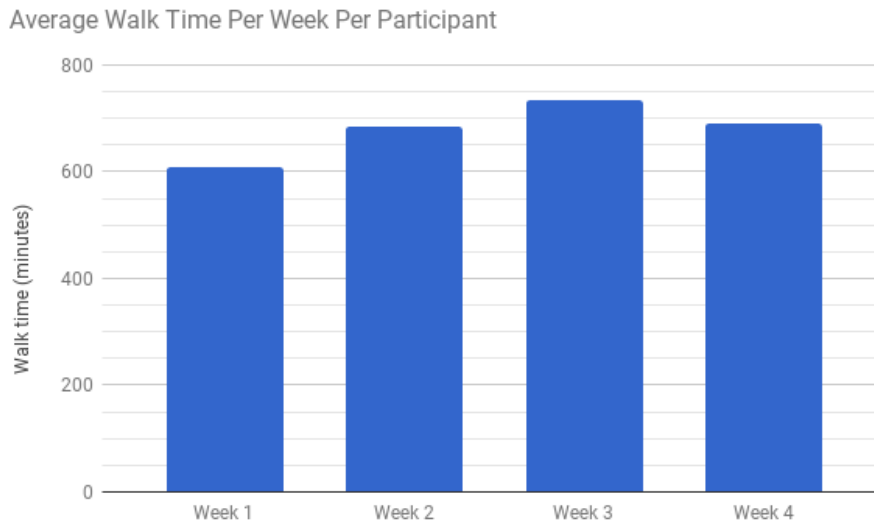


Figure 23.15: Average weekly walk time per participant.

The data about the average participants’ time spent running during the test period displayed in Figure 23.16, show that players ran the most during the two weeks the game was tested, with week 2 being the week the average

participant ran the most.

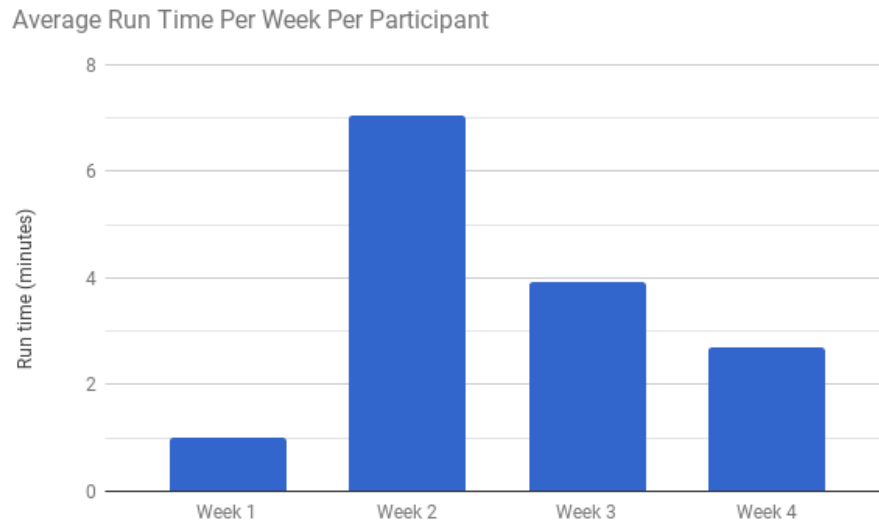


Figure 23.16: *Average weekly run time per participant.*

The overview of the time the average test subject biked is visualized in Figure 23.17.

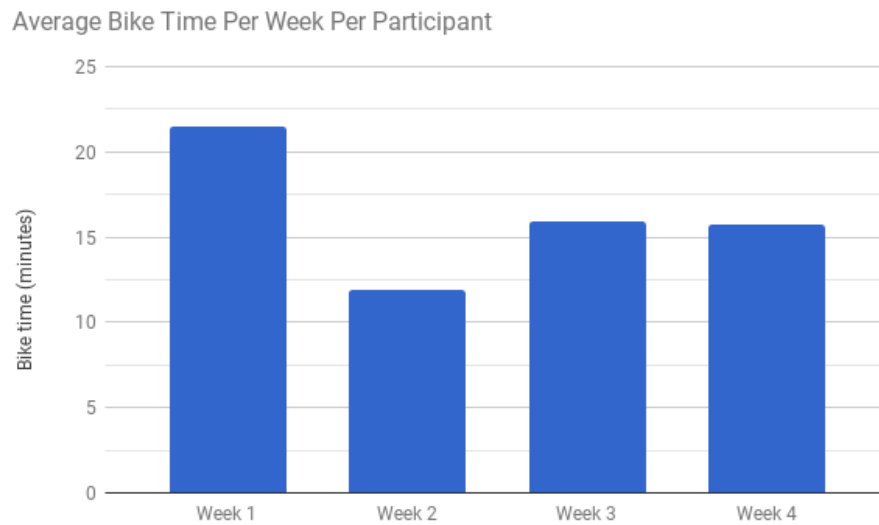


Figure 23.17: *Average weekly bike time per participant.*

Figure 23.18 shows the average total time the participants walked, ran and biked during the test period.

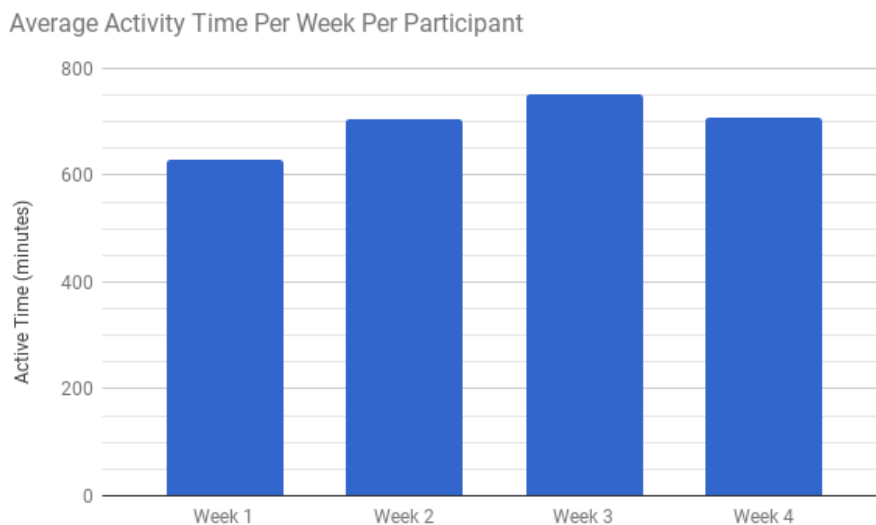


Figure 23.18: *Average weekly activity time per participant.*

The active energy expenditure among the participants are visualized in Figure 23.19. Active calorie expenditure is defined as the calories the body burns due to physical activity and not the basal metabolic rate. Basal metabolic rate is the rate at which the body at rest expends energy to keep it functioning (Wikipedia, 2017).



Figure 23.19: Average weekly active calories expended per participant.

### 23.3.3 Interview

Out of the eight Korean interviewees, five of them stated that they were motivated by the game to perform physical activity during the test period, though to various extents. Except from one participant, none of the participants went out to perform physical activity with just the purpose of leveling up the character, but they rather changed what kind of activity they performed and/or the distance they were performing the activities when they were performing physical activity in their everyday life. *“For me, it was more like trying to do detours, which I normally don’t do, rather than going shortcuts.”* a participant stated, adding *“I felt like the player on the top of the leaderboard and I have been competing each other throughout the experiment period. I felt like we were on similar level, and the gap between him and I has been not really huge. When I saw his score was only a few thousands higher than me at lunch, then I tried to perform exercise during the day and catch up with him at night.”* Another participant said that she had went off the subway one stop before the university almost every day when she was going to school, in order to increase her Fitogotchi’s endurance level, adding that she thinks she performed physical activity for 20 - 30 minutes more than she normally does during most of the days in the test period.

One test subject had started to go off the bus 2-3 stops before her final destination, so she could walk the rest. She also started using the stairs instead of using elevators during the test period.

The participants pointed at many different reasons for why they were motivated to exercise. For most of the participants, getting a higher score to beat other players was the main motivation to level up the character. Not far behind, was to see the character's appearance change and then to reach new worlds. *"I was also curious about how big the character can be in the end, which I thought was motivating."* one participant that considered seeing the character change appearance as the most important motivation for performing exercise and leveling up the character stated.

Two of the participants also said that it was motivating for them to visualize their physical activity level, and that the game together with Google Fit helped them giving them an idea of how much physical activity they performed. One of the participants even thought that Google Fit was motivating her even more than the game to perform physical activity.

The three participants that stated they were not motivated by the game pointed at various different reasons for why the game did not motivate them. One of the participants said *"I've been thinking that I should do exercise, but nothing has actually changed. I wanted to, but I didn't do any exercise."* before further explaining that *"I think I necessarily had to walk in my daily life even though I didn't actually try to, so I think I didn't feel the need to perform more exercise. And I've been quite busy nowadays, and had to walk more than usual, so I felt a little tired and I didn't want to exercise more."*

Another participant said that *"I went biking in purpose to check out if the level really goes up when I actually go biking."* but explained later that he was not interested enough in the game and mainly participated in the experiment to get the participation reward in the end of the experiment. Hence, he was not enough engaged in the game to perform any physical exercise to improve.

The last participant did not feel properly engaged and did not normally like to play video games, and she felt that she needed more than an in-game reward to be motivated to perform physical activity.

Two of the participants mentioned that it was inconvenient that the activities had to be performed outside, some participants pointing out that it especially was a problem during the test period, because the air quality in Seoul was very bad during these days due to high levels of fine dust in the air in this period. They suggested that the game would have more easily motivated them to perform physical activity if the activities could be done inside.

When the interviewees were asked about how the motivation to perform physical activity changed during the test period, their answer was mainly related to how enjoyable they perceived the game to be during the experiment. But one of the participants gave an answer related to the workings of the level system: *“It is more motivating now than in the beginning, because I can notice and realize which sub-level I should increase now. At first, I just walked a lot, but as time passed, I realized that it is both important to actually go for running and walking, and sometimes biking also.”*

## 23.4 Influence on Type of Physical Activity

Here the data that can give indications on the game’s ability to change the type of physical activity the players perform are presented.

### 23.4.1 Questionnaire

Table 23.5 displays the results from the statements in the questionnaire regarding the game’s effect on what type of activity the players perform.

ID	Statement	D	N	A
S23	I walked more because I wanted to increase the endurance level.	0.0%	31.8%	68.2%
S24	I ran more because I wanted to increase the dash level.	31.8%	40.9%	27.3%

<b>S25</b>	I biked more because I wanted to increase the regeneration level.	54.5%	31.8%	13.6%
<b>S35</b>	I did two or more kinds of activities to develop different character skills.	40.9%	22.7%	36.4%
<b>S36</b>	All the Fitogotchi's levels were useful.	9.1%	36.4%	54.5%
<b>S37</b>	The game sometimes influenced what kind of physical activity I performed.	9.1%	27.3%	63.6%

Table 23.5: The results from statements related to the game effects on players' type of physical activity.

### 23.4.2 Interview

Out of the five participants that had performed physical exercise, mentioned in Section 23.3.3, only one of them said that they had been performed different activities that they normally do.

*“I thought walking was really important at first, but then I realized that I need to upgrade my dash level when I died at some point of the game because of the lack of dash level. But running was quite different from walking, as we walk more in daily life compared to running. Then, I saw the two people on the top of the leaderboard who seemed like friends, and I kind of wanted to split them up.”*

In order to get between them in the leaderboard he explained that after leveling up the dash level to a certain level, there was no need for more dash energy and he then focused on increasing the regeneration level by biking.

The rest of the participants said that they had not changed what type of physical activity they had performed. One of the participants had tried to bike once to see if the game was actually able to register it, and another participant had ran to check the same, but had not went running or biking after this.



The participant that had tried to run once also said *“I actually tried to go biking. Since I don’t have a bicycle, I tried to borrow a bicycle from my friend or so, but I couldn’t actually put that into practice. And I also thought it would be quite inconvenient to carry the phone all the way while biking. But I really wanted to go biking.*

The rest of the participants had just not tried to do anything else, mostly reasoned that they did not like to go running and biking and hence did not want to do it.

## 23.5 Does the Effects Last?

This section the data that can give indications to whether or not the game might have had an effect on players’ physical activity habits also after they stop playing the game are presented.

### 23.5.1 Questionnaire

Table 23.6 lists the results of the statements related to the “after effects” of the game on players’ physical activity habits.

ID	Statement	D	N	A
S31	I got useful tips from the game that helped me do more exercise in my everyday life.	31.8%	40.9%	27.3%
S32	I enjoyed performing activities that I normally do not do during the test period.	63.6%	22.7%	13.6%
S33	The game inspired me to perform more exercise after the test period was over.	50.0%	22.7%	27.3%
S34	My physical activity level was higher the week after I played the game than the week before the test period, because of the game’s effect on my habits.	31.8%	27.3%	40.9%

Table 23.6: The results from statements related the after effects of the game.

### 23.5.2 Interview

Out of the eight Korean interviewees, three of them stated that they thought they would maintain a higher activity level also after they stopped playing the game. One of these participants had started going off the subway a stop earlier on her way to school, and believed she would continue doing that. Another participant stated that she was more conscious about her activity level after playing the game and wanted to continue to maintain a higher activity level for the sake of her health when the game testing period was over. Additionally, she would continue using Google Fit, which she perceived to give motivation to perform physical activity.

One of these participants had also followed the in-game tips for exercising: *“I actually tried to take a walk when I was studying. I have done it before I started playing this game, but I have been taking a walk more often after I began playing this game.”* This participant answered when she was asked if she had done as any of the in-game tips suggested. As this felt refreshing, according to her, she believed this might turn into a more regular habit.

The five remaining participants believed the game would not have an effect on their physical activity level after they stopped playing the game.

### 23.5.3 Fitness Data

The data from Figures 23.15, 23.16, 23.18 and 23.19 all indicate that the average physical activity level was higher the week after the game was blocked than before they started playing the game, indicating that the average player walked and ran more after they had played the game than before.

# Chapter 24

## Result – Total

In this chapter, the results from the questionnaire from Norwegian experiment and the Korean experiment are combined to see how the game has affected the entire test population. The qualitative data, like interviews and observations, are not reproduced here, but are found separately in Chapter 22 and 23. The fitness data from Norway and Korea are neither included here, as the data from Norway were likely affected by the participants' exam period to the extent they might not be usable to reason about the effects of the game, as mentioned in Section 22.3.2.

The statements in *all the tables in this chapter* presenting the results from the questionnaire are shortened to fit better into the tables. Furthermore, in the questionnaire, participants responded to each statement using either of the five options: *strongly disagree*, *disagree*, *neutral*, *agree*, *strongly agree*. To simplify the analysis, strongly disagree and disagree have been grouped together. The same has been done to agree and strongly agree. The original statements and the detailed distribution of the answers can be found in Appendix C.

When calculating the distribution of the answers from the questionnaire, the percentage of participants that disagreed was calculated and then rounded to the nearest decimal in one decimal place. This was also done for participants that answered neutral and agree. As each response was rounded separately, the total of all the responses from one question can range from 99.9% to 100.1%, hence not necessarily exactly 100%. This applies for *all tables* in this chapter that present the results from the statements in the questionnaire.

## 24.1 Test Population

The total test population consists of 43 participants, Figure 24.1 shows the gender distribution among the participants.

