First Person Exposure therapy for acrophobia

Master Degree Project in Informatics
One year Level 22.5 ECTS
Spring term 2017

Konstantinos Gkaris

Supervisor: Mikael Johannesson
Examiner: Björn Berg Marklund
Abstract

This thesis is focused on the development of games as a treatment for people who suffer from acrophobia, the fear of being in high-heighted situations. The purpose is to look over the immediate reactions of the players and study what effect first person gaming has on them in a short term. To achieve this, a series of three mini games is employed. Each game corresponds to a level. The first level is a tutorial which makes the player familiar with the game. In the second level, players are required to do a simple task. Finally, in the third level, the task is more pressuring and players need to be quicker to achieve the necessary goals.

What is expected from this study is that the full control of the playable character makes the players feel immersed. Additionally, as the game progresses, the players will be more comfortable with heights. Last but not least, it is assumed that fast pace enhances immersion, a major factor of this study.

As a result of our experiment, it is demonstrated that the control of the character from the player is a great tactic for immersion. Furthermore, it shows that the players start feeling better with heights even after one session. Finally, the study indicates that the fast pace enhances immersion, but over the time the increase of the pace has lower impact. These statements come as a result from the answers of the experiment’s participants and will be shown in detail in this paper.

**Keywords:** Acrophobia, Phobia Treatment, Serious Games, First Person
Table of Contents

Contents
1 Introduction ................................................................................................................................................. 4
2 Background.................................................................................................................................................. 5
  2.1 Electronic videogames and positive aspects ...................................................................................... 5
  2.2 Exposure therapy and its effects .......................................................................................................... 8
  2.3 Acrophobia ............................................................................................................................................ 10
  2.4 VR Research development in Acrophobia ............................................................................................. 11
3 Problem ..................................................................................................................................................... 14
  3.1 Aim ....................................................................................................................................................... 14
  3.2 Method .................................................................................................................................................. 14
    3.2.1 Procedure ....................................................................................................................................... 14
    3.2.2 Hardware ....................................................................................................................................... 15
    3.2.3 Participants ................................................................................................................................... 15
    3.2.4 Ethical considerations ..................................................................................................................... 15
    3.2.5 Expected results ............................................................................................................................. 16
    3.2.6 Limitations ..................................................................................................................................... 16
4 Prototypes .................................................................................................................................................... 17
  4.1.1 Level 1 .............................................................................................................................................. 17
  4.1.2 Level 2 .............................................................................................................................................. 17
  4.1.3 Level 3 .............................................................................................................................................. 18
5 Tests and Analysis ...................................................................................................................................... 19
  5.1.1 Part 1 ............................................................................................................................................... 19
  5.1.2 Part 2 ............................................................................................................................................... 24
  5.1.3 Part 3 ............................................................................................................................................... 25
  5.1.4 Part 4 ............................................................................................................................................... 29
  5.1.5 Part 5 ............................................................................................................................................... 33
6 Conclusions ................................................................................................................................................ 38
  6.1 Summary .............................................................................................................................................. 38
  6.2 Discussion ............................................................................................................................................ 38
  6.3 Future Work .......................................................................................................................................... 40
1 Introduction

Over the last few decades, videogames have been widely perceived as a hobby for many people, with a growing interest from the market and vast accessibility to them. Video games combine all the techniques that entertain and engage people to new and interesting experiences. As a result, games lately are being used in projects with other purposes, which go further than the pure entertainment. These kinds of projects are known as “Serious Games” (SG) and they are used in fields like military, health, education etc.

The huge spread of the specific field makes sense as Griffiths (2002) pointed out. As he stated, videogames are a very entertaining way of helping people to solve specific problems or teach specific skills. Additionally, as Miloff et al. (2016) realized, gamified exposure therapy is more preferable than the traditional exposure therapy. As a result, researchers tried to combine the gamification and the exposure therapy, most notably in the case of acrophobia. Acrophobic behavior can be perceived as the refuse of being in high-related conditions, such as stairs, apartments, planes, terraces, bridges, elevators and offices in high buildings, as Coelho et al. (2009) declare.

As the technology progresses, the expenses and the criteria of making digital environments appropriate for the treatment of the patients are not as high-priced and difficult as once were. With the employment of a program that simulates the cause of fear and a high-end level computer that is able to run that simulator in the most realistic way as possible, this goal can be achieved. All this is feasible, due to the fact that graphic engines and graphic cards become more advanced. This fact is important for the immersion, which makes the patient feel like everything around him is real. Previous efforts to combine the advanced technology and exposure therapy was done by Coelho et al. (2009), who used technology to describe thoroughly the case of acrophobia, and Schuemie et al. (2000) who used technology to generate some digital worlds for acrophobic people.

