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Sandhya Mahat

EXERGAMING: ITS SOCIAL ASPECTS

– Case Study with Exercise Monster Game

TURKU AMK
TURKU UNIVERSITY OF APPLIED SCIENCES

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It is widely believed that exergaming solely has physical benefits. However, several studies have emphasized the social effects of exergaming recently. This thesis, hence, makes use of those existing studies and compares the social risks of exergaming with its benefits. For this, extensive research was conducted with different online sources. Moreover, the thesis uses qualitative analysis method to study the social aspect of the Exercise Monster developed by Turku Game Lab.

The game was tested on sixteen voluntary participants in Turku Game Lab. Each participant played the game at least four times. Each complete session lasted for twenty to thirty minutes which included individual interviews, four gameplays and group discussions. The results suggested that the game was successful to socially engage the players to a certain extent. Moreover, it was determined that an increase in the number of players increased their social interaction. However, there were certain limitations such as the limited number of participants, enclosed area, time, validity, technical issues and language bias. It was deduced that the social aspects of Exercise Monster could be improved by further developing the game with multiple VR players and other social features where the players would have to perform certain tasks together.

These results have provided Turku Game Lab with an insight into the social aspect of Exercise Monster and thus help in the further development of the game to make it more social.

KEYWORDS:

Exergames, Exergaming, Social Effects, Social Benefits, Social Risks, Qualitative Analysis, Quantitative Analysis, Exercise Monster

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LIST OF ABBREVIATIONS

AR	Augmented Reality
BEE	Business Ecosystems in Effective Exergaming
CRT	Cathode-Ray Tube
GPS	Global Positioning System
HML	Head-Mounted Display
IT	Information Technology
LCD	Liquid Crystal Display
OLED	Organic Light-Emitting Diode
PMD	Photonic Mixer Device
VR	Virtual Reality

1 INTRODUCTION

With the advancement in information technology (IT), youths nowadays are increasingly spending their time on sedentary activities such as video games. A survey conducted with 3000 Finnish youths discovered that the gamers spent an average of 110 minutes every day playing digital games during the first three months of 2014 (Männikkö et al., 2015). Succumbing to such sedentary activities can result in the growth of health-related problems at an alarming rate (Matthews et al., 2012). Fortunately, technology has introduced exergaming to make leisure time more physically engaging. Today, there are plenty of serious exergames that help people exercise properly and hence, improve their overall health. However, it is still a concern that exergames might not be providing the same physical and social development that traditional sports and physical education provide.

Recently, researchers have increasingly portrayed their interest in exergaming. However, most of them (Daley, 2012; Siegel et al., 2009) have focused on the physical health aspects. Only a few (Li et al., 2018; Kari, 2017) have studied its social effects. Among them, most (Li et al., 2018) have targeted older adults for their studies. This thesis, however, focuses on the social health and behaviour of young adults.

This thesis was written on commission for Turku Game Lab. It is provided with a detailed overview of exergaming and its effects on social health. It can, hence, refer to the results of this thesis while taking important decisions regarding their future game projects. This will help Turku Game Lab target its game projects to the right customers and make necessary changes in their existing projects to fit the market needs in a better way.

The aim of this thesis is to discuss the effects of exergaming on the social health of the players. Its main objective is to analyze whether or not exergames can be socially beneficial. It makes use of an Exercise Monster exergame developed by Turku Game Lab. The detailed development process of the Exercise Monster is out of scope for this thesis.

Chapter 1 of this thesis familiarizes the reader with the work and presents its objectives. Chapter 2 gives detailed information about exergaming and its history. Similarly, Chapter 3 describes the types of exergaming and the technologies used. Then, Chapter 4

presents the social aspects of exergaming by comparing its benefits, risks and recommending solutions to optimize its effects . Chapter 5 introduces Exercise Monster developed by Turku Game Lab used for research. Chapter 6 points the measures taken to conduct a qualitative analysis with a real exergame. Chapter 7 basically provides the raw results of the analysis. Chapter 8 discusses the significance and limitations of the results and provides recommendations for future research. Finally, Chapter 9 evaluates the thesis and presents the final thoughts of the author.

2 BACKGROUND

The term ‘exergaming’ is derived from ‘exercise’ and ‘gaming’. It refers to the digital games that demand some physical activity from the players. Exergaming relies heavily on technology to detect and keep track of body movements.

Although the term ‘exergaming’ was only added to the Collins English Dictionary in 2007, its roots can be traced back to the arcade games of the 1970s and 80s. Arcade games such as Pac Man (shown in Figure 1) and Pole Position had to be played standing which required a significant amount of body effort from the players in comparison to the modern video games that are mostly played while sitting (Renke, 2018). However, Power Pad (also known as Family Trainer) for Nintendo Entertainment System (1986) and Atari 2600’s Foot Craz pad controller(1987) were one of the first exergames to be introduced (Bogost, 2005).

Figure 1. Pac Man Arcade Game (Strayhorn, 2017).

Similarly, in the 1980s, Autodesk developed two systems: HighCycle and Virtual Raquetball. The HighCycle was basically an exercise bike connected with controllers and balance boards. It was played by pedalling through a simulated landscape. On the other hand, Virtual Racquetball was a game that tracked the position and alignment of a real racquet to hit a virtual ball in the simulated environment. In both of these systems, the players wore the VPL eyephones, an HMD, to make the players more focused on the game. Similarly, the first very successful and popular exergame was Konami’s Dance

Dance Revolution in 1998. Its input devices included pads to track the user's movements with touch sensors (Stach 2009).

During the 1990s, the interest was slowly building for 'virtual reality' technology. Several LCD-based products and CRT-based systems started being available on the market. Despite such advancements in the field of exergaming, the hardware was still very costly for average home consumers. It was challenging to maintain; hence, additional expertise was required to operate the software which was quite intimidating for the users.

In the 2010s, new systems like the Microsoft Xbox, Nintendo Wii and Sony PlayStation were introduced. They used input devices such as the Kinect and PlayStation Move. The Kinect, shown in Figure 2, makes use of a combination of the infrared depth camera and colour camera, for the 3D motion tracking of the user.

Figure 2. Kinect for Xbox One (Evan-Amos, 2014).

The Move (shown in Figure 3), on the other hand, analyses images to extract the user's motion against the background in order to control the character while playing the game. Wii is basically a controller that makes use of accelerometers and gyroscopes (Bock, 2016). The accelerometers are used to measure linear acceleration based on vibration while gyroscopes measure the orientation using the principles of angular momentum.

Figure 3. Sony PlayStation Move Controller (Evan-Amos, 2016).