Total Gender Distribution

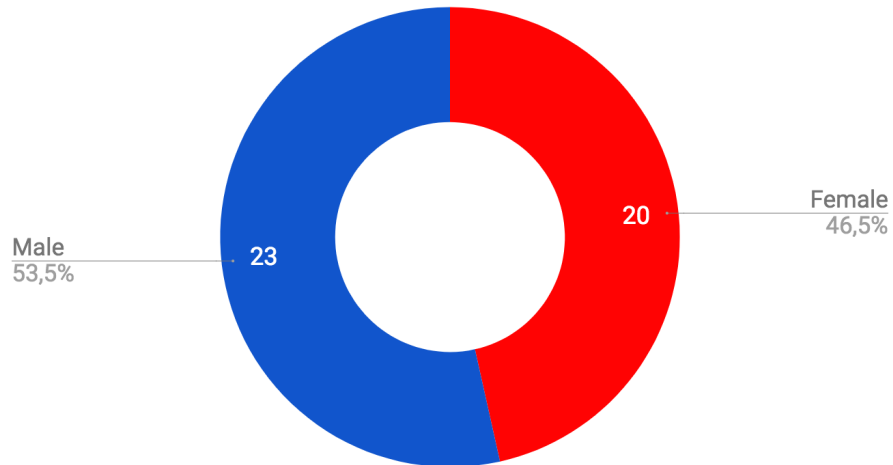


Figure 24.1: *The total gender distribution among all participants*

The age distribution of all the participants is shown in Figure 24.2.

## Age Distribution Total

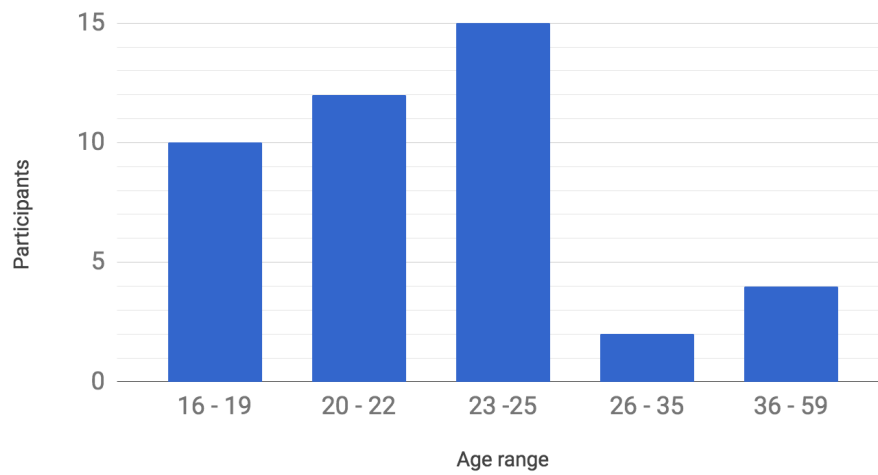


Figure 24.2: Age distribution among all the participants.

Figure 24.3 displays how much the participants normally play video games, excluding games for smartphones. It shows that a little more than half of the test subjects regularly play video games.

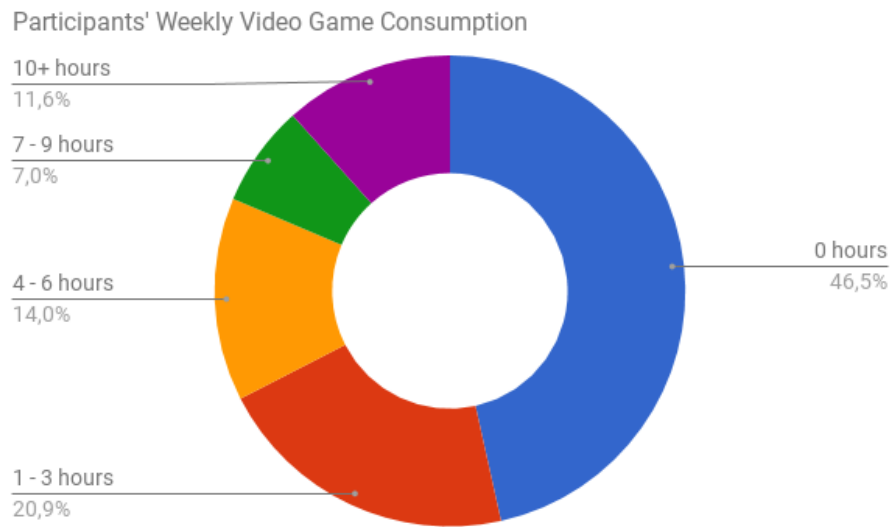


Figure 24.3: Participants' normal video game consumption (excluding smartphone games).

In Figure 24.4 the participants' time spent on playing games on their phone weekly is displayed. It shows that 62.8% of the participants play the games on their smartphones regularly.

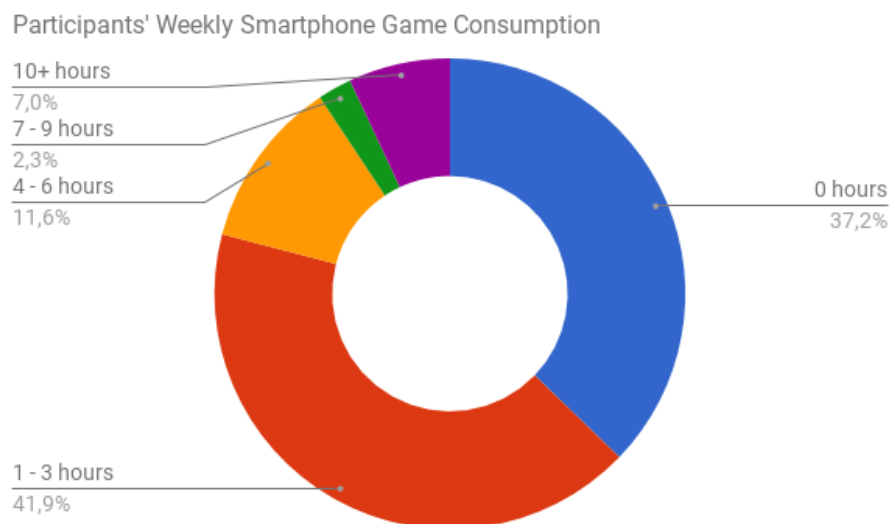


Figure 24.4: *Participants' normal smartphone game consumption.*

The test subjects' weekly time spent on performing physical activity is shown in Figure 24.5. This figure shows that 79.1% of the test population performs some sort of physical exercise regularly.

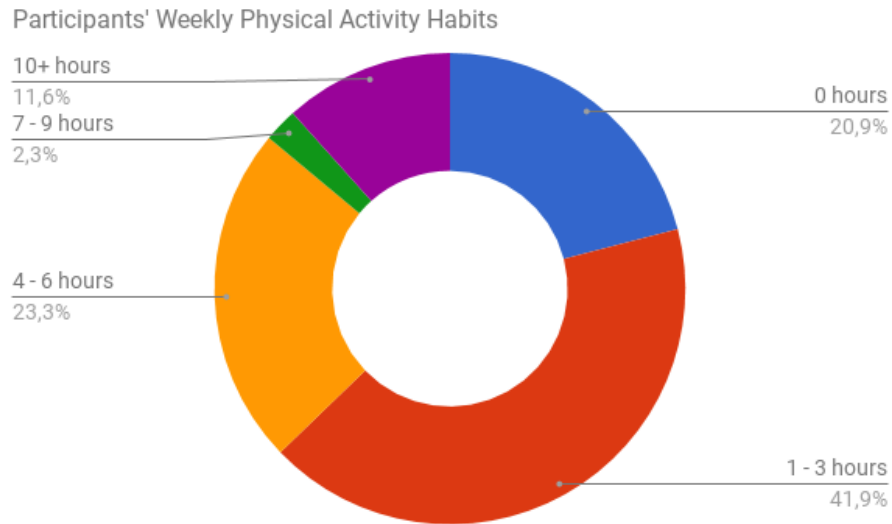


Figure 24.5: Participants' physical activity habits.

Table 24.1 displays what kind of physical activity the test subjects stated in the questionnaire that they regularly perform.

Activity Type	Percentage of Participants Performing Activity
Walking	58.1%
Running	34.9%
Biking	11.6%
Strength exercise	32.6%
Dancing	4.7%
Other	25.6%

Table 24.1: The test subjects regularly performed physical activities.

## 24.2 Player Enjoyment

The results from the statements in the questionnaire that is related to player enjoyment are presented in Table 24.2.

ID	Statement	D	N	A
S1	I was curious on seeing how my Fito-gotchi's appearance would change.	2.3%	23.3%	74.4%
S2	In the beginning I enjoyed reaching new worlds.	4.7%	7.0%	88.4%
S3	In the end I enjoyed reaching new worlds.	9.3%	16.3%	74.4%
S4	I was in control of my actions in the game.	2.3%	25.6%	72.1%
S5	The game was challenging, but not frustratingly hard.	7.0%	7.0%	86.0%
S6	The game required my full concentration.	9.3%	16.3%	74.4%
S7	I got better at playing the game, the more I played.	4.7%	9.3%	86.0%
S8	I finished the last game world early.	93.0%	2.3%	4.7%
S9	I was able to make progress during the entire test period.	16.3%	16.3%	67.4%
S10	I liked the universe and the character in the game.	7.0%	41.9%	51.2%
S11	In the beginning I enjoyed beating my high score.	0.0%	7.0%	93.0%
S12	In the end I enjoyed beating my high score.	9.3%	7.0%	83.7%
S13	In the beginning I enjoyed beating other players' score.	0.0%	9.3%	90.7%
S14	In the end I enjoyed beating other players' score.	14.0%	9.3%	76.7%



<b>S15</b>	I enjoyed getting a good score more in Fitogotchi, because I had exercised to achieve this score.	20.9%	39.5%	39.5%
<b>S16</b>	I enjoyed leveling up my character by exercising.	7.0%	20.9%	72.1%
<b>S17</b>	In the beginning I enjoyed playing the game.	4.7%	20.9%	74.4%
<b>S18</b>	In the end I enjoyed playing the game.	9.3%	32.6%	58.1%

Table 24.2: The results from statements related to enjoyment.

### 24.3 Effects on Players' Motivation to Exercise

In Table 24.3, the participants' response to the statements related to the game's ability to motivate them to perform physical exercise in the questionnaire is displayed.

<b>ID</b>	<b>Statement</b>	<b>D</b>	<b>N</b>	<b>A</b>
<b>S19</b>	My desire to get a better score than the other participants motivated me to exercise.	18.6%	25.6%	55.8%
<b>S20</b>	My desire to level up the levels of the character motivated me to exercise.	14.0%	27.9%	58.1%
<b>S21</b>	My desire to see how the characters' appearance would change when leveling up motivated me to exercise.	16.3%	41.9%	41.9%
<b>S22</b>	My desire to reach new worlds motivated me to exercise.	20.9%	30.2%	48.8%

<b>S23</b>	I walked more because I wanted to increase the endurance level.	11.6%	25.6%	62.8%
<b>S24</b>	I ran more because I wanted to increase the dash level.	39.5%	34.9%	25.6%
<b>S25</b>	I biked more because I wanted to increase the regeneration level.	55.8%	25.6%	18.6%
<b>S26</b>	I was properly rewarded for the exercise I performed.	7.0%	25.6%	67.4%
<b>S27</b>	I was motivated to perform exercise when I started playing the game.	16.3%	30.2%	53.5%
<b>S28</b>	I was motivated to perform exercise at the end of the test period.	18.6%	46.5%	34.9%
<b>S29</b>	My physical activity level increased because of the game.	23.3%	34.9%	41.9%
<b>S30</b>	I enjoyed doing the exercise I performed when playing the game.	14.3%	21.4%	64.3%
<b>S31</b>	I got useful tips from the game that helped me do more exercise in my everyday life.	30.2%	41.9%	27.9%

Table 24.3: The results from statements related the game’s ability to motivate players to exercise.

## 24.4 Influence on Type of Physical Activity

Table 24.4 shows the results from the statements related to the game’s influence on player’s choice on type of physical activity during the game testing period of the experiment.

<b>ID</b>	<b>Statement</b>	<b>D</b>	<b>N</b>	<b>A</b>
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<b>S23</b>	I walked more because I wanted to increase the endurance level.	11.6%	25.6%	62.8%
<b>S24</b>	I ran more because I wanted to increase the dash level.	39.5%	34.9%	25.6%
<b>S25</b>	I biked more because I wanted to increase the regeneration level.	55.8%	25.6%	18.6%
<b>S35</b>	I did two or more kinds of activities to develop different character skills.	34.9%	20.9%	44.2%
<b>S36</b>	All the Fitogotchi's levels were useful.	16.3%	25.6%	58.1%
<b>S37</b>	The game sometimes influenced what kind of physical activity I performed.	23.3%	23.3%	53.5%

Table 24.4: The results from statements related to the game's effects on players' type of physical activity.

## 24.5 Does the Effects Last?

Data from the statements related to the after-effects the game has on the participants are shown in Table 24.5.

<b>ID</b>	<b>Statement</b>	<b>D</b>	<b>N</b>	<b>A</b>
<b>S31</b>	I got useful tips from the game that helped me do more exercise in my everyday life.	30.2%	41.9%	27.9%
<b>S32</b>	I enjoyed performing activities that I normally do not do during the test period.	51.2%	30.2%	18.6%
<b>S33</b>	The game inspired me to perform more exercise after the test period was over.	53.5%	23.3%	23.3%

<b>S34</b>	My physical activity level was higher the week after I played the game than the week before the test period, because of the game's effect on my habits.	46.5%	20.9%	32.6%
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Table 24.5: The results from statements related to the after effects of the game.

## **Part VII**

# **Conclusion & Discussion**

In this part, the project will be wrapped up and concluded. Firstly, the results from this work will be discussed. Secondly, answers to the research questions will be presented in the conclusion. This part and the thesis are concluded with a presentation of future work that should be done related to this project.



# Chapter 25

## Discussion

In this chapter, the results from the experiment will be presented.

### 25.1 Player Enjoyment

Overall, the participants seemed to perceive the game as enjoyable to play. In the questionnaire, 74.4% of the participants agreed to statement S17: *“In the beginning of the test period I enjoyed playing the game.”*. Overall, out of the fourteen statements related to player enjoyment in the beginning of the test period in the questionnaire, all except three statements were responded positively to by more than 70% of participants. S10 *“I liked the universe and the character in the game”* and S15: *“I enjoyed getting a good score more in Fitogotchi than in other games, because I had exercised to achieve this score.”* were the two statements regarding player enjoyment that scored the lowest among the participants.

The reasons for the low agreement rate in statement S15 might be related to the fact that many players did not perform any extra physical activity because of the game. As later discussed in Section 25.2, 41.9% of the participants agreed to the statement that *“Overall, my physical activity level increased during the test period because of the game.”*, which corresponds quite well with the 39.5% agreement rate of statement S15.

The statements related to enjoyment that were responded the most positively to in the questionnaire was statement S11: *“In the beginning of the test period I enjoyed trying to beat my personal best score.”* where 93.0% of the participants agreed and then S13: *“In the beginning of the test period I*

*enjoyed beating the score of other players on the leaderboard.*” was the second with 90.7% agreement. The insight gotten from the interviews supports this data, as when players were asked what was the most enjoyable about the game, beating their own high score and others on the leaderboard was mentioned most often. Hence, it is clear that the *social interaction* among the participants and the *rewards of glory* were features about the game the participants enjoyed.

During the interviews the general perception was that players were excited to reach new worlds, as they were *curious* on seeing how the next level looked like. The participants were also in general curious about finding the secret cave in the second world after being teased that such a cave existed in the game’s hint system. The green multiplier coins in the game also added thrill to the experience according to a few interviewees. There was also a general agreement among the interviewees that the level system added entertainment value to the game, and some of the participants mentioned that the game was more fun to play because of the fact that they felt good about having exercised while making progress in the game.