Today, exergaming holds a whole new concept. It not only refers to the video games; but also to the gaming technologies combined with exercising equipment, mobile exergaming applications and virtual reality technologies. It has been extended in various sectors such as health and entertainment and focuses on agility, impulsion, reflex, running and training of the user. There are several fitness centres and specialized rooms with programs focusing on using exergaming for fitness. Some of the popular examples of exergames are Dance Simulation Games, GameBike, Interactive Aerobic Fitness Games and Sony EyeToy.

3 CATEGORIZATION OF EXERGAMES

There are several different types of exergames. The classification of the exergames can depend on several factors: location, usage of exercise data, sensor, health goal, hardware and output device (Wünsche et al., 2018). This section extensively reverberates the Univeristy of Auckland course work as compiled by Wünsche et al. (2018) because after an extensive literature search, it was found that very little could be added.

3.1 Location

According to the location where the games are played, exergames can be further divided into three types: home exergames, gym exergames and outdoor exergames.

Home exergames, as shown in Figure 4, are the exergames that are played indoors in an accessible location such as the player's home. Such exergames provide little exercise and often get boring quickly as they have limited content. They have little to no targeted health effects and thus cannot be relied on for physical benefits. These exergames are played primarily for social benefits; hence, physical activity is just a side effect of the gameplay. Most home exergames use motion sensing devices and are synchronous in the use of exercise data. Dance Dance Revolution, Kinect and PlayStation Move games, Wii and Wii Fit games are the examples of home-based exergames.

Figure 4. Home Exergame (Ogonowski, 2016).

Gym exergames, as shown in Figure 5, are generally the ones that are played in gyms and fitness centres. In this type of exergames, exercise is the primary activity and gameplay is just in order to encourage the players for the exercise. Such exergames primarily focus on improving the physical health of the players by tracking the exercise performance such as calories burned, horizontal/vertical distance travelled, and many more. Most gym exergames use exercise equipment and synchronously use the exercise data. BitGym, ExerBike, Kickr, Spivi Indoor Cycling Training system and TacX are the examples of gym exergames.

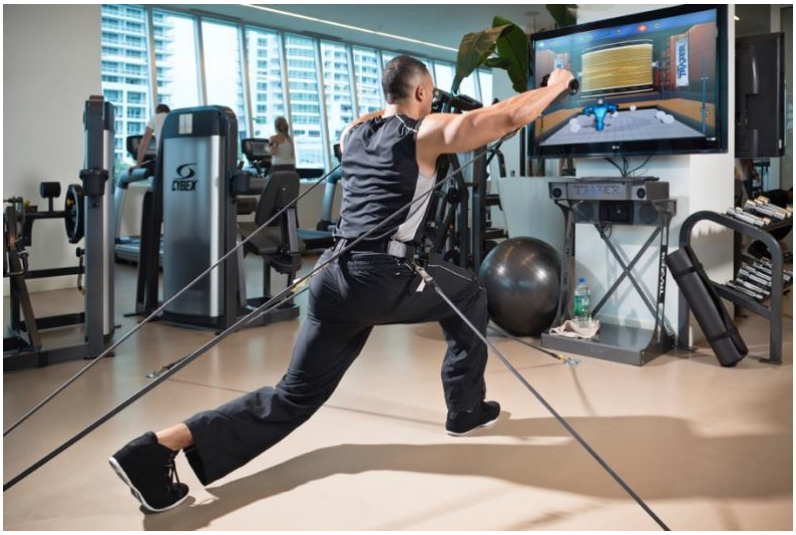

Figure 5. Gym Exergame (Spafinder, 2011).

Outdoor exergames are the exergames that are played outside an enclosed area. These type of exergames generally use motion sensors such as GPS and do not use the exercise data directly. Outdoor exergames encourage social interaction. In such games, exercise is not usually a part of the gameplay; however, exercise results such as steps taken are often used to control the gameplay by providing virtual rewards. For instance, Pòkemon Go!, as shown in Figure 6, is an outdoor exergame that uses AR and requires the player to physically move in order to catch the Pòkemons.

Figure 6. Outdoor Exergame - Pòkemon Go! (New York Post, 2016).

3.2 Usage of Exercise Data

According to the usage of the exercise data, exergames can be divided into three types: synchronous, asynchronous and disconnected.

Synchronous exergames are those exergames in which the exercise data is directly used in the gameplay. These exergames are usually played in a closed environment. Hence, they are either home-based or gym based exergames. Dance Dance Revolution, ExerBike, Kinect and PlayStation Move games, Wii & Wii Fit games are some of the examples of the synchronous exergames.

Asynchronous exergames are those exergames in which exercise data is used separately from the play sessions. However, the exercise data directly affects the gameplay. Asynchronous exergames are often played outdoors and make use of motion sensing devices. These exergames are designed primarily for increasing social interaction among the players and gameplay is just for motivation purposes. Some examples of asynchronous exergames are Burn your fat with me, Fitbit games(FitRPG, Weekend Warrior) and Zombie Run!.

Disconnected exergames are those games in which exercise data is not used directly. In these exergames, exercise is merely a side effect of the gameplay and not required in several cases. Such exergames are often developed for social purposes and not for physical benefits. Mobile exergames such as Ingress and Pòkemon Go! are the examples of disconnected exergames.

3.3 Sensor

Based on the type of sensors used in the exergames, they can be further divided into three types: motion-sensing exergames, location sensing exergames and exercise equipment-based exergames.

Motion sensing exergames are the ones that track motion with the help of infrared cameras, motion and pressure sensors (Lieberman et al., 2011). They use devices such as accelerometer, gyroscope, structured lighting, Web-Cam, PMD, and many more. Several examples of motion sensing exergames today include exergames such as EA Sports Active 2, Just Dance, Nike + Kinect Training and Your Shape Fitness Evolved.

Location sensing exergames are those exergames which are played outdoors with the help of GPS in mobile devices carried by the players. Such games demand the players to move and accomplish several game missions in a particular geographical area. Mobile exergames such as Ingress and Pokemon Go are the ideal examples of location sensing exergames.

Exercise equipment-based exergames are those exergames that combine different exercise equipment such as exercise bikes, rowing machines and treadmills, with virtual environments such as virtual landscapes, games and applications. There are systems where the players can either play games or use virtual landscapes during the training for further motivation. Additionally, some devices are also connected with social media and web browsers. This enables the players to compete with other players during the training. However, exercise is the main activity in such exergames; hence, the gameplay is just for motivation and enjoyment of the players. The exercise performance, such as calories burned, distance travelled, height climbed, are well tracked. Examples of such exergames are BitGym, Kickr, Spivi Indoor Cycling Training system and TacX.