Some participants also liked the design of the game, but in this regard the opinions differed a lot among the participants. One participant wrote in the feedback field of the questionnaire that *“I really enjoyed taking part in this project, especially because the overall design of the game was strong (music, art style, gameplay)”* while another participant was not that enthusiastic, as he wrote in the same feedback field that *“The design of the game is so shitty.”* This corresponds well to the response on statement S10: *“I liked the universe and the character in the game.”* where 51.2% of the participants agree, and 41.9% of the participants stated they were neutral to this statement.

According to the results of the questionnaire, some players perceived the enjoyment to decrease during the test period. 58.1% of the participants agreed to statement S18: *“In the end of the test period, I enjoyed playing the game.”*, which is a decline compared to the 74.4% of the participants that stated they enjoyed playing the game in the beginning. Analyzing the results of the other statements related to the wear out effect of the game, there is a steady, but not dramatic decline in all the measured factors, that include enjoyment related to reaching new worlds, beating the personal best score and beating other players’ score on the leaderboard.



The game statistics and the players' self reported play time, support this decline. The game statistics show that there is a decline in unique players playing the game per day during the second week of the test period in Korea, and the number of play sessions decreased drastically during the two last days of the Korean experiment. Players also report to play the game less in the second week of the experiment in both countries.

Only 4.7% of the participants stated in the questionnaire that they finished the last world of the game early in the test period, suggesting that the reason for players to lose interest in the game should not be related to running out of content.

During the interviews, some players argued that the reason for the game being less enjoyable in the end, was that they were tired of playing the first worlds of the game, as they had to play them every time they played. Other participants thought the game was more fun in the end as they could make progress during the entire test period, hence reach further in the worlds.

As the test period lasted for merely two weeks, it is not possible to reason about the long term enjoyment of Fitogotchi exceeding this period of two weeks. Nevertheless, the game seems to have been enjoyable among almost 60% of the participants in the end of the two week long test period.

## **25.2 Effects on Players' Motivation to Exercise**

In Fitogotchi, players could perform three different kinds of physical exercise, walking, running and biking, to increase three different stats of their character. Walking is the most important stat to increase in the beginning of the game, but later, the stats connected to running and biking get increasingly important for players to improve in order to make further progress in the game. This increasing need of the more physically intensive exercises is implemented to adhere to dual flow; players can start by increasing their walking, but will later need to run and go biking as they progress in the game.

In the questionnaire, the participants were asked which factors in the game that motivated them to exercise, and the participants' desire to get a better score was the factor that motivated most participants, second was the desire to reach new worlds and lastly the participants' desire to see how the character's appearance change was the least motivating factor. This coincides with the data from the interviews.

While developing Fitogotchi, the goal was to make a game that would change the players' everyday habits in regards of physical exercise. This might be to make players walk detours to, for instance school, work and the grocery store, or walk or go biking instead of public transportation or driving the car. Data from the interviews indicate that this is also the way the majority of the players of Fitogotchi are playing it, as only one out of the fourteen interviewees said that he went out to perform physical exercise *just* to increase the level of the character.

The participants' response on statement S29 in the questionnaire indicate that 41.9% of the participants perceived their physical activity level to have increased during the test period. The amount of additional exercise that the game had motivated them to perform varied.

Some participants had increased their physical activity level considerably. Two of the Korean interviewees stated that they had started to get off the bus and subway some stations earlier than their final destination almost every day, so they could walk the remaining distance and level up their Fitogotchi. Another Korean interviewee was high on the leaderboard, and had increased his physical activity level in order to keep up with the competition.

Other participants were more reluctant and thought it was hard to quantify since the additional physical exercise they had performed occurred in small portions multiple times a day, such as walking detours to the grocery store and taking breaks at work to walk a little extra was also mentioned among the interviewees.

The players that said they were not motivated by the game to perform physical exercise gave reasons such as that they were not properly engaged or interested in the game. Other participants stated that they already exercised, hence they did not need motivation by a game to exercise. This was

especially prevalent in Norway, which might be a result of the fact that 57.1% of the participants in Norway exercise more than four hours a week, while the same number was only 37.2% in Korea.

Furthermore, players not being punished for performing too little physical exercise was one of the weak points of the level system, especially in the beginning of the game, as the endurance level of the character which required walking to level up, was the most important sub level to make progress in the beginning. As people normally walk as a mean of transportation, this made many of the players feel that they had steady progress even though they did not actively perform extra exercise in order to do so. A punishment system was initially planned to be implemented in the game, but due to time constraints, there was not enough time to make it.

In the questionnaire, 53.5% of the participants stated that they were motivated by the game to perform physical exercise in the beginning of the test phase of the experiment. This number decreased to 34.9% at the end of the test period. During the interviews, most of the participants that experienced a decrease in motivation pointed at the fact that they lost interest in the game as the main reason for this. One participant also mentioned that, as the time requirements for leveling up increased, the motivation to level up decreased as it was not very fun to walk for two hours to level up the character, pointing out that implementing some sub goals or challenges related to physical exercise could have fixed this problem.

Even though there was a decrease in the amount of participants that were motivated by the game to perform physical exercise over the course of time, some participants stated the exact opposite and claimed that the game motivated them more in the end of the test period. One of the participants said that *“It is more motivating now than in the beginning, because I can notice and realize which sub-level I should increase now. At first, I just walked a lot, but as time passed, I realized that it is both important to actually go for running and walking, and sometimes biking also.”* This is also reflected in the questionnaire, as if we break down the results of statements S27 and S28, the number of participants that strongly agree increased from statement S27 to S28, as seen in Table E.2.

As mentioned in Section 22.3.2, the Fitness data in Norway have most likely

been heavily affected by the exam period in Norway, as many of the test subjects in Norway were students. Hence, the Google Fit data from Norway will not be used to reason about the game's effects.

The Google Fit data from the Korean experiment give indications that the participants' physical activity level has increased in the time period that the participants played the game. The walking level increased by 78 minutes per week per average participants from week 1 to week 2, and further increased in week 3 by 48 minutes per average participant, indicating that the game continued to motivate the second week. The Korean participants also ran considerably more during the test period they played, as the average player increased their run time from 1 minute to 7 minutes from week 1 to week 2. In week three, the average participant ran 4 minutes.

These results are encouraging, but it is important to be aware of the limitations of the Google Fit data. Many things other than the game can might have affected the participants' physical activity level during the test period. But nonetheless, triangulated with the data from the questionnaire and interviews, indications are given that many players increased their activity level because of the game, but the motivation for a considerable amount of players has decreased during the two weeks the experiment lasted.

### 25.3 Influence on Type of Physical Activity

In Fitogotchi, the level system is on purpose implemented so that players have to perform different kinds of activities in order to level up all the Fitogotchi's levels, so that it is not possible to level up all sub-levels by performing only one or two types of physical activity.

According to the results of statement S36: *"I felt that all the Fitogotchi's levels were useful in order to reach my goals in the game."* 58.1% of the participants perceived all the sub-levels useful.

Furthermore, 44.2% of the participants stated that they had performed two or more types of physical activity in order to develop the skills of the character, according to the response on statement S35. From the results of statement

S23 - S25, it can be seen that 62.8% of the players perceived that they walked more because they wanted to level up their character, while 25.6% of the participants ran and 18.6% of the participants biked more than normal because of the game.

During the interviews, one participant claimed that he had started biking to the train station as a mean of transport instead of walking, as he normally did, because he wanted to increase his regeneration level. Another participant had been running for short periods while going for a walk, so her dash level could increase. One Korean participant that had played the game a lot, had adapted what kind of physical activity he did in accordance to which level he perceived to be most useful for him to level up at the moment, and did both run, bike and walk during the test period to level up the character.

The participants that did not want to perform other types of activities gave reasons such as they did not like to run or bike. Other participants were limited by the fact that they did not own a bike.

In the general statement S37: *“The game sometimes had an influence on what kind of physical activity I performed during the test period.”* 53.5% stated that they agreed. This is more than the number of participants that stated that they performed two or more kinds of activities to develop different skills of the character, but an explanation might be that some participants changed activities not implemented in Fitogotchi with activities that are implemented. One participant stated in the feedback section of the questionnaire that: *“Some strength exercises were just swapped out in advantage of running to make it count in the game.”*

All in all, the data retrieved from both interviews and the questionnaire suggest that the game has influenced what kind of physical activity about half of the players have performed during the experiment, but it seems to fail to make players perform activities that they normally do not like to perform.

## 25.4 Does the Game Change Players' Habits?

During the interviews, some of the participants had incorporated more physical exercise as part of their everyday transportation, an example being a Korean participant that had started going off the subway a stop earlier than her final destination. Some of the participants thought they might keep these habits after they stopped playing the game. It is though important to keep in mind that the participants were interviewed before the game was closed, hence these statements are limited to giving information about the players' wish to keep these habits, and not a confirmation that this happened.

In the questionnaire, 23.3% of the participants agreed to statement S33: "*The game has given me inspiration to perform more physical activity after the test period was over.*". Furthermore, according to the response on statement S34, 32.6% of the participants thought their physical activity level was higher the week after they stopped playing the game, than the week before, due to the effect the game had on their habits.

The Google Fit data in Korea also indicates that the Korean participants' physical activity level were higher in week 4 of the experiment than week 1, although many things can affect the test subjects' physical activity levels, hence it is hard to say if this is a coincidence or not. Nevertheless, the Google Fit data can be considered, together with the results from the questionnaire, to be an indication that the game *might* have had an effect on some of the participants' habits also the week after they stopped playing the game. But in order to make more reliable conclusions on this matter, more research have to be conducted in this regard.

# Chapter 26

## Conclusion

The purpose of this thesis was to *examine if an exergame can make a positive impact on players' daily habits in regards of physical exercise*. This thesis is a continuation of my specialization project, where a literature review was performed on existing exergames to understand what has already been done in this field. Then a review of today's technology was conducted in order to get an understanding of its capabilities and constraints in regards of tracking players' movement. This review also gave an understanding of what platforms that might be suited for an exergame. Additionally, frameworks for rating players' enjoyment in games were studied to get an understanding of what features that characterizes good games. This made it possible to design an interesting game concept that is desirable for players to play. Moreover, health effects and daily recommendations of physical activity were studied in order to get an understanding of how much physical activity an exergame should promote players to perform.

Then, to contribute to the field of exergaming, different existing game genres were reviewed and reasoned about in regards of how physical activity could be implemented as a core part of the gameplay of games of every genre. Furthermore, these ideas were refined and further ideas were introduced, in order to invent different specific exergame concepts. Elements of these suggested exergames were put together and combined with new ideas to invent the game concept of Fitogotchi.

In the work on this thesis, Fitogotchi was developed, before it was later tested on 43 participants from Norway and South Korea. Data from this experiment gave answers to the research questions defined in Chapter 3.

***RQ1*** *How does this exergame affect players' enjoyment?*

In the literature review of game design theory, it was discovered that to

trigger players' curiosity, rewarding them for their actions in the game and facilitating social interactions were all important factors for enjoyment in games. In Fitogotchi, players' curiosity was triggered by putting restrictions on how far in the game world players could reach with a low-level Fitogotchi, and gradually increase how far players could possibly reach as they leveled up their character. Furthermore, rewards of glory and social interactions were implemented as a score system and an online leaderboard. These features proved to be important factors for the test subjects' enjoyment of the game. Overall 74.4% of the test subjects enjoyed playing the game in the beginning of the test period.

***RQ2*** *How does this exergame affect players' enjoyment over time?*

In order to answer this question, the players' enjoyment was compared in the beginning and the end of a two week long test period. The data showed mixed results, as some players stated the game was more enjoyable in the beginning, while others claimed the game's enjoyability increased over the course of time. Overall, the results show a moderate decrease in player enjoyment over time. Despite this, two weeks is a rather short time frame, hence experiments spanning over more time have to be performed to get more insights on the long-term wear out effect of the game.

***RQ3*** *How will this exergame affect the players' motivation to perform physical activity?*

In order to level up the character, hence making progress in Fitogotchi, players have to perform different kinds of physical exercise. This includes running, walking and biking. 41.9% of the participants perceived they had increased their physical activity level during the test period, but how much each of them increased their activity level varied considerably among the participants.

***RQ4*** *How will this exergame affect the players' motivation to perform physical exercise over time?*

The results on this research question are mixed. Some participants stated their motivation had decreased during the test period, as they got tired of playing the game. Some players also perceived the level system to be monotonous as they reached higher levels. On the other hand, a few players stated that their motivation increased over time, as they fully understood the level system of the game and realized the importance of running and biking, in addition to walking.



**RQ5** *How does this exergame affect what kind of physical exercise the players perform?*

Fitogotchi implements a level system that encourages players to vary the type of physical activity they perform. About half the test population states in the survey that the game sometimes has had an impact on what kind of activity they performed. Running was the exercise apart from walking the participants had performed the most, while just a few participants went biking because of factors related to the game. Interviews revealed that Fitogotchi in general fails to motivate players to perform physical activities they dislike, but the results indicate that players motivated by the game to perform exercise, performed more of the activities they liked doing.

**RQ6** *How will this exergame impact the players' activity levels after they stop playing the game?*

This research question was answered using the participants' fitness data, retrieved from Google Fit, one week before they played the game and the week after the game was shut down. This was triangulated with data from a questionnaire the participants filled out after the experiment was over. Data from the questionnaire suggest that approximately one third of the test subjects perceived their physical activity level to be higher the week after they stopped playing the game, than it was before they started playing it, as a result of the effect the game had on their physical activity habits. The Google Fit data confirm that the participants' average physical activity level was higher after the game testing period.

Exergames such as Fitogotchi have potential to motivate users to exercise more. However, such games do not motivate everyone, but it can be effective in parts of the population.



# Chapter 27

## Further Work

This chapter presents further work that should be done on this project.

### 27.1 Further Research on Fitogotchi

The experiment performed during the work on this thesis gave insight into how the game could motivate players to perform more physical exercise. This includes:

- Daily challenges, giving players smaller goals along the way in the exercise part of the game. This also opens up a chance to implement more variations in how the activities are performed.
- Punish players who do not perform enough physical exercise. This can be done by deteriorating the Fitogotchi's levels if the players do not meet predefined goal, and ultimately make the character die if the players perform too little physical exercise for a longer time period. To determine the limit for what "is enough" exercise, the guidelines regarding recommended physical activity level, presented in Chapter 9, should be considered.
- Improve the graphics and the sound in the game to make players being able to care more about their character.

When these changes have been made, the effects of the game should be tested again, preferably over a longer period of time and with more participants. This in order to get a better understanding of the long term effects of the

game, and get more data about player enjoyment. If possible improvements to the game concept are uncovered during these experiments, they should be implemented and the game should be tested again.

Furthermore, the game should be developed for iOS also, in order to include players who do not possess an Android phone. An appropriate business model should be identified, before a full scale development of the game should be implemented and released on Google Play and Apple's AppStore.

In Section 27.2, a suggestion for how Fitogotchi could be expanded to become a more comprehensive concept, both as a game, but also as a platform for tracking exercise is presented. A prototype for a concept like this should be developed and tested on users to see how this can affect players motivation to perform exercise. If successful, a full scale version of this idea should be developed and released to the public.

## **27.2 Fitogotchi - The Bigger Picture**

Due to time constraints, limits had to be set when designing the game concept and developing the game. The idea behind Fitogotchi, the game that was developed while working on this thesis (presented in Chapter 12) has potential for vast expansion. As there was not enough time to realize all the ideas, the bigger picture and how Fitogotchi fits into this expanded concept will be presented here – both to give the reader an understanding of the limitations that were put on the game concept while developing it, but also to give a picture of how this game can be expanded in the future.

### **27.2.1 Algorithmic Character Evolution**

In the current version of Fitogotchi, the Fitogotchi evolves linearly in one pre-determined character evolution path. As Fitogotchi supports multiple physical exercises, it would be natural to make the character's appearance change in different ways based on what type of physical exercise the player performs. For instance, a player that mainly does strength exercise would end up with

a different appearance to their Fitogotchi than a player that performs more biking, in addition to different strengths and weaknesses.

This character design should be determined algorithmically to enable fluent transition between different character appearances, but also to make “endless” different designs. By not revealing the details about how this algorithm works, the players’ *curiosity* is triggered as players want to understand the pattern of how each different type of exercise affects the characters’ appearance. It will also add a social element to the experience, as players can compare their Fitogotchis’ with other players and together figure out why their Fitogotchis look like they do and together uncover how the underlying system works.

### **27.2.2 Tracking of More Types of Activities**

The character development system of the current version of Fitogotchi relies on the three activity types: walking, running and biking. These physical activities were chosen because of a multitude of reasons: most people can perform one or more of these activities, they vary in intensity and players can choose the exercise that fits their fitness level the most. Furthermore, these activities can also be means of transportation and make them suited for incorporation in every day life, by walking detours to school, work or grocery store or to use the bike instead of driving a car when traveling shorter distances. Hence, these exercises are a reasonable selection of activities to facilitate the goal of the game: to change players’ habits in everyday life to increase their general physical activity level.

But the Fitogotchi concept allows flexibility in the type of exercises that are implemented in the game, an opportunity that should not be missed. Various strength exercise, but also other cardiovascular exercises and sports should be supported by the character development system in Fitogotchi. Then the game can motivate players to perform more of the physical activities they enjoy. The more activities it could support, the better. Technology to track many of these exercises precisely will probably rely on technology of the future. Preventing cheating when tracking strength exercises can also be challenging with today’s technology (Høivik and Olsen, 2015). But the use of sensors

from smartwatches and other wearable devices might provide opportunities to track different kinds of exercises more precisely.

Adding a wider selection of exercises would also make the algorithmic character development system more interesting, as the character’s design would have a wider range of directions to evolve in.

### 27.2.3 Fitogotchi as Platform

Right now Fitogotchi is “just” a game, but if the game could track a large number of activity types, it would be interesting to explore the opportunity to make Fitogotchi a fusion of a game and a workout log, such as Fitocracy (described in Section 6.9), but with more focus on the game elements.

Imagine a workout log, with the Fitogotchi being the users’ exercise mascot. It could recommend physical exercises that players might be interested in performing, in addition to giving tips about exercise. This platform could automatically track the physical exercises the users perform and display statistics about their Fitness data. In addition to visualizing the users’ activity level, the physical exercise players perform would strengthen different stats of the Fitogotchi, according to the character development system described in Section 27.2.1.

Then, instead of just being able to play the *endless runner* in Fitogotchi, the Fitogotchi could be used in a *variety of different games*. Hence, exercising would give players the advantage of getting a more powerful character in a diverse collection of games. Depending on the business model, players could buy these games, or unlock them by performing physical exercise – the latter giving players further motivation to exercise.

### 27.2.4 Summary

As discussed in this chapter, Fitogotchi is a concept that has potential to be expanded upon. A more dynamic character development system and adding support for more types of exercises are the two most obvious expansions.

Experimenting with Fitogotchi as a platform for games and fitness tracking is a more radical, but interesting idea that should be explored in the future.





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# Appendices



# Appendix A

## Fitogotchi Questionnaire – English

# Fitogotchi

\*Må fylles ut

1. **Please enter your participant number. \***

You can find your participant number by opening Fitogotchi on your phone and press the "Start"-button. The participant number consists of 4 digits. The participant number can NOT be used to identify who you are.

---

## Personal information and habits in regards of video games and physical exercise

---

2. **Gender \***

Markér bare én oval.

- Male
- Female

3. **How old are you? \***

---

## Your habits on gaming.

---

If you want to enter fractions of hours, you can use the punctuation symbol ( . ). For instance 1 hour and 30 minutes = 1.5.

4. **How many hours a week do you normally play video games (excluding games on your phone)? \***

By video games, we mean games on your computer or a video game console but NOT counting games on smartphones.

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5. **How many hours a week do you normally play games on your phone? \***

Normally: outside of the Fitogotchi test period.

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## Your habits on physical exercise.

---

If you want to enter fractions of hours, you can use the punctuation symbol ( . ) . For instance 1 hour and 30 minutes = 1.5.

**6. How many hours per week do you normally perform physical exercise? \***

By physical exercise we mean physical activity you perform in order to improve your health or activity that is not a part of your everyday life. For instance, walking as a mean of transportation does not count, but having a walk with the purpose of staying fit counts.

---

**7. What kind of physical exercises do you normally do? \***

Choose all the alternatives that applies for you. If your the exercises you normally do is not here, please write the missing activities in the "other"-option. If you normally do not exercise, select "I do not exercise".

*Merk av for alt som passer*

- Walking
- Running
- Bicycling
- Soccer
- Basketball
- Cross country skiing
- Down hill skiing
- Dancing
- Strength exercise
- I do not exercise
- Andre: \_\_\_\_\_

**8. Did you play Fitogotchi enough to form an opinion about the game during the test period? \***

If the game didn't work on your phone or of other reasons you did not play the game enough to get an impression about the game, please answer no.

*Markér bare én oval.*

- Yes
- No *Hopp til spørsmål 22.*

## Your experience with Fitogotchi

Please answer these questions about your experiences with the game during the test period.

### 1st week of test period

---

9. **About how many times did you play Fitogotchi the first week of the experiment?** \*

By number of times you played we mean the number of times you opened the game to play the game on your phone.

---

10. **On average, for how many minutes did you play Fitogotchi each time you played it the first week of the test period?** \*

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## 2nd week of test period

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11. **About how many times did you play Fitogotchi the second week of the experiment?** \*

By number of times you played, we mean the number of times you opened the game to play the game on your phone.

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12. **On average, for how many minutes did you play Fitogotchi each time you played it during the second week of the test period?** \*

---

## Your experiences with Fitogotchi in the test period

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Please answer as precisely as possible.

13. **Answer these statements based on your experience with the game.** \*

*Markér bare én oval per rad*

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I was curious on seeing how my Fitogotchi's appearance would change as I leveled up.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In the beginning of the test period I enjoyed trying to reach new worlds in the game.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In the end of the test period I enjoyed trying to reach new worlds in the game.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I felt I was in control of my actions in the game (the	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



controls where responsive and intuitive).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The game was challenging, but not frustratingly hard.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The game required my full concentration when I played.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I felt I got better at playing the game, the more I played.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I finished the last world of the game (the lava world) early in the test period.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I felt I was able to make progress in the game during the entire testing period.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I liked the universe and the character in the game.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In the beginning of the test period I enjoyed trying to beat my personal best score.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In the end of the test period I enjoyed trying to beat my personal best score.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In the beginning of the test period I enjoyed beating the score of other players on the leaderboard.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In the end of the test period I enjoyed beating the score of other players on the leaderboard.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I enjoyed getting a good score more in Fitogotchi than in other games, because I had exercised to achieve this score.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I enjoyed leveling up my character by performing physical exercise.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In the beginning of the test period I enjoyed playing the game.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In the end of the test period, I enjoyed playing the game.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My desire to get a better score than the other participants motivated me to perform more physical exercise.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My desire to level up the different levels of the character motivated me to perform physical exercise.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My desire to see how the characters' appearance would change when leveling it up motivated me to perform physical exercise.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My desire to reach new worlds in the game motivated me to perform physical exercise.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

During the test period I walked more than normal because I wanted to increase my Fitogotchi's endurance level.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
During the test period I ran more than normal because I wanted to increase my Fitogotchi's dash level.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
During the test period I biked more than normal because I wanted to increase the Fitogotchi's regeneration level.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I felt I was properly rewarded for the physical activity I performed.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I was motivated by the game to perform physical exercise when I started playing the game.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I was motivated by the game to perform physical activity at the end of the test period.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Overall, my physical activity level increased during the test period because of the game.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I enjoyed doing the physical exercise I performed when trying to level up the character.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I got useful tips from the games hints that helped me perform more physical exercise in my everyday life.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I enjoyed performing physical exercises that I normally do not do during the test period.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The game has given me inspiration to perform more physical activity after the test period was over.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe my physical activity level was higher the week after I stopped playing Fitogotchi than the week before I started playing Fitogotchi because the game has changed my physical activity habits.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I performed two or more kinds of physical activities during the test period in order to develop different skills of the character.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I felt that all the Fitogotchi's levels were useful in order to reach my goals in the game.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The game sometimes had an influence on what kind of physical activity I performed during the test period.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## Fitogotchi Technical Part

14. **Did you experience any technical problems that affected the game experience in a negative way? \***

Please describe any technical problems you might have encountered and how it affected your experience with the game.

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15. **Answer these statements on how well the game registered your physical activity. \***

Markér bare én oval per rad

	Too little	Correct amount	Too much
The amount of workout time that was registered by the game when I was walking was	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The amount of workout time that was registered by the game when I ran was	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The amount of workout time that was registered by the game when I biked was	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

16. **Did you register data about running, walking or biking manually in the Google Fit app during the period of the experiment? \***

By registering data manually, I mean that you added data in Google Fit that was not gathered automatically. Either by adding data or starting an activity in the Google Fit application.

Markér bare én oval.

- Yes
- No, Google Fit gathered all my registered fitness data automatically for me.

17. **Did you cheat while playing the game? \***

If you cheated while playing the game, it is totally okey, but it is very important for the results of the research that you answer honest on this question.

Markér bare én oval.

- Never *Hopp til spørsmål 21.*
- Sometimes *Hopp til spørsmål 18.*
- Often *Hopp til spørsmål 18.*
- All the time *Hopp til spørsmål 18.*

*Hopp til spørsmål 21.*

## Cheating

**18. How did you cheat? \***

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**19. Did the cheating involve manually registering data in Google Fit during the play period? \***

By registering data manually, I mean that you added data in Google Fit that was not gathered automatically. Either by adding data or starting an activity in the Google Fit application.

*Markér bare én oval.*

Yes

No

**20. What was your motivation for cheating? \***

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**Feedback**

If you have anything else on your heart, I am very interested in hearing about your opinions about the game and how it can be improved here.

**21. Feedback**

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*Stopp å fylle ut dette skjemaet.*

**Feedback****22. Is there any particular reason you didn't play the game that much? \***

If there is, please explain briefly.

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# Appendix B

## Fitogotchi Questionnaire – Korean

# Fitogotchi

\*Må fylles ut

## 1. 참가자 번호를 입력해주세요. \*

참가자 번호는 게임에 접속하여 "Start" 버튼을 누르면 확인하실 수 있습니다. 참가자 번호는 5글자의 숫자로 구성됩니다. 이 번호는 랜덤으로 부여되며 참가자들의 신분을 확인하는 데에 이용될 수 없음을 알려드립니다.

---

## 개인 정보와 게임 및 운동 관련 평소 습관

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## 2. 성별 \*

Markér bare én oval.

남성

여성

## 3. 여러분의 출생 년도를 입력해주세요. \*

생년월일은 오로지 여러분의 나이를 측정하는 데에 사용됩니다.

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4. 여러분이 태어난 달을 선택해주세요. \*

출생 정보는 오로지 여러분의 나이를 측정하는 데에 사용됩니다.

Markér bare én oval.

- 1월
- 2월
- 3월
- 4월
- 5월
- 6월
- 7월
- 8월
- 9월
- 10월
- 11월
- 12월

## 평소 게임 습관

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시간을 분 단위로 입력하고 싶으신 경우 온점(.)을 이용해주세요. 예) 1.5시간(O) 1시간 30분(X)

5. 일주일에 몇 시간 정도 게임을 하시나요?(스마트폰 게임 제외) \*

여기서 게임이란, 스마트폰 게임을 제외한 컴퓨터 게임 혹은 비디오 게임 콘솔을 말합니다.

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6. 일주일에 몇 시간 정도 스마트폰 게임을 하시나요? \*

실험 기간 이전 여러분의 평소 게임 습관을 말씀해주시면 됩니다.

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## 평소 운동 습관

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시간을 분 단위로 입력하고 싶으신 경우 온점(.)을 이용해주세요. 예) 1.5시간(O) 1시간 30분(X)

7. 일주일에 몇 시간 정도 운동을 하시나요? \*

여기서 운동이란, 여러분의 일상 생활 속에서 필수적으로 이루어지는 신체 활동이 아닌 건강 혹은 운동 자체를 위해 별도로 행하는 신체 활동을 말합니다.

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**8. 주로 어떤 종류의 운동을 하시나요? \***

복수 응답 가능합니다. 해당되는 종류에 모두 체크해주세요. 보기에 있는 운동이 아닌 다른 종류의 운동을 즐겨 하신다면 "기타" 란에 적어주세요. 평소에 운동을 하지 않으신다면 "운동 하지 않음" 항목을 선택하세요.

*Merk av for alt som passer*

- 걷기
- 뛰기
- 자전거 타기
- 축구
- 농구
- 크로스컨트리 스키
- 다운힐 스키
- 댄스
- 근력 운동
- 운동하지 않음
- Andre: \_\_\_\_\_

**9. 실험 기간 동안 Fitogotchi 게임에 대한 의견을 종합할 정도로 게임을 충분히 플레이하셨나요? \***

게임을 설치하지 못하셨거나, 다른 이유로 게임에 대한 의견을 종합할 만큼 충분히 플레이하지 못하셨다면, "아니오"를 선택해주세요.

*Markér bare én oval.*

- 예
- 아니오 *Hopp til spørsmål 23.*

**Fitogotchi에 관한 경험**

실험 기간 동안 참가자 분들의 Fitogotchi 게임 관련 경험에 대해 답해주세요.

**게임 플레이 기간의 첫째 주**

---

**10. 게임 플레이 기간의 첫째 주 동안 대략 몇 번 정도 게임을 하셨나요? \***

이 때 게임 플레이 횟수는 게임을 몇 판 했는지가 아닌 '게임을 플레이하기 위해 게임에 접속한 횟수'를 말합니다.

\_\_\_\_\_

**11. 게임 플레이 기간의 첫째 주에 한 번 접속하실 때마다 평균적으로 몇 분 동안 플레이하셨나요? \***

\_\_\_\_\_

**게임 플레이 기간의 둘째 주**

---

12. 게임 플레이 기간의 둘째 주 동안 대략 몇 번 정도 게임을 하셨나요? \*

이 때 게임 플레이 횟수는 게임을 몇 판 했는지가 아닌 '게임을 플레이하기 위해 게임에 접속한 횟수'를 말합니다.

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13. 게임 플레이 기간의 둘째 주에 한 번 접속하실 때마다 평균적으로 몇 분 동안 플레이하셨나요? \*

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## 실험 기간 동안 Fitogotchi 관련 경험 조사

최대한 솔직하게 답변해주세요.