3.4 Health Goal

Based on the health objectives of the exergames, they can be further classified into three types: exergames with exercise as a side effect, exergames with fitness results and exergames with medical results.

The exergames that are not primarily designed for any targeted health outcomes fall into the category of exergames with exercise as a side effect. In such exergames, exercise is usually just a side effect of the gameplay and not required in many situations. Examples of such exergames include Ingress, Pokemon Go, and Fitbit games such as FitRPG and Weekend Warrior.

The exergames that target specific fitness results such as weight loss, muscle-strengthening and core-strengthening fall into the category of exergames with fitness results. Such exergames are most commonly used in fitness centres and help the players work out more effectively by guiding them with the correct form and technique of different exercises. Examples of the exergames with fitness results include BitGym, Kickr, Spivi Indoor Cycling Training system and TacX.

The exergames that are used on the health patients for certain clinical results such as rehabilitation, treatment and therapy fall into the category of exergames with medical results. Such exergames are most commonly used by physiotherapists and rehabilitation practitioners in order to keep track of the patients' personal progress. FlyFit and PlayTherapy Exergame are examples of exergames for specific clinical outcome.

3.5 Hardware

According to the hardware used by the exergames, they can further be classified into three types: console exergames, mobile exergames, special equipment-based exergames.

Console exergames are the exergames that are played indoors on game consoles. They require a computer screen or a television set for the gameplay; hence, they are also known as 'screen-based' exergames. Most of these exergames have limited content and

provide exercise of light to moderate intensity. They usually do not have targeted fitness or clinical results. Examples of console exergames include Kinect and PlayStation Move games and Wii & Wii Fit games.

Mobile exergames are generally played on portable devices such as smartphones or tablets. Almost every person in the developed society today owns a smartphone with a built-in accelerometer, gyroscope and a GPS. The accelerometer in mobile phones can track not only walking but also actions like jumping. This opens up the opportunity for mobile exergames. There are several mobile exergames in the market today that count the number of steps walked by the user to earn achievements and reach certain goals within a limited time frame. Several examples of mobile exergames today include mobile applications such as Zombies, Run! (2012), Ingress(2013), Pokémon Go (2016). These games use recent technologies such as motion sensors and augmented reality and have proved to be a huge motivator for the users to take a walk to the landmarks in their neighbourhood. It is almost certain that mobile exergames will become more popular in the future, with many opportunities for game applications that promote health and fitness.

Special equipment-based exergames are those exergames that make use of special types of equipment such as exercise bikes, rowing machines and treadmills. Those equipment are connected with virtual environments such as virtual landscapes, games and applications. These exergames target specific fitness results such as weight loss and are commonly used in fitness centres. Exercise is the main activity in such exergames. Examples of special equipment-based exergames include gym-based exergames such as BitGym, Kickr, Spivi Indoor Cycling Training system and TacX.

3.6 Display Device

According to the type of display device used in the exergames, they can further be divided into three categories: monitor display, head-mounted display, mobile display.

The exergames that require either a computer screen or a television set for the display of the gameplay fall into the category of monitor display exergames. They are also commonly known as ‘screen-based’ exergames. Such exergames are played indoors on game consoles and use input devices such as controllers, keyboards and mice. They make use of non-immersive VR technology by providing the players with a computer-

generated environment without making them completely immersed in the virtual world. This technology transmits the same image for both eyes of the player; hence, the player perceives that image only in two dimensions. Thus, the players are still aware of their physical surrounding. In order to add to the level of immersion, several exergames of this type include the first-person view for the players to associate more closely with their game avatar. In addition, several physical input devices such as the pedals and racing wheels are used in these exergames for a better gaming experience. Examples of monitor display exergames include Kinect and PlayStation Move games and Wii & Wii Fit games.

The exergames that use devices such as the VR headsets to display the computer-generated surroundings for the player fall into the category of head-mounted display exergames. Such exergames make use of fully-immersive VR technology that allows the players to interact with a 3D virtual environment. This technology provides a digital image that is perceived in three dimensions: height, width and depth. The VR headsets used in such exergames have two displays that produce digital content on player's each eye separately. This ensures a binocular image that seems like a real-world surrounding to the player. HMDs consist of built-in head tracking systems that determine the co-ordination of the player's head in order to ensure the interactivity in the virtual world. This provides the players with a sense of presence within the VR environment and hence permits them to be engaged in it like a physical environment. The players become unaware of the physical objects and sounds around them; hence, they are isolated from the physical environment. Some examples of exergames that use head-mounted display are Monster Exergame and VRun.

The exergames that use the screen of portable devices such as mobile phones and tablets to display the gameplay fall into the category of mobile display exergames. Such exergames can be played both indoors and outdoors. Similar to the exergames with monitor display, these exergames also make use of the non-immersive VR technology; hence, the players are aware of their physical surrounding while playing exergames on mobile phones or tablets. In addition, these exergames make use of the built-in GPS in the smartphones and tablets in order to enable the players to move and accomplish several game missions in a particular geographical area. Examples of exergames with mobile display include mobile exergames such as Ingress(2013) and Pokémon Go (2016) and Zombies, Run! (2012).

4 SOCIAL ASPECTS

Social interaction or communication is very crucial for the well-being of individuals and society as a whole. The need for social interaction with one another is a primary human nature. Lack of social communication leads to several problems, such as loneliness and social isolation. Hence, it is essential for individuals to participate in activities to promote social connection.

One such activity to promote social interaction is exergaming in a social environment. With the rapid development of technology, the use of exergames, or active games, has increased exponentially. Nowadays, exergames are not only played on the console at homes but also in social settings such as schools and workplaces. Similarly, there are exergames that can be played with other players over the internet. Today, most of the children and youth prefer to play exergames in a social environment. In fact, social communication was reported as the most crucial motivational aspect for adolescents in a twenty-week exergaming intervention (Staiano, Abraham and Calvert, 2012). While exergaming can have several effects on the physical and mental aspects of the players, it can also significantly contribute to the social well-being of the players. However, these effects can be both positive and negative.

4.1 Benefits

Exergames with multi-player features have several social benefits. A systematic review conducted in 2018 concluded that most of the exergame related research exhibited positive social effects such as reduction of loneliness, increased social connection, and positive attitudes towards others (Li et al., 2018).