14. Fitogotchi 게임 플레이 경험을 토대로 아래의 문장들에 답해주세요. \*

Markér bare én oval per rad

	절대 동의하지 않는다	동의하지 않는다	그저 그렇다	동의한다	정말 동의한다
레벨업한 후 Fitogotchi의 모습이 어떨지 궁금했다.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
게임 플레이 기간이 시작되었을 때 게임에서 새로운 맵에 도달하는 것이 즐거웠다.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
게임 플레이 기간이 끝날 무렵에 새로운 맵에 도달하는 것이 즐거웠다.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
나의 의지대로 게임을 컨트롤하기가 전반적으로 수월했다.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
게임은 도전적이었지만, 좌절감을 느낄 정도로 어렵지는 않았다.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
게임을 할 때 게임에 온전히 집중해야 했다.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
게임을 플레이하면 할수록 게임 실력을 향상시킬 수 있었다.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
게임 플레이 기간 초기에 마지막 맵(용암 맵)에 도달했다.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
게임 플레이 기간 동안 캐릭터 레벨업, 높은 점수 획득 혹은 새로운 맵 체험 등 게임 속 어떠한 요소를 계속해서 발전시킬 수 있었다.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
게임의 캐릭터와 전체적인 테마가 마음에 들었다.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
게임 플레이 기간 초기에 나 자신의 최고 기록을 갱신하는 것이 즐거웠다.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
게임 플레이 기간이 끝날 무렵에 나 자신의 최고 기록을 갱신하는	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

것이 즐거웠다.					
게임 플레이 기간 초기에 랭킹에서 다른 플레이어들의 최고 기록을 깨는 것이 즐거웠다.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
게임 플레이 기간이 끝날 무렵에 랭킹에서 다른 플레이어들의 최고 기록을 깨는 것이 즐거웠다.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fitogotchi 게임에서 점수를 얻기 위해서는 운동을 해야하기 때문에 다른 게임보다 Fitogotchi 게임에서 좋은 점수를 얻는 것이 더 즐거웠다.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
신체 활동을 통해 캐릭터를 레벨업하는 것이 즐거웠다.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
게임 플레이 기간이 시작되었을 때, 게임을 플레이하는 것이 즐거웠다.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
게임 플레이 기간이 끝날 무렵에도 여전히 게임을 플레이하는 것이 즐거웠다.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
다른 참가자들보다 더 높은 점수를 얻는 것이 운동에 대한 동기 부여가 되었다.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
캐릭터의 하위 레벨들을 향상시키기 위한 욕구가 운동을 하는데 동기부여가 되었다.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
레벨업 후 캐릭터의 변화된 모습을 보고 싶어하는 것에 대한 욕구가 운동을 하는데 동기부여가 되었다.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
새로운 맵에 도달하고자 하는 욕구가 운동에 대한 동기부여가 되었다.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
게임 플레이 기간 동안 Fitogotchi의 Endurance Level을 올리기 위해 평소보다 더 많이 걸었다.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
게임 플레이 기간 동안 Fitogotchi의 Dash Level을 올리기 위해 평소보다 더 많이 뛰었다	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
게임 플레이 기간 동안 Fitogotchi의 Regeneration Level을 올리기 위해 평소보다 자전거를 더 많이 탔다.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
게임 내에서 운동량에 따른 보상이 적절하다고 느꼈다.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
게임을 처음 시작했을 때 이 게임이 운동을 하는데 대한 동기부여가 되었다.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
게임 플레이 기간이 끝날 무렵에 게임이 운동을 하는데 대한 동기부여가 되었다.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
게임 플레이 기간 동안 게임으로 인해 나의 전반적인 신체 활동 지수가 향상되었다.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

캐릭터를 레벨업시키기 위해 운동하는 것이 즐거웠다.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
게임 내 몇몇 힌트들은 일상생활 속에서 운동을 더 많이 하는 데에 대한 유용한 팁이 되었다.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
게임 플레이 기간 동안 평소에 주로 하지 않는 운동을 즐겨 했다.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
이 게임은 실험 기간이 끝난 후에 운동을 더 많이 하도록 동기 부여가 되었다.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fitogotchi 게임이 나의 운동 습관을 바꾸었기 때문에 게임 플레이 기간 전보다 게임 플레이 기간이 끝난 후에 나의 신체 활동 지수가 향상되었다고 생각한다.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
게임 플레이 기간 동안 캐릭터의 하위 레벨들을 향상시키기 위해 뛰거나 자전거 타기 운동을 하였다.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fitogotchi의 하위 레벨들 모두가 게임에서 나의 목적을 도달하는 데에 유용하게 느껴졌다.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
게임 플레이 기간 동안 게임이 나의 신체 활동의 종류에 영향을 끼쳤다.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## Fitogotchi 게임의 기술적인 부분

**15. 게임에 부정적인 영향을 미쳤던 기술적인 문제들을 경험한 적이 있으신가요? \***

경험하셨던 게임 내 버그와 해당 버그가 게임 플레이에 미쳤던 영향을 적어주세요.

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**16. 게임이 운동량을 정확하게 측정하여 가져왔는지에 대한 질문들에 답해주세요. \***

*Markér bare én oval per rad*

	적다	적당하다	많다
게임이 측정한 걷기 운동량 데이터가 실제 걷기 운동량에 비해	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
게임이 측정한 뛰기 운동량 데이터가 실제 뛰기 운동량에 비해	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
게임이 측정한 자전거 타기 운동량 데이터가 실제 자전거 타기 운동량에 비해	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

17. 실험 기간 동안 걷기, 뛰기, 자전거 타기에 대한 데이터를 Google Fit 앱에 직접 등록하셨나요? \*

이 때 데이터를 직접 등록하는 것이란, Google Fit 앱이 자동적으로 수집하지 않은 데이터를 여러분이 직접 추가하거나 Google Fit 앱에서 '활동 시작' 버튼을 따로 눌러서 측정하게 하는 것을 말합니다.

Markér bare én oval.

- 예
- 아니오, Google Fit 앱이 모든 운동 데이터를 자동으로 가져왔습니다.

18. 게임을 하실 때 속임수를 쓰셨나요? \*

게임을 하실 때 속임수를 쓰셨더라도 이것이 전혀 문제가 되지 않습니다. 하지만 이는 연구 결과에 중요한 영향을 끼치므로 최대한 솔직히 답변해 주시면 정말 감사하겠습니다.

Markér bare én oval.

- 전혀 없음      Hopp til spørsmål 22.
- 가끔 속임수를 썼음      Hopp til spørsmål 19.
- 자주 속임수를 썼음      Hopp til spørsmål 19.
- 항상 속임수를 썼음      Hopp til spørsmål 19.

Hopp til spørsmål 22.

## 속임수

19. 어떤 방식으로 속임수를 쓰셨나요? \*

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20. 실험 기간 동안 사용하신 속임수중 Google Fit 앱에 운동 데이터를 직접 등록하는 방법이 포함되나요? \*

이 때 데이터를 직접 등록하는 것이란, Google Fit 앱이 자동적으로 수집하지 않은 데이터를 여러분이 직접 추가하거나 Google Fit 앱에서 '활동 시작' 버튼을 따로 눌러서 측정하게 하는 것을 말합니다.

Markér bare én oval.

- 예
- 아니오

21. 속임수를 사용한 이유가 무엇인가요? \*

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## 피드백

게임의 개선 사항 혹은 게임에 관한 기타 의견이 있으시면 적어주세요.

## 22. 피드백

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*Stopp å fylle ut dette skjemaet.*

## 피드백

23. 게임에 대한 의견을 종합할 만큼 충분히 플레이하지 못하신 이유가 무엇인가요? \*

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Drevet av  
 Google Forms





# Appendix C

## Detailed Questionnaire Results – Norway

When calculating the distribution of the answers from the questionnaire, the percentage of participants that disagreed was calculated and then rounded to the nearest decimal in one decimal place. This was also done for participants that answered strongly disagree, neutral, agree and strongly agree. As each response was rounded separately, the total of all the responses from one question will not necessarily be exactly 100%.

ID	Statement	SD	D	N	A	SA
S1	I was curious on seeing how my Fitogotchi's appearance would change as I leveled up.	0.0%	4.8%	14.3%	61.9%	19.0%
S2	In the beginning of the test period I enjoyed trying to reach new worlds in the game.	0.0%	9.5%	4.8%	38.1%	47.6%
S3	In the end of the test period I enjoyed trying to reach new worlds in the game.	0.0%	19.0%	9.5%	38.1%	33.3%
S4	I felt I was in control of my actions in the game (the controls where responsive and intuitive).	0.0%	0.0%	28.6%	47.6%	23.8%

<b>S5</b>	The game was challenging, but not frustratingly hard.	4.8%	4.8%	4.8%	57.1%	28.6%
<b>S6</b>	The game required my full concentration when I played.	0.0%	9.5%	14.3%	28.6%	47.6%
<b>S7</b>	I felt I got better at playing the game, the more I played.	0.0%	4.8%	0.0%	61.9%	33.3%
<b>S8</b>	I finished the last world of the game (the lava world) early in the test period.	85.7%	4.8%	4.8%	4.8%	0.0%
<b>S9</b>	I felt I was able to make progress in the game during the entire testing period.	0.0%	23.8%	9.5%	52.4%	14.3%
<b>S10</b>	I liked the universe and the character in the game.	4.8%	0.0%	33.3%	33.3%	28.6%
<b>S11</b>	In the beginning of the test period I enjoyed trying to beat my personal best score.	0.0%	0.0%	9.5%	38.1%	52.4%
<b>S12</b>	In the end of the test period I enjoyed trying to beat my personal best score.	0.0%	9.5%	4.8%	42.9%	42.9%
<b>S13</b>	In the beginning of the test period I enjoyed beating the score of other players on the leaderboard.	0.0%	0.0%	9.5%	33.3%	57.1%
<b>S14</b>	In the end of the test period I enjoyed beating the score of other players on the leaderboard.	4.8%	4.8%	9.5%	38.1%	42.9%

<b>S15</b>	I enjoyed getting a good score more in Fitogotchi than in other games, because I had exercised to achieve this score.	14.3%	19.0%	28.6%	23.8%	14.3%
<b>S16</b>	I enjoyed leveling up my character by performing physical exercise.	0.0%	9.5%	14.3%	38.1%	38.1%
<b>S17</b>	In the beginning of the test period I enjoyed playing the game.	4.8%	0.0%	28.6%	28.6%	38.1%
<b>S18</b>	In the end of the test period, I enjoyed playing the game.	0.0%	9.5%	28.6%	23.8%	38.1%

Table C.1: The results from statements related enjoyment.

<b>ID</b>	<b>Statement</b>	<b>SD</b>	<b>D</b>	<b>N</b>	<b>A</b>	<b>SA</b>
<b>S19</b>	My desire to get a better score than the other participants motivated me to perform more physical exercise.	0.0%	28.6%	23.8%	33.3%	14.3%
<b>S20</b>	My desire to level up the different levels of the character motivated me to perform physical exercise.	0.0%	9.5%	23.8%	42.9%	23.8%
<b>S21</b>	My desire to see how the characters' appearance would change when leveling it up motivated me to perform physical exercise.	0.0%	23.8%	38.1%	33.3%	4.8%

<b>S22</b>	My desire to reach new worlds in the game motivated me to perform physical exercise.	4.8%	23.8%	28.6%	28.6%	14.3%
<b>S23</b>	During the test period I walked more than normal because I wanted to increase my Fitogotchi's endurance level.	4.8%	19.0%	19.0%	38.1%	19.0%
<b>S24</b>	During the test period I ran more than normal because I wanted to increase my Fitogotchi's dash level.	23.8%	23.8%	28.6%	19.0%	4.8%
<b>S25</b>	During the test period I biked more than normal because I wanted to increase the Fitogotchi's regeneration level.	38.1%	19.0%	19.0%	23.8%	0.0%
<b>S26</b>	I felt I was properly rewarded for the physical activity I performed.	0.0%	14.3%	9.5%	47.6%	28.6%
<b>S27</b>	I was motivated by the game to perform physical exercise when I started playing the game.	0.0%	23.8%	28.6%	38.1%	9.5%
<b>S28</b>	I was motivated by the game to perform physical activity at the end of the test period.	4.8%	19.0%	33.3%	23.8%	19.0%
<b>S29</b>	Overall, my physical activity level increased during the test period because of the game.	9.5%	23.8%	19.0%	28.6%	19.0%

<b>S30</b>	I enjoyed doing the physical exercise I performed when trying to level up the character.	9.5%	14.3%	9.5%	47.6%	19.0%
<b>S31</b>	I got useful tips from the games hints that helped me perform more physical exercise in my everyday life.	9.5%	19.0%	42.9%	19.0%	9.5%

Table C.2: The results from statements related to the game’s ability to motivate players to exercise.

<b>ID</b>	<b>Statement</b>	<b>SD</b>	<b>D</b>	<b>N</b>	<b>A</b>	<b>SA</b>
<b>S23</b>	During the test period I walked more than normal because I wanted to increase my Fitogotchi’s endurance level.	4.8%	19.0%	19.0%	38.1%	19.0%
<b>S24</b>	During the test period I ran more than normal because I wanted to increase my Fitogotchi’s dash level.	23.8%	23.8%	28.6%	19.0%	4.8%
<b>S25</b>	During the test period I biked more than normal because I wanted to increase the Fitogotchi’s regeneration level.	38.1%	19.0%	19.0%	23.8%	0.0%
<b>S35</b>	I performed two or more kinds of physical activities during the test period in order to develop different skills of the character.	19.0%	9.5%	19.0%	23.8%	28.6%

<b>S36</b>	I felt that all the Fito-gotchi's levels were useful in order to reach my goals in the game.	9.5%	14.3%	14.3%	33.3%	28.6%
<b>S37</b>	The game sometimes had an influence on what kind of physical activity I performed during the test period.	14.3%	23.8%	19.0%	33.3%	9.5%

Table C.3: The results from statements related to the game effects on players' type of physical activity.

<b>ID</b>	<b>Statement</b>	<b>SD</b>	<b>D</b>	<b>N</b>	<b>A</b>	<b>SA</b>
<b>S31</b>	I got useful tips from the games hints that helped me perform more physical exercise in my everyday life.	9.5%	19.0%	42.9%	19.0%	9.5%
<b>S32</b>	I enjoyed performing physical exercises that I normally do not do during the test period.	19.0%	19.0%	38.1%	23.8%	0.0%
<b>S33</b>	The game has given me inspiration to perform more physical activity after the test period was over.	9.5%	47.6%	23.8%	14.3%	4.8%
<b>S34</b>	I believe my physical activity level was higher the week after I stopped playing Fito-gotchi than the week before I started playing Fito-gotchi because the game has changed my physical activity habits.	19.0%	42.9%	14.3%	9.5%	14.3%

Table C.4: The results from statements related to the after effects of the game.





# Appendix D

## Detailed Questionnaire Results – Korea

When calculating the distribution of the answers from the questionnaire, the percentage of participants that disagreed was calculated and then rounded to the nearest decimal in one decimal place. This was also done for participants that answered strongly disagree, neutral, agree and strongly agree. As each response was rounded separately, the total of all the responses from one question will not necessarily be exactly 100%.