Exergaming motivates the players to play together instead of alone. This gives an opportunity for the players to interact with their fellow peers having similar interests. Hence, exergaming can be used as an ice-breaking activity in events as it brings new people together and helps them bond. This can even result in the fostering of friendship and social networking among the players. Similarly, when several people play together at different difficulty levels, it can have a positive effect on the self-confidence of the players, especially children. The encouragement and social support received by the

players, in turn, improves the overall player's psychological state. Moreover, the immersive nature of the exergames can provide the players with a sense of unity and teamwork.

Exergaming also helps in motivating the players to improve their health habits. While playing exergames in a social setting, players begin to share their opinions about their health and workouts with fellow players. This ultimately results in appreciation, coaching, comparison and encouragement for the fellow players to be physically active, which hence improves the overall health behaviours of the players. In a study regarding console exergames, it was discovered that playing the exergames in multiplayer mode led to greater heart rate and expenditure of energy than while playing alone in single-player mode (O'Donovan et al., 2012). Exergaming provides the players with the benefit of having exercise partners which can be greatly motivating. In such a social environment, players receive feedback on their gameplay and can have fun while getting fit. Similarly, competition against other players also greatly increases the motivation of the players to do better in each gameplay.

Regardless of the age group, exergames can fit ideally in a social environment as they provide numerous social benefits. Such games are especially effective for physical fitness when played in a social setting.

4.2 Risks

While there are several benefits of the exergames to the social well-being of the players, there are risks as well. Some of those risks include loneliness, cyberbullying, aggressiveness or violence, privacy breach and unhealthy competition.

Single-player exergames are likely to cause social isolation as a result of excessive gaming alone. Such games have the tendency to entertain the players and separate them from their physical world. Players sometimes tend to zone out of their real-world and use the games as their escape from their reality. This can hence, result in loneliness and ultimately, social isolation.

Cyberbullying is another major social risk of exergaming where players are bullied online. This is most common among the children; however, it is also present among adolescents

and youths. Reports show that about 34 per cent of students have been harassed over the internet (Walsh, 2011). Picking on other people and trying to embarrass and intimidate them by fat-shaming, name-calling, slut-shaming, and many more are some of the examples of cyberbullying. Today, there are many exergames that allow playing with strangers over the internet. This allows people to bully other players during online gameplay. While cyberbullying is more common in the video gaming world, it definitely exists in the world of exergaming as well. There have been several accounts of suicides due to Cyberbullying. In fact, it has been reported that students experiencing bullying or cyberbullying are twice more likely to attempt suicide (Hinduja and Patchin, 2018). Hence, cyberbullying can be very dangerous.

Another social risk involved in exergaming includes aggressiveness and often, violence. Today, there are several shooting exergames available in the market. Augmented reality makes violent games feel so real that the morality of the players gets questioned. Experimental research conducted with children, undergraduate students and adults reported that those who played violent video games showed a higher level of aggressive behaviour in comparison to those who did not play (Anderson, Gentile and Buckley, 2007; Anderson and Carnagey, 2009; Sestir and Davis, 2005).

A privacy breach is another social concern resulted by exergaming. Not all people playing the exergames over the internet are just looking to play the games. There are several people such as hackers, spammers and stalkers that are waiting for the perfect moment to steal personal information such as the card details and home address from the fellow players for their personal gain.

Similarly, exergames can also result in unhealthy competition among the players; especially children. Sometimes while playing player versus player, the gamers can take the competition too seriously. Behaviours such as attention and validation seeking, diminishing others, and attitude to win at all costs resulting in unhealthy competition. In such situations, the sole reason for playing becomes winning and not enjoying the game. Such behaviour may result in unnecessary quarrelling among friends playing together.

4.3 Solutions

The social risks of exergaming can be quite intimidating; several measures can be taken to minimize them and hence optimize the social benefits of exergaming. Some of the solutions include supervision by guardians, trusting reputed exergames based on ratings and reviews, limiting the playtime, avoiding playing with unknown strangers over the internet and never sharing personal information.

It is crucial for the parents to supervise their children while playing exergames. Among all the age groups, adolescents and children are the most frequent users of exergame. Without supervision from the parents, children can fall victim to various social attacks such as cyberbullying, stalking and spamming. Similarly, only reputed exergames should be trusted based on the user ratings and reviews available on the particular exergames. This can help in finding one of the most reliable and suitable exergames available. Moreover, it is crucial for the players to check the guide for using the exergames prior to playing them. This helps in avoiding injuries in case the exergame advises the players to perform warm-up exercises before playing. Similarly, not all exergames are targeted for players with previous injuries or heart patients. Hence, it is advisable to check the instructions very carefully. Similarly, it is recommended to limit the playtime so that the players do not get addicted to the game and exhaust themselves and neglect their other important part of their lives. Furthermore, choosing to play multi-player games instead of single-player ones ensures that the players do not isolate themselves from their social circle. Additionally, it is crucial for the players to avoid playing with unknown strangers over the internet in order to prevent cyberbullying and stalking. Moreover, players should never share personal information such as home address and credit card details while playing exergames over the internet in order to prevent the loss of their data and hacking.

5 CASE STUDY: EXERCISE MONSTER

Exercise Monster is basically a prototype exergame developed for Business Ecosystems in Effective Exergaming (BEE) project in Turku Game Lab. The main objective of BEE was to create several rehabilitation and exercise games by utilizing various game technologies such as motion detection, virtual reality and augmented reality. For this, different game prototypes were created so that the BEE project team can later decide which of those prototypes can be further developed into real games.

Exercise Monster is a local PvP (Player Versus Player) exergame, which means that the exergame can only be played among the participants that are physically present. It utilizes VR technology for the monster player and game controllers for other players. It is developed with Unity for Steam VR.

5.1 Development

The concept of the Exercise Monster first originated during the brainstorming of ideas by the project engineers of a research group in Futuristic Interactive Technologies. It was later developed in a learning environment called Turku Game Lab during the autumn of 2017. The majority portion of the game was developed by Sami Laukkanen, a project engineer of Turku Game Lab. For developing the entire game, he received some help from a few other developers and interns working at the lab. All the sprites and designs used in the game are originally developed by the team themselves.

Although the game was not completely developed, Exercise Monster was tested in a gaming convention called GamXpo 2017 in Helsinki representing Turku University of Applied Sciences (Turku Game Lab, 2017). However, further development of the game was later discontinued by the decision of the BEE project team.

5.2 Avatars

In the current prototype, there are two types of players: Exercise monster and Couch Potatoes.

5.2.1 Exercise Monster

The VR player is termed as the ‘exercise monster’ in the game. Currently, there can only be one exercise monster. He/she needs to prevent the controller players referred to as the ‘couch potatoes’ from painting the symbols in the playing arena. He/she can use different methods for this, such as throwing bombs or using a tentacle. The tentacle is handled with the left arm of the VR players. It follows the movement of the arm. Usually, the tentacle can be used to block the way of the couch potatoes or to block the symbols. Similarly, the monster can also rotate the whole view by pressing two buttons that are on his two sides. Moreover, the monster also has a possibility to move objects such as the logs of wood to block the way for the couch potatoes.

The monster can quickly run out of power when he/she continuously throws bombs at the potatoes. In order to increase the power of the monster, he/she needs to physically perform squats to recharge for power. If his/her power lowers, he/she can no longer throw enough bombs and ultimately lose the game.

5.2.2 Couch Potatoes

The players playing with game controllers are referred to as the ‘couch potatoes’. The game supports a maximum of four couch potatoes. The couch potatoes have the power to shield themselves from the attack of the monster. While using the shield, they are less likely to be pushed away or knocked off by the monster’s attacks.

5.3 Game Strategy

The game begins in an arena with wrecks of wood. It was supposed to be a shipwreck, but due to low time availability, the playground was converted to an arena with wrecks of wood and other similar materials. The monster (VR player) is in the centre of the arena and has to stop the couch potatoes (the controller players) from painting the symbols that are on the floor.

The potatoes are supposed to paint the symbols by standing over them. Painting a particular symbol is faster if all or multiple couch potatoes are standing on the same symbol at the same time. There are currently two symbols in the game that the couch

potatoes need to paint. The couch potatoes (controller players) win if they successfully paint all the symbols in the scene before the time runs out. On the other hand, the monster wins if he successfully prevents the potatoes from painting the symbols until time runs out.

Currently, there is only one level in the game since it is just a prototype. The game currently only supports a maximum of five players.

5.4 Challenges

There were several challenges during the development of the Exercise Monster. Since the Exercise Monster was a side project for Turku Game Lab, they did not have plenty of time or resources for developing the game. The developers considered this game as a hobby project and were not fully focused into its development. At one time, there were so many projects going on in Turku Game Lab that the development of the game was halted completely.

5.5 Significance

The Exercise Monster only consists of multiplayer mode. Hence, it requires at least two players to play. This makes it more social than other single-player exergames. In addition, the monster exergame requires the exercise monster to do squats which has various health benefits such as increasing body muscle and strength, burning fat, improving circulation and many more.

6 METHODOLOGY

6.1 Procedure

The procedure of the game experiment conducted can be categorized into four sections: Preparation, Gameplay, Individual Interview and Group Discussion.

6.1.1 Preparation

Firstly, approval was obtained from the Turku Game Lab to use their space and equipment for the experiment on a scheduled date. For this, emails were sent out to the laboratory engineer and the project engineer of Turku Game Lab and to the supervisor of this thesis. Then, one day prior to the scheduled date, the Exercise Monster game was tested for any bugs. On the day of the experiment, consoles of Exercise Monster was set in the Turku Game Lab, and the passersby were informed about the experiment and asked if they would like to participate. In addition, some participants were contacted via phone and informed about the experiment to see if they would be interested in participating in the experiment.

Upon agreement, basic information about each participant such as age, sex, cultural background and occupation was obtained. Then, they were asked several questions in order to figure out if they had played any exergames before and whether they considered it as a social experience or not. The detailed list of questions asked to the participants before the gameplay can be found in Appendix 1. Additionally, informed consent was obtained from them to use their information for the purpose of experiment and analysis. When the number of participants reached four, the volunteers were provided with the instructions explaining how to play the game. After that, they were encouraged to practice the game for a minute in order to get themselves acquainted with the game. Participants were informed that they would have to play the game until either the Monster player or the couch potatoes win.

6.1.2 Gameplay

Each game experiment started with two players chosen randomly among the participants. As shown in Figure 7, one of them played as the VR player and another player as the couch potato. After every gameplay, the number of players increased by one and the VR player switched places with the controller player. This process continued until all four participants were playing: three as controller players and one as the VR player. This ensured that each participant got the opportunity to play both as the VR player and the controller player. The entire game sessions were recorded with Go Pro Hero 4 camera in order to analyse the social aspect of the participants later. Overall, the game was played sixteen times, excluding the test plays.

Figure 7. Participants playing Exercise Monster game in Turku Game Lab.

6.1.3 Individual Interview

Immediately after the completion of each game experiment, each participant was interviewed separately in the next room. Before beginning the interviews, the participants were informed that the entire interview would be video recorded with Go Pro Hero 4. The interviews were standardized and open-ended. All the participants were asked the same open-ended questions in order to get their opinions in an elaborative manner. Most of the questions asked during the individual interviews were related to how socially beneficial they found the game and what could have been better to make it more socially interactive. The list of questions asked during the individual interviews after the gameplay

can be found in Appendix 1. While the individual interviews were going on, the remaining participants were requested not to share their opinions about the game. This was done in order to avoid the influence of other participants on the opinions of the interviewed participant.

6.1.4 Focus Group Discussion

After all four participants were interviewed, they were seated together for a focus group discussion. The participants were again informed that the session would also be video recorded. First of all, the participants were asked if they knew each other prior to this experiment. Then, each participant was requested to briefly introduce themselves to the group as an ice-breaker. Then, they were requested to reflect on the social aspect of the Exercise Monster game as a group. The participants were allowed to take the lead in the discussion until the discussion ceased or went too far from the topic: Social aspect of exergaming. Sometimes when there was a pause or silence during the discussion, some answers from the interviews were referred in order to encourage the group to agree or disagree for active participation in the discussion.

After the discussion, participants were rewarded with candies and chocolates as a form of gratitude for volunteering to participate in the experiment. They were then permitted to leave the game lab.

6.2 Equipment

There were several types of equipment used for the successful conduction of the experiment. They are Sony TV, Go Pro Hero 4, Keyboard, Mouse, HTC Vive VR Headset, HTC Vive VR Controllers and X-box 360 controllers. Sony TV was used to display the game to the controller players. Keyboard and Mouse were used to navigate through the menu in order to start the exergame. Go-Pro Hero 4 camera was used to record the entire gameplay, interviews and the group discussions. The Vive VR Headset, Vive Controllers and X-box 360 controllers were exclusively used by the participants in order to control the avatars in the Exercise Monster Exergame. The specifications and use of the VR Headset, Vive Controllers and Xbox 360 Controllers can be elaborated further.