ID	Statement	SD	D	N	A	SA
S1	I was curious on seeing how my Fitogotchi's appearance would change as I leveled up.	0.0%	0.0%	31.8%	45.5%	22.7%
S2	In the beginning of the test period I enjoyed trying to reach new worlds in the game.	0.0%	0.0%	9.1%	63.6%	27.3%
S3	In the end of the test period I enjoyed trying to reach new worlds in the game.	0.0%	0.0%	22.7%	54.5%	22.7%
S4	I felt I was in control of my actions in the game (the controls where responsive and intuitive).	0.0%	4.5%	22.7%	59.1%	13.6%

<b>S5</b>	The game was challenging, but not frustratingly hard.	4.5%	0.0%	9.1%	54.5%	31.8%
<b>S6</b>	The game required my full concentration when I played.	0.0%	9.1%	18.2%	40.9%	31.8%
<b>S7</b>	I felt I got better at playing the game, the more I played.	0.0%	4.5%	18.2%	36.4%	40.9%
<b>S8</b>	I finished the last world of the game (the lava world) early in the test period.	45.5%	50.0%	0.0%	4.5%	0.0%
<b>S9</b>	I felt I was able to make progress in the game during the entire testing period.	0.0%	9.1%	22.7%	54.5%	13.6%
<b>S10</b>	I liked the universe and the character in the game.	4.5%	4.5%	50.0%	36.4%	4.5%
<b>S11</b>	In the beginning of the test period I enjoyed trying to beat my personal best score.	0.0%	0.0%	4.5%	40.9%	54.5%
<b>S12</b>	In the end of the test period I enjoyed trying to beat my personal best score.	0.0%	9.1%	9.1%	36.4%	45.5%
<b>S13</b>	In the beginning of the test period I enjoyed beating the score of other players on the leaderboard.	0.0%	0.0%	9.1%	45.5%	45.5%
<b>S14</b>	In the end of the test period I enjoyed beating the score of other players on the leaderboard.	4.5%	13.6%	9.1%	40.9%	31.8%

<b>S15</b>	I enjoyed getting a good score more in Fitogotchi than in other games, because I had exercised to achieve this score.	0.0%	9.1%	50.0%	31.8%	9.1%
<b>S16</b>	I enjoyed leveling up my character by performing physical exercise.	0.0%	4.5%	27.3%	40.9%	27.3%
<b>S17</b>	In the beginning of the test period I enjoyed playing the game.	0.0%	4.5%	13.6%	59.1%	22.7%
<b>S18</b>	In the end of the test period, I enjoyed playing the game.	0.0%	9.1%	36.4%	31.8%	22.7%

Table D.1: The results from statements related player enjoyment.

<b>ID</b>	<b>Statement</b>	<b>SD</b>	<b>D</b>	<b>N</b>	<b>A</b>	<b>SA</b>
<b>S19</b>	My desire to get a better score than the other participants motivated me to perform more physical exercise.	0.0%	9.1%	27.3%	40.9%	22.7%
<b>S20</b>	My desire to level up the different levels of the character motivated me to perform physical exercise.	0.0%	18.2%	31.8%	40.9%	9.1%
<b>S21</b>	My desire to see how the characters' appearance would change when leveling it up motivated me to perform physical exercise.	4.5%	4.5%	45.5%	31.8%	13.6%

<b>S22</b>	My desire to reach new worlds in the game motivated me to perform physical exercise.	0.0%	13.6%	31.8%	45.5%	9.1%
<b>S23</b>	During the test period I walked more than normal because I wanted to increase my Fitogotchi's endurance level.	0.0%	0.0%	31.8%	36.4%	31.8%
<b>S24</b>	During the test period I ran more than normal because I wanted to increase my Fitogotchi's dash level.	9.1%	22.7%	40.9%	22.7%	4.5%
<b>S25</b>	During the test period I biked more than normal because I wanted to increase the Fitogotchi's regeneration level.	18.2%	36.4%	31.8%	9.1%	4.5%
<b>S26</b>	I felt I was properly rewarded for the physical activity I performed.	0.0%	0.0%	40.9%	45.5%	13.6%
<b>S27</b>	I was motivated by the game to perform physical exercise when I started playing the game.	0.0%	9.1%	31.8%	50.0%	9.1%
<b>S28</b>	I was motivated by the game to perform physical activity at the end of the test period.	4.5%	9.1%	59.1%	22.7%	4.5%
<b>S29</b>	Overall, my physical activity level increased during the test period because of the game.	0.0%	13.6%	50.0%	36.4%	0.0%

<b>S30</b>	I enjoyed doing the physical exercise I performed when trying to level up the character.	0.0%	9.1%	31.8%	45.5%	13.6%
<b>S31</b>	I got useful tips from the games' hints that helped me perform more physical exercise in my everyday life.	18.2%	13.6%	40.9%	22.7%	4.5%

Table D.2: The results from statements related to motivation to perform exercise.

<b>ID</b>	<b>Statement</b>	<b>SD</b>	<b>D</b>	<b>N</b>	<b>A</b>	<b>SA</b>
<b>S23</b>	During the test period I walked more than normal because I wanted to increase my Fitogotchi's endurance level.	0.0%	0.0%	31.8%	36.4%	31.8%
<b>S24</b>	During the test period I ran more than normal because I wanted to increase my Fitogotchi's dash level.	9.1%	22.7%	40.9%	22.7%	4.5%
<b>S25</b>	During the test period I biked more than normal because I wanted to increase the Fitogotchi's regeneration level.	18.2%	36.4%	31.8%	9.1%	4.5%
<b>S35</b>	I performed two or more kinds of physical activities during the test period in order to develop different skills of the character.	18.2%	22.7%	22.7%	31.8%	4.5%

<b>S36</b>	I felt that all the Fito-gotchi's levels were useful in order to reach my goals in the game.	0.0%	9.1%	36.4%	36.4%	18.2%
<b>S37</b>	The game sometimes had an influence on what kind of physical activity I performed during the test period.	9.1%	0.0%	27.3%	45.5%	18.2%

Table D.3: The results from statements related to the game effects on players' type of physical activity.

<b>ID</b>	<b>Statement</b>	<b>SD</b>	<b>D</b>	<b>N</b>	<b>A</b>	<b>SA</b>
<b>S31</b>	I got useful tips from the games hints that helped me perform more physical exercise in my everyday life.	18.2%	13.6%	40.9%	22.7%	4.5%
<b>S32</b>	I enjoyed performing physical exercises that I normally do not do during the test period.	9.1%	54.5%	22.7%	13.6%	0.0%
<b>S33</b>	The game has given me inspiration to perform more physical activity after the test period was over.	13.6%	36.4%	22.7%	27.3%	0.0%
<b>S34</b>	I believe my physical activity level was higher the week after I stopped playing Fito-gotchi than the week before I started playing Fito-gotchi because the game has changed my physical activity habits.	13.6%	18.2%	27.3%	31.8%	9.1%

Table D.4: The results from statements related the after effects of the game.





# Appendix E

## Detailed Questionnaire Results – Total

When calculating the distribution of the answers from the questionnaire, the percentage of participants that disagreed was calculated and then rounded to the nearest decimal in one decimal place. This was also done for participants that answered strongly disagree, neutral, agree and strongly agree. As each response was rounded separately, the total of all the responses from one question will not necessarily be exactly 100%.

ID	Statement	SD	D	N	A	SA
S1	I was curious on seeing how my Fitogotchi's appearance would change as I leveled up.	0.0%	2.3%	23.3%	53.5%	20.9%
S2	In the beginning of the test period I enjoyed trying to reach new worlds in the game.	0.0%	4.7%	7.0%	51.2%	37.2%
S3	In the end of the test period I enjoyed trying to reach new worlds in the game.	0.0%	13.3%	20.0%	40.0%	26.7%
S4	I felt I was in control of my actions in the game (the controls where responsive and intuitive).	0.0%	2.3%	25.6%	53.5%	18.6%

<b>S5</b>	The game was challenging, but not frustratingly hard.	4.7%	2.3%	7.0%	55.8%	30.2%
<b>S6</b>	The game required my full concentration when I played.	0.0%	9.3%	16.3%	34.9%	39.5%
<b>S7</b>	I felt I got better at playing the game, the more I played.	0.0%	4.7%	9.3%	48.8%	37.2%
<b>S8</b>	I finished the last world of the game (the lava world) early in the test period.	65.1%	27.9%	2.3%	4.7%	0.0%
<b>S9</b>	I felt I was able to make progress in the game during the entire testing period.	0.0%	16.3%	16.3%	53.5%	14.0%
<b>S10</b>	I liked the universe and the character in the game.	4.7%	2.3%	41.9%	34.9%	16.3%
<b>S11</b>	In the beginning of the test period I enjoyed trying to beat my personal best score.	0.0%	0.0%	7.0%	39.5%	53.5%
<b>S12</b>	In the end of the test period I enjoyed trying to beat my personal best score.	0.0%	9.3%	7.0%	39.5%	44.2%
<b>S13</b>	In the beginning of the test period I enjoyed beating the score of other players on the leaderboard.	0.0%	0.0%	9.3%	39.5%	51.2%
<b>S14</b>	In the end of the test period I enjoyed beating the score of other players on the leaderboard.	4.7%	9.3%	9.3%	39.5%	37.2%

<b>S15</b>	I enjoyed getting a good score more in Fitogotchi than in other games, because I had exercised to achieve this score.	7.0%	14.0%	39.5%	27.9%	11.6%
<b>S16</b>	I enjoyed leveling up my character by performing physical exercise.	0.0%	7.0%	20.9%	39.5%	32.6%
<b>S17</b>	In the beginning of the test period I enjoyed playing the game.	2.3%	2.3%	20.9%	44.2%	30.2%
<b>S18</b>	In the end of the test period, I enjoyed playing the game.	0.0%	9.3%	32.6%	27.9%	30.2%

Table E.1: The results from statements related to enjoyment.

<b>ID</b>	<b>Statement</b>	<b>SD</b>	<b>D</b>	<b>N</b>	<b>A</b>	<b>SA</b>
<b>S19</b>	My desire to get a better score than the other participants motivated me to perform more physical exercise.	0.0%	18.6%	25.6%	37.2%	18.6%
<b>S20</b>	My desire to level up the different levels of the character motivated me to perform physical exercise.	0.0%	14.0%	27.9%	41.9%	16.3%
<b>S21</b>	My desire to see how the characters' appearance would change when leveling it up motivated me to perform physical exercise.	2.3%	14.0%	41.9%	32.6%	9.3%

<b>S22</b>	My desire to reach new worlds in the game motivated me to perform physical exercise.	2.3%	18.6%	30.2%	37.2%	11.6%
<b>S23</b>	During the test period I walked more than normal because I wanted to increase my Fitogotchi's endurance level.	2.3%	9.3%	25.6%	37.2%	25.6%
<b>S24</b>	During the test period I ran more than normal because I wanted to increase my Fitogotchi's dash level.	16.3%	23.3%	34.9%	20.9%	4.7%
<b>S25</b>	During the test period I biked more than normal because I wanted to increase the Fitogotchi's regeneration level.	27.9%	27.9%	25.6%	16.3%	2.3%
<b>S26</b>	I felt I was properly rewarded for the physical activity I performed.	0.0%	7.0%	25.6%	46.5%	20.9%
<b>S27</b>	I was motivated by the game to perform physical exercise when I started playing the game.	0.0%	16.3%	30.2%	44.2%	9.3%
<b>S28</b>	I was motivated by the game to perform physical activity at the end of the test period.	4.7%	14.0%	46.5%	23.3%	11.6%
<b>S29</b>	Overall, my physical activity level increased during the test period because of the game.	4.7%	18.6%	34.9%	32.6%	9.3%

<b>S30</b>	I enjoyed doing the physical exercise I performed when trying to level up the character.	4.7%	11.6%	20.9%	46.5%	16.3%
<b>S31</b>	I got useful tips from the games hints that helped me perform more physical exercise in my everyday life.	14.0%	16.3%	41.9%	20.9%	7.0%

Table E.2: The results from statements related to motivation to exercise.

<b>ID</b>	<b>Statement</b>	<b>SD</b>	<b>D</b>	<b>N</b>	<b>A</b>	<b>SA</b>
<b>S23</b>	During the test period I walked more than normal because I wanted to increase my Fitogotchi's endurance level.	2.3%	9.3%	25.6%	37.2%	25.6%
<b>S24</b>	During the test period I ran more than normal because I wanted to increase my Fitogotchi's dash level.	16.3%	23.3%	34.9%	20.9%	4.7%
<b>S25</b>	During the test period I biked more than normal because I wanted to increase the Fitogotchi's regeneration level.	27.9%	27.9%	25.6%	16.3%	2.3%
<b>S35</b>	I performed two or more kinds of physical activities during the test period in order to develop different skills of the character.	18.6%	16.3%	20.9%	27.9%	16.3%
<b>S36</b>	I felt that all the Fitogotchi's levels were useful in order to reach my goals in the game.	4.7%	11.6%	25.6%	34.9%	23.3%
<b>S37</b>	The game sometimes had an influence on what kind of physical activity I performed during the test period.	11.6%	11.6%	23.3%	39.5%	14.0%

Table E.3: The results from statements related to the game effects on players' type of physical activity.

<b>ID</b>	<b>Statement</b>	<b>SD</b>	<b>D</b>	<b>N</b>	<b>A</b>	<b>SA</b>
<b>S31</b>	I got useful tips from the games hints that helped me perform more physical exercise in my everyday life.	14.0%	16.3%	41.9%	20.9%	7.0%
<b>S32</b>	I enjoyed performing physical exercises that I normally do not do during the test period.	14.0%	37.2%	30.2%	18.6%	0.0%
<b>S33</b>	The game has given me inspiration to perform more physical activity after the test period was over.	11.6%	41.9%	23.3%	20.9%	2.3%
<b>S34</b>	I believe my physical activity level was higher the week after I stopped playing Fitogotchi than the week before I started playing Fitogotchi because the game has changed my physical activity habits.	16.3%	30.2%	20.9%	20.9%	11.6%

Table E.4: The results from statements related the after effects of the game.

# Appendix F

## Subject Agreement Contract – Norway

# Forespørsel om deltakelse i forskningsprosjekt

## **Bakgrunn og formål**

Formålet med studien er å undersøke om et dataspill kan endre personers vaner når det kommer til fysisk aktivitet. Et spill som oppfordrer fysisk aktivitet, et såkalt exergame, skal testes. Forsøket gjennomføres i forbindelse med en masterstudie ved institutt for datateknologi og informatikk(IDI), NTNU.

Deltakerne trenger en Android telefon som er 2 år eller nyere eller en 3 år eller nyere high-end Android telefon for å delta i studien. Det er også et krav at deltakerne er i stand til å utføre fysisk aktivitet som gåing, løping og/eller sykling.

## **Hva innebærer deltakelse i studien?**

Forsøket vil ha en varighet på 4 uker.

*Uke 1:* deltakerne kreves kun å ha Google Fit, en applikasjon som blant annet registrerer tiden løpt, syklet og gått mens telefonen er i lommen, installert og aktivert på telefonen sin. Dataen samlet av Google Fit iløpet av forsøkets 4 uker vil bli samlet inn ved eksperimentets slutt. Formålet med innsamlingen av aktivitetsdata i denne perioden er å kunne sammenligne treningsvaner før, under og etter spillet spilles.

*Uke 2 og 3:* deltakerne får tilsendt spillet og blir bedt om å installere det på telefonen. Det er forventet at deltakerne prøver spillet, men deltakerne spiller spillet i ønsket mengde iløpet av denne toukers perioden. Iløpet av denne perioden kan enkelte deltakere bli forespurt å stille opp på et skype-intervju for å fortelle om deres erfaringer med spillet. Det vil være frivillig å akseptere denne forespørselen. Ved denne periodens slutt, vil deltakerne bli spurt om å fylle inn en spørreundersøkelse som samler inn data om deltakernes kjønn, alder, treningsvaner, dataspillvaner og erfaringer gjort med spillet under testperioden.

*Uke 4:* spillet vil bli deaktivert, og det vil bli en uke til hvor Google Fit samler inn data om ditt aktivitetsnivå uten at du spiller spillet. I slutten av perioden bes deltakerne om å sende inn dataene samlet inn av Google Fit iløpet av hele perioden forsøket har pågått. Disse dataene består av tiden du som deltaker har gått, løpt og syklet iløpet perioden forsøket vil pågå, samt et estimat av ditt kaloriforbruk mens disse aktivitetene ble utført i perioden. Dataene vil bli samlet inn anonymt.

## **Hva skjer med informasjonen om deg?**

Alle personopplysninger vil bli behandlet konfidensielt. Anonymisert statistikk fra eksperimentet vil bli offentliggjort i masteroppgaven. Det vil aldri være mulig å gjenkjenne deltakerne i publikasjonen.



### **Frivillig deltakelse**

Det er frivillig å delta i studien, og du kan når som helst trekke ditt samtykke uten å oppgi noen grunn. Dersom du trekker deg, vil alle opplysninger om deg bli anonymisert.

Dersom du ønsker å delta eller har spørsmål til studien, ta kontakt med Jonas Andre Dalseth (e-post: [jonas.dalseth@gmail.com](mailto:jonas.dalseth@gmail.com), tlf: +82 10 4979 6109 (Sør-Koreansk nummer grunnet at oppgaven skrives i Sør-Korea)) eller veileder Alf Inge Wang (e-post: [alf.inge.wang@ntnu.no](mailto:alf.inge.wang@ntnu.no)).

### **Samtykke til deltakelse i studien**

Jeg har mottatt informasjon om studien, og er villig til å delta

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(Signert av prosjektdeltaker, dato)



# Appendix G

## Subject Agreement Contract – Korea

# 연구대상자용 설명문 및 동의서 ver 2.0

## (인간대상연구용)

### 연구대상자 설명서

연구제목: 액서게임이 현대인의 운동 습관에 미치는 영향

본 연구는 액서게임이 현대인의 운동 습관에 미치는 영향에 대한 연구입니다. 귀하는 본 연구에 참여할 것인지 여부를 결정하기 전에, 설명서와 동의서를 신중하게 읽어보셔야 합니다. 이 연구가 왜 수행되며, 무엇을 수행하는지 귀하가 이해하는 것이 중요합니다. 이 연구를 수행하는 고박우 연구책임자 또는 Jonas Andre Dalseth 연구원이 귀하에게 이 연구에 대해 설명해 줄 것입니다. 이 연구는 자발적으로 참여 의사를 밝히신 분에 한하여 수행 될 것입니다. 다음 내용을 신중히 읽어보신 후 참여 의사를 밝혀 주시길 바라며, 필요하다면 가족이나 친구들과 의논해 보십시오. 만일 어떠한 질문이 있다면 담당 연구원이 자세하게 설명해 줄 것입니다.

귀하의 서명은 귀하가 본 연구에 대해 그리고 위험성에 대해 설명을 들었음을 의미하며, 이 문서에 대한 귀하의 서명은 귀하께서 자신(또는 법정대리인)이 본 연구에 참가를 원한다는 것을 의미합니다.

#### 1. 연구의 배경과 목적

신체 활동의 결핍으로 인한 건강상의 문제가 점차 중요한 화두로 선정됨에 따라 현대인들의 신체 활동을 장려하는 다양한 방법들이 논의되고 있습니다. 이러한 현상에 착안하여 액서게임 (Exergame) 컨셉이 신체 활동 습관 형성에 미치는 영향을 연구하여 사용자의 스마트폰 게임이 해당 문제를 해결하는 데 기여할 수 있다는 것을 제안하고자 합니다.

액서게임이란, 게임 플레이와 신체 활동을 중심 요소로 병합한 게임을 말합니다. 현재 이미 게임플레이와 신체 활동을 통합한 다양한 게임들이 개발되어 있습니다. 하지만 대다수 게임의 경우 흥미롭지 않거나 혹은 사용자들에게 충분한 신체 활동을 장려할 만큼 엄격하지 않습니다. 따라서 게임의 흥미와 신체 활동의 강도를 적절히 조정하여 사용자들의 신체 활동을 유도하고자 합니다.

#### 2. 연구 참여 대상

2015 년 1 월 이후 출시된 최신 안드로이드 기반 스마트폰을 사용하는 만 19 세 이상 30 세 이하 건국대학교 학생 30 명. 추가로, 김형석 교수님과 고박우 연구 책임자의 학생들은 실험에 참여할 수 없음

#### 3. 연구 방법

총 실험 기간: 4 주

1 주차: 실험 참가자들은 구글 Fit 을 스마트폰에 설치합니다. 구글 Fit 은 4 주라는 전체 실험 기간 동안 참가자들의 일상 생활 속 신체 활동 관련 데이터를 수집하는 데 이용될 것입니다. 수집되는 구글 Fit 데이터는 구체적으로 활동 시간, 활동 거리, 칼로리 소모량, 걸음 수 입니다. 또한 해당 신체 활동에는 걷기, 뛰기와 자전거 타기 등 본 실험에서 측정되는 활동 등을 포함합니다.

2주차, 3주차: 구글 Fit을 설치한 후, 실험 참가자들은 Fitogotchi 게임을 설치하고 게임 방법에 대한 정보를 제공받을 것입니다. 2주 동안 게임을 플레이한 후, 참가자들은 게임 플레이를 중단하셔야 합니다. 이 때, 게임 플레이와 신체 활동은 별도의 실험실 없이 참가자들의 일상 생활 속에서 이루어집니다.

이 단계가 마무리되면 참가자들은 해당 단계에서의 게임 플레이 경험에 대한 설문조사를 작성

하게 될 것입니다. 또한 해당 기간 동안 몇몇 참가자들은 조금 더 심도 있는 인터뷰 참여 요청을 받을 수도 있습니다.

4주차: 게임 플레이를 중단 1주일 후, 참가자들의 구글Fit 건강 데이터를 수집할 것입니다. 이는 게임 플레이 기간 중 게임이 참가자들의 신체 활동 지수에 영향을 끼쳤는지 여부와 게임 플레이 중단 후 신체 활동 습관 변화 여부를 분석하는 데 이용될 것입니다.

#### 4. 연구대상자가 준수해야 하는 사항

참가자들은 4 주간의 실험 과정을 완료해야 하며 실험 데이터를 제출해야 합니다.

#### 5. 연구 참여 기간

4 주

#### 6. 연구 참여 도중 참여철회

귀하는 연구에 참여하신 후에도 언제든지 도중에 그만 둘 수 있습니다. 만일 귀하가 연구에 참여하는 것을 그만두고 싶다면 담당 연구원이나 연구책임자에게 즉시 말씀해 주십시오.

#### 7. 연구참여 중지 또는 철회 시 연구대상자의 자료 및 정보 처리방법

연구대상자의 모든 자료가 즉시 삭제될 것입니다.

#### 8. 부작용 또는 위험요소 및 불편함

해당 사항 없음

#### 9. 연구 참여에 따른 이익 또는 보상

문화 상품권

#### 10. 연구에 참여하지 않을 시 불이익

귀하는 본 연구에 참여하지 않을 자유가 있습니다. 또한, 귀하가 본 연구에 참여하지 않아도 성적 평가 및 기타 학생 평가 등에 어떠한 불이익도 없습니다.

#### 11. 개인정보보호와 비밀보장

수집되는 개인 정보는 성별, 관련 경험, 행동관찰 결과, 설문조사 결과 이다. 이 정보는 연구를 위해 1 년간 사용되며 수집된 정보는 개인정보보호법에 따라 적절히 관리될 것이며, 관련 정보는 잠금 장치가 있는 연구 수행자의 개인 컴퓨터에 보관되며 연구 지도교수와 책임 연구자만이 접근이 가능하다. 연구를 통해 얻은 모든 개인 정보의 비밀 보장을 위해 최선을 다할 것이며, 이 연구에서 얻어진 개인 정보가 학회지 또는 학회에 공개 될 때 이름과 다른 개인 정보는 사용되지 않을 것이다. 연구 종료 후 연구관련 자료는 3 년간 보관되며 이후 원본 파일 삭제 방법으로 폐기될 것이다.

#### 12. 연구 문의

해당 연구와 관련하여 질문 사항이 있거나 문제가 생길 경우, 아래의 연락처로 연락 바랍니다:

핸드폰: 010 4797 6109

이메일: [jonas.dalseth@gmail.com](mailto:jonas.dalseth@gmail.com)

IRB 연락처(건국대학교 기관생명윤리위원회) : 02- 2049- 6289



# 동 의 서

**연구제목: 액서게임이 현대인의 운동 습관에 미치는 영향**

1. 나는 본 연구의 설명문을 읽었으며 담당 연구원과 이에 대하여 의논하였습니다.
2. 나는 위험과 이득에 관하여 들었으며 나의 질문에 만족할 만한 답변을 얻었습니다.
3. 나는 이 연구에 참여하는 것에 대하여 자발적으로 동의합니다.
4. 나는 이 연구에서 얻어진 나에 대한 정보를 현행 법률과 건국대학교 기관생명윤리위원회 규정이 허용하는 범위 내에서 연구자가 수집하고 처리하는데 동의합니다.
5. 나는 담당 연구자나 위임 받은 대리인이 연구를 진행하거나 결과 관리를 하는 경우와 보건 당국, 학교 당국 및 국가기관에서 실태 조사를 하는 경우에는 비밀로 유지되는 나의 개인 신상 정보를 직접적으로 열람하는 것에 동의합니다.
6. 나는 언제라도 이 연구의 참여를 철회할 수 있고 이러한 결정이 나에게 어떠한 해도 되지 않을 것이라는 것을 압니다.
7. 나의 서명은 이 동의서의 사본을 받았다는 것을 뜻하며 연구 참여가 끝날 때까지 사본을 보관하겠습니다.

연구대상자    성명:                                  서명:                                  서명일:

법정대리인    성명:                                  서명:                                  서명일:

(필요 시)      연구대상자와의 관계:

입회인        성명:                                  서명:                                  서명일:

(필요 시)

연구책임자    성명:                                  서명:                                  서명일:





# Appendix H

## Fitogotchi User Manual – English

# FITOGOTCHI

## User Manual

### Dash boxes



Dash boxes requires, as the name implies, players to dash through them in order to not get hurt (by pressing the dash button(3)). As you dash through them, you will earn points, but if you hit them without dashing, your Fitogotchi will be damaged.

### Coins



Coins gives you points:

- Gold coins = 10 points
- Purple coins = 50 points
- Green coins = multiplier coins.

The value of these coins doubles for every consecutive coin you pick up. The first coin is worth 50, the next 100, then 200, 400, 800 and so on. But if you fail to pick up one of them, the multiplier resets, so make sure you do not miss one. Higher dash & regeneration levels increase the coins score.

### Enemies



During the Fitogotchi's adventure, you will meet evil creatures trying to stop your Fitogotchi from reaching the ultimate goal of getting the highest possible high score. Try to jump on their heads to defeat them and get some valuable points, or avoid them at all cost to not get hurt!



### Controls:

1: Health- and dash energy-meter.

**Health:** Health is drained as the Fitogotchi gets exhausted while running. It is also reduced whenever the Fitogotchi hits a dash box without dash, gets attacked by an enemy or hits an obstacle, the characters health is also reduced.

**Dash energy:** dash energy is used by the Fitogotchi to perform dashes. Recovers when dashing is not performed and is fully recovered at the start of a new level.

2, **Jump button:** makes character jump. Pressing the button while in mid-air while make the Fitogotchi perform a double jump.

3: **Dash button:** character dashes as long as the character has dash energy left.

4: **The current score of the run.**

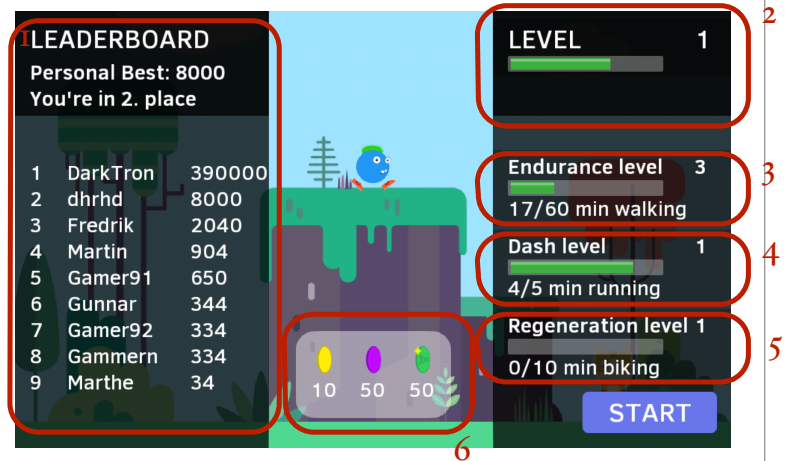
## What do I need to do in order to register my physical activity in the game?

*The short answer is nothing except from having Google Fit installed on the phone and bring the phone with you whenever you walk, run or go biking. The screen doesn't even need to be turned on while you perform the exercise. Try it for yourself, it works!*

The lengthy explanation is that the game gets the fitness data from the Google Fit application. Google Fit is a service by Google that gathers fitness using sensors in your phone. The phone gathers data both while the screen is turned on and while it is in sleep mode.

Due to this, you don't need to worry about starting Fitogotchi before you are going for a walk, a run or if you go biking. The data will automatically be gathered and as long as you bring the phone and be used to power up your Fitogotchi character the next time you play the game.

## The Fitogotchi Character



**LEVEL(2):** This is the overall level of your Fitogotchi. Your Fitogotchi will evolve and get stronger when you level it up.

How to level up: this level is an average of the sub-levels (endurance, dash, regeneration). By leveling up these levels, the total Fitogotchi's level will improve.

*Endurance level(3):* Affects the character's health and endurance.

How to level up: By walking you bring your phone will level up the endurance level.

*Dash level(4):* Affects the character's amount of dash power and makes every coin you pick up in the game are 10% more worth for every dash level.

How to level up: By running, while bringing the phone.

*Regeneration level(5):* Affects the degeneration rate of the character, and regeneration rate of the dash power.

Coins are also work 10% more for every regeneration level you have leveled up.

How to level up: By having your phone in the pocket while bicycling, you will level up the regeneration level.

*Leaderboard (1):* An online leaderboard showing the highscore of all Fitogotchi players. Do whatever it takes to reach to the top!

*Coin view(6):* Showing how much every coin is worth on your current level. The value under the green coin is the base value, as this value increase as you retrieve the green coins consecutively. If you miss one, the multiplier is reset.

**Hope you will have fun playing the game.**



# Appendix I

## Fitogotchi User Manual – Korean

# FITOGOTCHI

## User Manual

### 대쉬 벽돌



대쉬는 이름 그대로 캐릭터가 생명을 잃지않기위해위와같은 벽돌모양의장애물을3 번대쉬 버튼을 눌러 대쉬하는 것입니다. 대쉬 기능을 사용하시면 점수가 올라갑니다. 하지만 벽돌 장애물에 대쉬하지 않고 부딪힐 경우 생명이 줄어들 것입니다.

### 코인



코인 획득시 점수가 올라갑니다.

- 골드코인=10점
- 보라코인=50점

- 초록코인=멀티플라이어코인  
이 코인을 연속적으로 획득할 경우가치가2 배가됩니다.첫 코인은50 점, 그다음은100 점, 200 점, 400 점등과같이점수가 올라갑니다. 단, 초록코인을 연속적으로 획득하지 못할 경우(중간에 하나라도 놓칠 경우) 배수코인은 다시 50 점으로 리셋됩니다. 그러므로 초록 코인을 빠짐없이 연속적으로 획득해주세요! 대쉬와 생명력 지수가 높아질수록 코인의 가치가 올라갑니다.

### 악마 장애물



게임 플레이시, Fitogotchi 의 모험을 방해하는 악마 장애물들이 등장할 것입니다. 악마들의 머리에 점프하여 악마를 소탕하면 점수를 얻을수있습니다.아니면악마위로 점프하여 악마를 피해주세요.



### 게임 컨트롤:

#### 1:생명-대쉬에너지

생명력 : 게임을 플레이할 경우 생명력 게이지는 모험도중 서서히 소진됩니다. 또한 대쉬 벽돌에 대쉬하지 않은 채로 부딪힐 경우, 악마나 장애물로부터 공격을 받을 경우 생명력이 감소합니다.