6.2.1 HTC Vive VR Headset

HTC Vive VR Headset, as shown in Figure 8, is the most important equipment used in the experiment. It provides the player with fully immersive first-person experience. It consists of a front-facing camera so that the user can observe their real surroundings without removing the headset. Additionally, it has adjustable straps and interchangeable inserts, eye relief adjustments such as interpupillary distance and lens distance adjustment, and it fits most glasses. The headset is pretty heavy due to the fact that they are built with thick plastic.

Figure 8. HTC Vive VR Headset (The Verge, 2016).

The Vive headset uses a 1200 by 1800 pixel OLED panel in front of each eye with a refresh rate of 90Hz. It provides the user with a field view of 110 degrees. There are many infrared sensors located inside its outer-shell divots. These sensors detect the IR pulses of the base stations up to 15 feet by 15 feet in order to determine the real-time location of the headset. Other sensors such as accelerometer, gyrosensor and proximity sensors help in tracking the rotation of the head so that the user can naturally look around the virtual environment as he would in real-life (Vive, n.d.).

In Exercise Monster exergame, the VR Headset was worn by the player playing Exercise Monster. As soon as the player wore the headset, he would experience being on a wooden arena or a shipwreck surrounded by water. Towards the right, he could see the controls to switch the method of attack. Towards the top, he could see his power level.

6.2.2 HTC Vive VR Controllers

HTC Vive VR Controllers, as shown in Figure 9, are exclusively designed for VR. They are primarily used for intuitive controls and movements. The input methods in a VR controller include a multi-functional circular plane trackpad, a menu button on top of the trackpad, a system button in the bottom of the trackpad, a dual-stage trigger on the underside, and two grip buttons at the bottom of the controllers. Its charge lasts for about six hours. There are twenty-four infrared sensors across the ring of the controllers which detect the base stations in order to determine the position of the controllers in relation to the stations.

Figure 8. HTC Vive VR Controllers (Evetech, n.d.).

The main circuit board on the inside of the controllers consists of NXP's LPC11U3x 32-bit ARM Cortex-M0 microcontroller and Lattice's iCE40 HX FPGA. InvenSense's MPU-6500 Six-Axis integrates a 3-axis accelerometer and a 3-axis gyroscope into a single unit in order to track the motion. A Micron M25P40 3V 4Mb low-power Serial Flash Embedded Memory unit is located next to the Six-Axis. On the back of the circuit board, sits a 960mAh Li-poly battery to power the controller. The battery is recharged using the Micro USB port located at the bottom of the controller (Brown, 2016).

In Exercise Monster exergame, when the player holds these controllers, they appear as human hands to the player playing as the Exercise Monster. While the left controller controls the tentacle in the game, the right controller is used to throw bombs at the controller players.

6.2.3 Xbox 360 Controllers

Xbox 360 Controller, as shown in Figure 10, is one of the important types of equipment used during the gameplay. A typical Xbox 360 controller consists of two analogue triggers, two analogue sticks, a digital directional pad (D-pad) and eleven digital buttons. The left face of the controller features the digital D-pad and the left analogue stick. The centre of the controller consists of three digital buttons: the Start button, the Guide button and the Back button. The Guide button is labelled with the Xbox logo. There is also a right analogue stick near the centre of the controller. The right face of the controller houses four multi-coloured digital action buttons: a green "A" button, a red "B" button, a blue "X" button and an amber "Y" button. There are digital buttons commonly known as the ‘bumpers’ and the analogue triggers on each ‘shoulder’ of the controller.

Figure 9. Xbox 360 Controller.

In the experiment, the Xbox 360 controllers were used by the players playing as couch potatoes to move their respective game avatars during the gameplay and to turn on their shielding power to protect themselves from the attacks of the Exercise Monster.

6.3 Measures

There were several measures adopted for the successful execution of the experiment. First of all, qualitative analysis method was chosen over the quantitative method in order to explore the social aspects of exergaming. This was because it was crucial to understand the participants' behaviour, opinions and feelings in order to test the social aspect of the Exercise Monster Exergame. Secondly, the experiment required the participants to be physically present in the same room. Online exergaming would not be as real, and it would be much more difficult to analyze the social aspect if this measure was not taken seriously. Additionally, Go Pro Hero 4 camera was used to record the behaviour of the participants during the gameplay, the interviews and the group discussions. The recordings were later used to study the social behaviour of the participants. This measure was adopted in order to avoid missing out on any participant behaviour that the conductor of the experiment might have missed. Moreover, the conductor of the experiment was always observing the participants' behaviour along with a helper from Turku Game Lab. Similarly, the interviews and the group discussions were conducted in a casual tone so as to avoid intimidating the participants and to encourage them to share their feelings and opinions. During the interviews, all the participants were asked the same open-ended questions, so that, the interviews can be conducted faster, and the answers can be analysed and compared easily afterwards. At the end of the interview, all the participants were thanked for their valuable participation in the experiment, along with some candies and chocolates. This measure was adopted to make the participants feel that the time and effort they invested in the experiment was very much appreciated and valuable for the experiment.

7 RESULTS

7.1 Participants

In total, sixteen participants agreed to play Exercise Monster and participate in the interviews as well as group discussions. The participants were adults aged between 18 and 35 [mean (M) = 25.0 years, standard deviation (SD) = 3.35]. Most of the participants in the experiment were males (n = 12, 75.0%). The participants consisted of Nepalese (n = 8, 50.0%), Finnish (n = 5, 31.3%), Chinese (n = 2, 12.5%), and Russian (n = 1, 6.3%). Most of them were students of Turku University of Applied Sciences (n=12, 75.0%).

7.2 Observation

The experiments with the Exercise Monster Exergame were conducted in Turku Game Lab. Each gameplay began with a test play. During the test plays, most of the participants asked questions mostly related to the game. They were primarily focused on playing the game rather than their peers during the test plays.

Every gameplay started with two players: one as the Exercise Monster and another as the couch potato. When there were only two players, the participants played very consciously and barely talked to each other. The only time the participants seemed to talk was to ask for instructions about the game. It seemed that the fact that the experiment was recorded and they were the first ones among the group somehow made them conscious. Hence, the gameplays started with a rough note on the social aspect.

With each gameplay, the number of players increased by one and hence, the conversation between the players also increased. However, this conversation was mostly among the controller players who were playing as a team. Most of them talked about which symbol they should be standing on together to paint them.

The Monster Players, on the other hand, did not interact as much with the other players. Although they spoke and made comments, they were not directed to anyone. Hence, the Exercise Monster players seemed to be lost in their own world. However, they seemed to be more intrigued for the gameplay rather than the controller players; this may be due

to the virtual reality experience. Every player whose turn came to play as the Exercise Monster seemed more excited than the rest of the players. They even seemed to be having fun while squatting for increasing their power. On the other hand, most of the players who played as the couch potatoes seemed to be bored after a while as they started complaining about being tired for having to stand while playing the game.

Similarly, it seemed that the players in some playgroups already knew each other before the experiment as they were much more comfortable with each other and were making snide jokes at each other. The Monster players lost almost every time the number of controller players reached three or more. Since there were only two symbols to paint, four players against one was a tough challenge.

The lighting during the experiment was bright, and the atmosphere was rather light-hearted with several people cracking jokes. The game created a lively environment with the players laughing and having fun while playing the exergame. Some groups were more interactive than others. The observers were only interacting with the participants when they needed help with the equipment or had any questions regarding the gameplay.

7.3 Interview

Participants were interviewed twice during the experiment: once before the gameplay and then after the gameplay. During the interviews before the gameplay, it was discovered that not all the participants had played an exergame before. Two participants out of sixteen admitted that they had never played an exergame before. Among those who had played, Pokemon Go! was the most popular exergame. Some of the participants admitted that they used to play exergames daily in the past. However, they mentioned that they rarely play exergames in the present. The majority claimed that they played exergames for both physical and social purposes. When asked about their expectations from the Exercise Monster game, some mentioned they think it would be somewhat socially interactive.

During the interviews after the gameplays, most of the participants admitted that they enjoyed playing the game, especially as the Exercise Monster. Majority of them admitted to enjoying the game as the Exercise Monster more than as the Couch Potatoes solely due to the thrilling experience of the VR technology. Most participants admitted that they

liked the concept of the game and the VR experience it provides the players with. However, few agreed that it was stressful to be the Exercise Monster due to the unfamiliarity to the VR technology. One participant even reported feeling dizzy while experiencing VR technology whilst wearing the headset. A few of the participants mentioned that wired headset and controllers annoyed them during the gameplay as they had to remain standing in a limited area and could not freely move around.

Reflecting on the social aspects of the Exercise Monster game, most participants agreed that the Exercise Monster exergame had some social aspects, especially for the couch potatoes. Some mentioned that the fact that the couch potatoes had to play as a team against the Exercise Monster contributed to the social aspect. Similarly, most participants also agreed that the game could definitely do better on its social aspects if further developed into a real and finished game with multiple advanced tasks and levels. One of the participants even recommended having multiple VR players in the game. Many recommended that Exercise Monster will need to involve tasks that require joint efforts from the players in order to increase the social interaction during the gameplay.

The individual interviews were held separately in the next room. When it was announced that the interviews would be recorded, it was noticed that some of the participants became aware of their sitting position and cautious of their answers. The participants were much more self-conscious during their interviews than during the gameplay. It was noticed that the participants opened up more during personal interviews rather than in the group discussions. The individual interviews last for a maximum of five minutes each.

7.4 Group Discussion

For the focus group discussion, all the four participants were seated facing each other on the couches of the Turku Game Lab. Although the participants were informed regarding the session being video recorded, it did not seem to affect them as much as it did during the interviews and the gameplays. During the introduction of the participants, they came to know that most of them were either current students of the Turku University of Applied Sciences or past students.

While reflecting on the social aspects of the Exercise Monster game, most participants agreed that Exercise Monster was definitely a social game, especially for the couch potatoes. Most of them felt that being social was easier while playing as the couch

potatoes since they had to play as a team. However, the majority of the participants considered that the Exercise Monster exergame lacked social motivation for the players playing as the Exercise Monster. Similarly, the majority agreed that the game could do better on its social aspects if further developed into a real and finished game with multiple advanced tasks and levels. One of the recommendations was to consider having multiple VR players. However, there was a long debate during one of the discussions where the participants debated if having multiple VR players would contribute to improving the social aspects of the exergame. Furthermore, some players suggested that the Exercise Monster should be able to increase its power with different kinds of other exercises and not just squats. It was agreed upon that exergames like the Exercise Monster needs to involve tasks that require joint efforts from the players to increase the social interaction during the gameplay. In general, most participants felt that exergames could be socially effective as long as they have multi-player features where the players are required to interact with each other to succeed in the game.

The tone of the focus group discussion was casual. Everyone was speaking informally and sometimes even used slang words during the discussion. This made it easier for the participants to open up during the discussion. However, in each discussion, only one or two participants were taking the lead. Hence, sometimes, the conductor of the experiment had to encourage others to voice their opinions as well. In all the four groups, there were at least two participants who knew each other prior to the experiment. In one of the groups, it was discovered that all four participants knew each other well. In fact, they were good friends. Obviously, this group was the most interactive one during the experiment.

Each focus group discussion lasted for about five to ten minutes. However, some of the participants chose to stay back for a while after the group discussion was over in order to interact with the fellow participants. Some of these conversations revolved around the topics of what the past students of the university were doing currently and how did some of them land jobs related to their field.

8 DISCUSSION

In the experiment, the behaviour of the players was analysed, particularly concentrating on their social aspect. The analysis made use of three qualitative methods: Observation, Interviews and Group Discussions. The results of the experiment have several implications as well as limitations. Similarly, there are several recommendations that can be followed in order to improve the quality of the results in the future.

8.1 Implications

The results of the game experiment primarily demonstrate that the increase in the number of players increases the social aspects of the players. Similarly, from the observation of the players, it is obvious that the couch potatoes or the controller players were more social than the VR players. This could be due to the fact that there were multiple controller players playing as a team against one Exercise Monster. However, it is obvious from the observation of the gameplays and the interviews that the players who played as the exercise monster enjoyed more due to the thrilling experience of the VR technology. Similarly, the results also suggest that the players mainly play exergames for fun and prefer to play in multiplayer mode rather than in singleplayer mode. Hence, it is crucial for exergames to be equipped with good and advanced multiplayer features to make the game more socially interactive for the players. Moreover, the fact that some participants knew each other prior to the experiment definitely affected the social aspect during the experiment.

Since the test was conducted with a very limited number of participants within a limited time frame, it cannot be guaranteed whether the Exercise Monster Exergame is actually a social game or not. However, Hwang and Salvendy reported that a sample size of 10±2 is sufficient for discovering 80% of all usability problems with a product or system (2010). Hence, the sample size of sixteen young adults participating in the experiment should be enough to evaluate the social aspects of the Exercise Monster Exergame. Based on the observation, interviews and group discussions, it can be somewhat deduced that it definitely helps people open up to the possibilities of socializing.