대쉬 에너지 : 대쉬 에너지는 Fitogotchi 가 대쉬를 할 때 사용하는 에너지입니다. 대쉬를 하지 않을 경우 대쉬 게이지가 회복되고, 새로운 레벨을 시작할 시 대쉬 에너지가 모두 회복되어 꽉 찬 대쉬 에너지로 플레이

2, 점프 버튼 : Fitogotchi 가 점프하도록 만듭니다. 공중에서 점프를한번더누를시2 단점프가능합니다

3:대쉬버튼:화면의우측하단버튼을이용하여대쉬 에너지가 남은 만큼 사용할 수 있습니다.

4: 현재 스코어 : 현재 스코어를 보여줍니다.

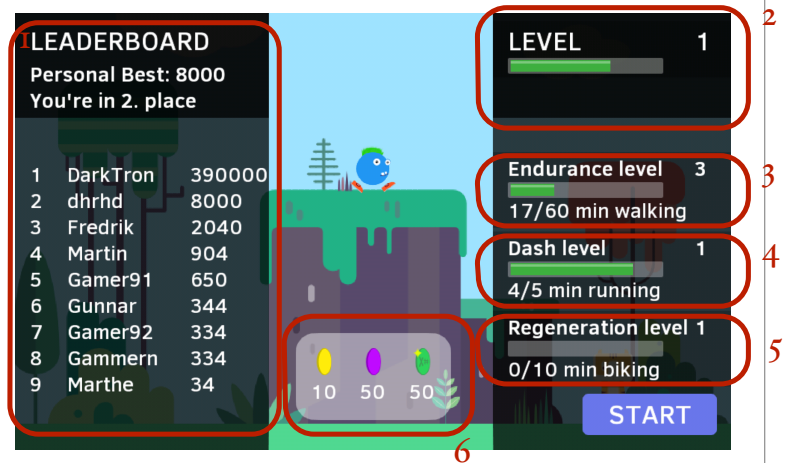
## Fitogotchi 게임에 자신의 실제 운동량을 적용하기 위해 무엇을 해야 하는가?

간단히 말씀드리자면 Google Fit 이 설치된 핸드폰을 지닌 채로 걷기, 뛰기, 자전거 타기 등의 운동을 해주셔야 합니다. 운동하실 때 스크린을 켜지 않으셔도 됩니다. 직접 시도해보세요!

자세히 말씀드리자면 게임이 Google Fit 앱으로부터 피트니스 데이터를 불러옵니다. Google Fit 은 핸드폰의 센서를 이용하여 피트니스 데이터를 수집하는 구글 앱입니다. 스마트폰은 Google Fit 앱이 깔려있기만한다면 앱을 따로 켜지 않아도 데이터를 수집합니다.

따라서 걷기, 뛰기, 자전거 타기 등의 운동을 시작하기 전에 Fitogotchi 앱과 Google Fit 앱을 켜지 않으셔도 됩니다. 핸드폰을 지닌 채로 운동하시지만 하면 데이터는 자동적으로 수집됩니다. 여러분의 운동량에 따라 Fitogotchi 캐릭터가 강화될 것입니다.

## Fitogotchi 캐릭터



**LEVEL(2):** Fitogotchi의 레벨입니다. 이 레벨은 여러 하위 레벨들 (지구력, 대쉬, 생명력)의 평균입니다. 레벨이 높아질수록 Fitogotchi는 진화하고 강해질 것입니다.

레벨업하는 방법: 실제 운동을 통해 하위 레벨들을 올리셔야 합니다.

**Endurance level(3):** 캐릭터의 생명력과 지구력에 영향을 미칩니다. 레벨업하는 방법: 핸드폰을 지닌 채로 걷기 운동을 하셔야 합니다.

**Dash level(4):** 캐릭터의 대쉬 에너지량에 영향을 미칩니다. 대쉬 에너지 레벨이 1씩 올라갈 때마다 코인의 가치가 10%씩 증가합니다.

레벨업하는 방법: 핸드폰을 지닌 채로 뛰기 운동을 하셔야 합니다.

**Regeneration level(5):** 캐릭터의 생명력과 대쉬 에너지 감소에 영향을 미칩니다. 생명력 레벨이 1씩 올라갈 때마다 코인의 가치가 10%씩 증가합니다.

레벨업하는 방법: 핸드폰을 지닌 채로 자전거 타기 운동을 하셔야 합니다.

**Leaderboard (1):** Fitogotchi 게임 플레이어들의 랭킹 순위입니다. 높은 랭킹을 차지하기 위해 노력하세요^^

**Coin view(6):** 현재 레벨에서 각 코인의 가치를 보여줍니다. 초록 코인은 해당 레벨에서의 기본값을 나타냅니다. 만약 초록 코인을 하나라도 놓치게 되면 가치가 리셋됩니다.

즐거운 플레이가 되길 바랍니다^^



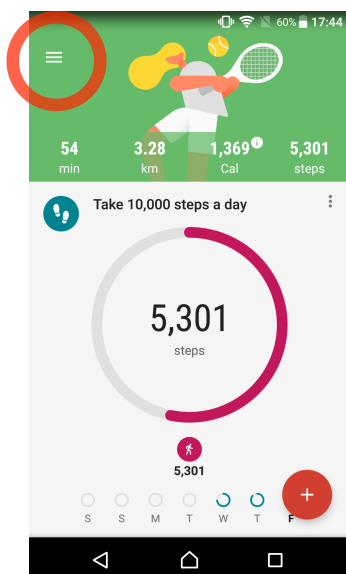


# Appendix J

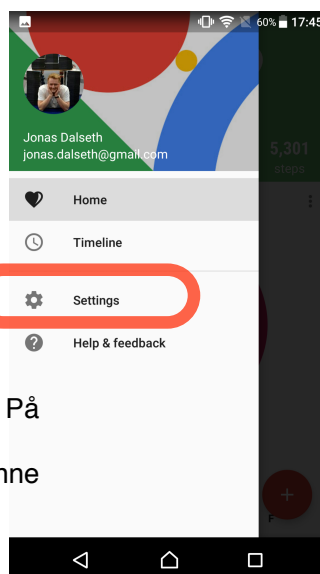
## Google Fit Installation Manual – Norway

# Google Fit installasjonsguide

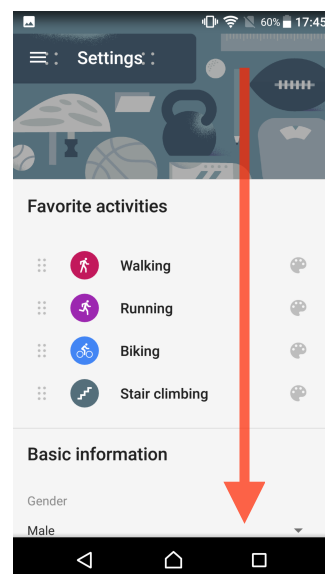
For å forsikre deg om at Google Fit samler inn dataene som kreves av forsøket, gjennomfør disse 5 stegene.



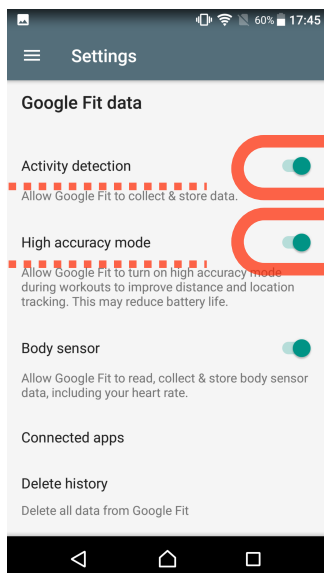
1. Trykk på ikonet markert på illustrasjonen til venstre.



2. Deretter, trykk på «settings-knappen». På telefoner med norsk menyspråk heter denne knappen innstillinger.

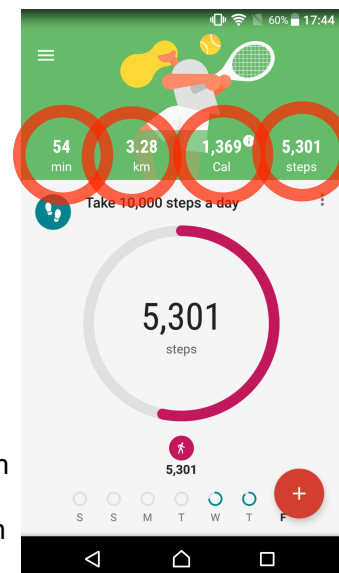


3. Bla deg deretter nedover siden helt til du kommer til Activity detection (Aktivitetsregistrering) og high accuracy mode (Modus for høy presisjon).



4. Sørg for at alternativene nevnt i punkt 3 er skrudd på, slik illustrasjonen til venstre viser.

5. Gå tilbake til startskjermen avbildet på illustrasjonen til høyre og legg telefonen i lommen. Gå litt frem og tilbake. Sjekk deretter at verdiene som er ringet rundt i illustrasjonen til høyre har endret seg og at de ikke er lik 0.



Fungerte dette har du satt opp applikasjonen riktig. Telefonen din logger nå tiden du går, sykler og løper automatisk selv om skjermen på telefonen er skrudd av. Du trenger med andre ord ikke å tenke på å starte Google Fit applikasjonen i forsøksperioden. Google Fit gjør alt som kreves uten at du foretar deg noe som helst.

Skulle det oppstå problemer på et eller flere av punktene, er det fint om du kan ta kontakt med meg på [jonas.dalseth@gmail.com](mailto:jonas.dalseth@gmail.com), så skal jeg hjelpe med å komme i gang så fort som mulig.

# Appendix K

## IRB Certificate

## 심의결과통보서

과제번호	7001355-201704-HR-175		
과제명	(국문) 액서게임이 현대인의 운동 습관에 미치는 영향 (영문) Evaluating the effects of exergames on people's habits in regards of physical exercise.		
연구책임자	성명	직책	소속
	고박우	박사과정	인터넷미디어공학과
심의대상	연구계획심의의뢰서	심의종류	<input checked="" type="checkbox"/> 신속심의 <input type="checkbox"/> 정규심의
연구예정기간	승인일-6개월(2017.12.17)		
승인유효기간	승인일(2017.06.18)- 2018.06.17	* 연구예정기간이 IRB 승인유효기간을 초과할 경우, 유효기간 만료 최소 한달 전에 최소 한달 전에 [지속심의의뢰서] 승인을 받아야 연구지속진행이 가능합니다. * 연구 예정기간이 IRB 승인유효기간 이전일 경우, 연구예정기간 만료 최소 한달 전에 [연구계획변경심의의뢰서] 또는 [지속심의의뢰서] 승인을 받아야 연구지속진행이 가능합니다. * 연구종료 시 6개월이내에 [종료 및 결과보고서]를 제출해주시기 바랍니다.	
심의결과	<input checked="" type="checkbox"/> 승인 <input type="checkbox"/> 수정 후 승인 <input type="checkbox"/> 수정 후 신속심의 <input type="checkbox"/> 보완 후 정규심의 <input type="checkbox"/> 반려 <input type="checkbox"/> 중지 <input type="checkbox"/> 보류 <input type="checkbox"/> 강제종료 <input type="checkbox"/> 승인취소 <input type="checkbox"/> 기타 :		
연구대상자 동의 취득	<input checked="" type="checkbox"/> 서면 <input type="checkbox"/> 불필요		
접수일자	2017-06-02	심의일자	2017-06-18
심의내용	검토의견에 대한 답변서 변경대비표 연구계획심의의뢰서 연구계획서요약 연구대상자 설명문 및 동의서 Ver 2.0 모집공고문		
심의의견	수정요청사항이 잘 이행되어 승인합니다.		

- 본 통보서에 기재된 사항은 건국대학교 기관생명윤리위원회의 기록된 내용과 일치함을 증명합니다.
- 본 기관생명윤리위원회는 생명윤리 및 안전에 관한 법률 등 관련 법규를 준수합니다.
- 본 연구와 이해관계(Conflict of Interest)가 있는 위원이 있을 경우 연구의 심의에서 배제하였습니다.
- 만약 본 위원회의 심의판정에 불복할 경우 심의결과 통보 후 1 개월 이내 이의신청서를 작성하여 본 위원회로 제출하여 주십시오.

# 기관생명윤리위원회위원장

<b>건국대학교 기관생명윤리위원회</b>	
Tel. 02-2049-6289	서울시 광진구 능동로 120

모든 연구자들은 아래의 사항을 준수하여야 합니다.

1. 승인된 계획서에 따라 연구를 수행하여야 합니다. (연구기간, 연구대상자 수 등)
2. 위원회의 승인을 받은 동의서를 사용하여야 합니다.
3. 모국어가 한국어가 아닌 연구대상자들에게는 승인된 동의서를 연구대상자의 모국어로 인증된 번역본을 사용할 것이며 이러한 동의서 번역본은 반드시 위원회의 승인을 받아야 합니다.
4. 연구진행에 있어 연구대상자를 보호하기 위해 불가피한 경우를 제외하고 연구의 어떠한 변경이든 위원회의 사전 승인을 받고 수행하여야 하며 연구대상자들의 보호를 위해 취해진 어떠한 응급상황에서의 변경도 즉각 위원회에 보고하여야 합니다.
5. 위원회에서 승인된 계획서에 따라 등록된 어떠한 연구대상자라도 사망, 입원, 심각한 질병에 대하여는 위원회에 서면으로 보고하여야 합니다.
6. 연구 또는 연구대상자의 안전에 대해 유해한 영향을 미칠 수 있는 어떠한 새로운 정보도 즉각적으로 위원회에 보고하여야 합니다.
7. 위원회의 요구가 있을 때에는 연구의 진행과 관련된 보고를 위원회에 제출하여야 합니다.
8. 위원회가 심의한 과제에 대해 조사 및 감독 차원에서 현장점검을 실시할 시 원활한 점검절차 진행을 위해 연구자는 연구진행과 관련된 서류를 준비하고 협조하여야 합니다.
9. 연구대상자 모집광고를 사용할 시에는 사용 전에 위원회의 승인을 받아야 합니다.
10. 동의는 강제 혹은 부당한 영향이 없는 상태에서 충분한 설명에 근거하여 수행되어야 하며, 잠재적인 연구대상자에게 연구에 참여여부를 고려할 수 있도록 충분히 기회를 제공하여야 합니다.
11. 연구자와 그 밖에 이해당사자는 연구계획서 승인을 광고나 홍보, 상업적 목적으로 사용할 수 없습니다.
12. 위원회의 심의결과 시정요구에 대해 모두 이행 및 충족될 경우에만 연구를 진행할 수 있습니다.

13. 위원회의 승인은 1 년을 초과할 수 없으며, 1 년 이상 연구를 지속하고자 하는 경우에는 적어도 승인만료일 1 개월 전에 연차지속보고를 해야 하며, 위원회에서 요구한 중간보고주기에 따라 연구 진행과 관련한 보고서를 제출 하여야 합니다.
14. 연구 종료 후 6 개월 이내에 종료 및 결과보고를 하여야 합니다.
15. 연구와 관련된 기록은 연구가 종료된 시점을 기준으로 최소 3 년간 보관하여야 합니다.
16. 위원회 심의판정에 불복할 경우에 연구자는 이의신청을 할 수 있습니다. 단, 같은 사항에 대하여 2 번 연속으로 이의 신청을 할 수는 없습니다.
17. 위반·이탈사항 발생시 연구책임자 앞으로 경고가 누적되며, 연구책임자가 학생일 경우 지도교수 앞으로도 경고가 누적됩니다.