8.2 Limitations

Although the literature review provides various insights into the social aspects of exergaming, there are several limitations, such as language bias and limited keywords. For the research, only the studies published in the English language are referred to. Hence, all the other articles that might have added significant value to the research are omitted solely because of the language issue. Similarly, relevant research works have not been referred to due to the use of particular keywords.

The research experiment with Exercise Monster also consists of several limitations: technical issues, validity, the limited number of participants, time constraint and the venue of the game experiment.

While the experiment with Exercise Monster was going on, several technical issues occurred such as malfunctioning of the controllers and the symbols in the game not getting painted as they should. While these issues were solved with quick fixes such as replacing the controllers and restarting of the game, they certainly impacted the experiment by causing havoc among the players.

Similarly, the experiment with Exercise Monster game cannot be termed as a controlled experiment. Most of the players participating in the experiment either already knew each other prior to the gameplay or were from the same cultural background. This may have influenced their social interaction during the gameplay. Similarly, during the group discussions, not all the players were vocal about their feelings. Only a few voiced their opinions. Hence, the results of the group discussions might be biased towards those who actively participated in the discussion. Moreover, it is challenging to assess the quality of the studies referred to and the questions included in the interviews as well as the group discussions. Hence, the validity of the monster game experiment might be compromised.

Another limitation to the game experiment is the limited number of participants. Only 16 participants agreed to participate in the Exercise Monster game experiment, give interviews and participate in group discussion. Similarly, all the participants who participated in the experiment seemed physically fit and familiar with gaming and its technology. Hence, the results of the experiment may not best represent the entire young adults user-group.

Similarly, the game experiment was conducted within a very limited timeframe in a limited setting. The game experiment was conducted for only seven hours during a working day. This was due to the fact that the room used for the experiment was frequently used by Turku Game Lab for internal meetings, and the availability of the room for the experiment had to be checked beforehand. Hence, the results obtained from the limited timeframe may not accurately represent the social effects of the exergame.

Additionally, the venue that was used for the experiment is another limitation. The experiment was conducted in Turku Game Lab instead of a homely environment. This caused the gameplay experience to be different from a real-life gaming experience. Similarly, the closed setting of the Turku Game Lab limited the number of people who saw the game experiment going on. Hence, there were fewer participants in the game experiment than expected. Moreover, the room was only open during office hours, which limited the time frame for the experiment.

Moreover, the equipment used for the experiment can be considered as another limitation. The VR Headset and the Xbox 360 controllers were wired. This limited the participants from moving around during the gameplay. Similarly, since the VR Headset was wired, it was always a concern that the players playing as Exercise Monster might trip over the wire.

Hence, these limitations definitely impacted the literature review and the validity of the game experiment to some extent.

8.3 Recommendations

It is evident that due to the shortage of literature within the field of social aspects of exergaming, further research is essential. Any further research conducted in the future should investigate the joint results with various exergame experiments concerning the social effects of different types of exergames. Additionally, it is recommended that a controlled group of participants should be included in the game experiments so that the social behaviour of the participants do not get biased with the facts that they knew each other prior to the experiment or they are all from similar ethnical background. Similarly, the research should also implement follow-ups in order to evaluate the social effects of the exergames over an extended period of time.

There are several recommendations to improve the social aspects of Exercise Monster Exergame. One of them is to include multiple VR players in the game. Similarly, the game should be further developed with multiple advanced tasks and levels requiring joint efforts from the players to increase the social interaction during the gameplay. Furthermore, the Exercise Monster should be able to increase its power with different kind of other exercises and not just squats. This increases the variety of exercises in the game and thus increases the enjoyment level in the game.

9 CONCLUSION

The thesis basically examined exergaming, its history and types; but more prominently its social aspects with the help of several studies available online. In addition, the thesis tested the social effectiveness of Exercise Monster: a game prototype developed by Turku Game Lab. For this, a game experiment with the Exercise Monster was conducted in the premises of Turku Game Lab where the passersby were requested if they would like to participate in the game experiment along with the interviews and group discussions. Observation, Interviews and Group discussions were the main methods of qualitative analysis used during the experiment.

The results of the game experiment indicated that the increase in the number of players increased the social interaction among the players. Similarly, from the observation of the players, the couch potatoes or the controller players seemed to be more social than the Exercise Monster. This could be due to the fact that there were multiple controller players playing against one Exercise Monster or the VR player. On the other hand, in the individual interviews, most of the participants admitted that they enjoyed playing as the Exercise Monster more than as couch potatoes. This is credited to the thrilling experience of the VR technology. Moreover, it was observed that the participants opened up more during the personal interviews, while only one or two of the participants were taking the lead in the conversation during the group discussions.

Although many conclusions can be deduced from the research and the experiment, there were certain limitations that cannot be ignored. The key limitations in the research mainly included the limited keywords used in the research and the language bias as the research was only conducted in the English language. Similarly, the experiment also has limitations such as the limited number of participants, the enclosed setting of Turku Game Lab, the limited availability of time , and validity issues due to the experiment not being a controlled one, and technical issues.

Since the test was conducted with a very limited number of participants within limited a time frame, it cannot be concluded accurately whether the Monster exergame is actually a social game or not. However, based on the observation, interviews and group discussions, it can be cautiously claimed that the Exercise Monster exergame definitely helps people open up to the possibilities of socializing. Many participants, also agreed

that the Exercise Monster definitely has the potential to become socially more engaging if the game is developed further with more levels, advanced tasks and multi-player features where the players are required to interact with each other more during the gameplay itself.

The results of the thesis can be used by Turku Game Lab to develop the Exercise Monster further and make it more social. However, further research on the social aspects of exergaming seems to be essential in order to mitigate the limitations in this research and obtain more reliable results. Any further research as such should include experiments with multiple exergames of various types and controlled participants. Furthermore, further research should also implement follow-ups to evaluate the long-term social effects of the exergames.

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Interview Questions

The participants were interviewed twice during the experiment: first before the gameplay and second after the gameplay.

Questions before the gameplay:

a) What is your age?
b) Where are you originally from?
c) Are you a student of Turku University of Applied Sciences?
d) Have you ever played an exergame before?
e) If yes, which exergames have you played?
f) How often did you play exergames?
g) How social do you think exergames are?
h) What are your expectations from the Monster Exergame?

Questions after the gameplay:

a) How did you find the Monster Exergame?
b) Did you have fun, or was it stressful?
c) What did you like about the game?
d) What did you dislike about the game?
e) Do you think the game is a social exergame?
f) How can we improve the social aspect of the Monster Exergame?