In all these cases though there was an issue. There was no control of the character from the patient. In these cases, the character was controlled either by the therapist or by the game designer. In this study we are going to investigate the immediate reactions and the short term effects of first person gaming in the case of acrophobia, with the patient having full control of the character. For this purpose, a small series of prototypes was developed in order to analyze the reactions and thoughts of the players. The development has been done with the use of Unity 5. The levels are quite similar, but the difference is that the level of difficulty and the heights are steadily rising.
2 Background

2.1 Electronic videogames and positive aspects

There are many reasons why games are considered beneficial and over the last decades the scientific community is trying to turn them into a tool for learning.

Although videogames at first were developed for their entertaining nature, it has eventually come to realization that they had many things to offer (Griffiths, 2002). One of those things is for example the fact that they can help people to solve specific problems or teach specific skills. But it is also clear to the author that they can potentially lead to gaming addiction, aggressive behavior and the generating of other psychological and mental problems. Despite all these dangers, according to the writer, researchers believe that positives surpass the negatives, stating that they can offer great help for educational purposes.

The most obvious thing to the author is that videogames are a very entertaining way of teaching adolescents and dive them in to new experiences. This is clear to Griffiths, since the entertainment that people get from the videogames is beyond compare to any other means of education that exists today. Sadly though, it has come to many people's attention that few games with an educational manner have succeeded commercially. Still though, as Griffiths says, it can be understood easily, that videogames enhance or develop new skills that were non-existent before. This becomes even clearer when the games are being tried by kids that lack extremely in abilities and skills. Additionally, any differences in spatial skill performance are steadily and slowly equalized.

As Griffiths says, these facts forced scientists to look deeper into the way that videogames can help individuals. The findings are that through videogames, scientists can take measurements, conduct research and easily change the parameters of the games. What is also extremely important is that they attract all different types of people. Furthermore, it assists adolescents to be more driven. Additionally, they are useful when it comes to measuring certain aspects of personality. It is also noticed that they are interactive, to the point of becoming immersive, realizing that they can be used as simulators. They also trigger curiosity, which is a good learning method. Finally, people are keener with technology, ending up growing IT skills. But there are some issues when it comes to usage as research tool. First, the participants are becoming overexcited, generating additional variables. Additionally, results cannot be compared due to the quick evolution of gaming technology. Finally, the participants get better gamers in time, a fact that makes the results untrustworthy.

Even so, Griffiths states that videogames have been tested on groups of people with special needs. It was proven to be efficient in helping individuals with special needs, for example autism. Like it was mentioned before, games possess assets that assist youngsters to develop skills.

In an article coming from Boyle, Connolly, and Hainey (2011), it was written that although video games are popular, early research was based on their negative effects on youngsters, with the most common results to be shown is the violence promotion, gender stereotypes and addiction. The reason behind it was due to the fact that many commercial games are
considered to be violent, which was a major concern. These claims though are rejected according to the authors, saying that the research which reported the effects of violent games is a subject of publication bias, since the effects were overrepresented in the literature. Furthermore if game playing is regulated it can be an enjoyable behavior. In the article the positive effects were stated. They are popular and that they are really entertaining. Additionally, according to the authors, players need to be competent and autonomous. Plus, commercial off the shelf games can construct new skills and knowledge. The writers mentioned the category of serious games that are specifically designed for learning, skill mastering and training. The concern though is the correlation of fun and learning, which is enormous. Furthermore, Commercial of the Shelf games are a freely chosen activity, while the educational games feel a little mandatory. But the motivational aspects are only half of the story here. The writers say that they support high cognition, like judgmental though, troubleshooting, decisiveness, speech support and hypothesis testing, plus they support skills necessary for the businesses, like creativity, organizing, communication, collaboration and team work. Also, dance and exercising games enhance fitness lifestyle. The article also states that games help in research. Finally in the article, terms like flow immersion and presence were proposed for understanding the feelings that come to the surface while playing.

Marsh (2011) also had a close look over the positive contribution of video games. He admitted that it is possible to take advantage of the engaging and motivational side of gaming, in a way that will make learning enjoyable. Serious games offer that for learning specific skills. He also stated that in serious games, education is first rather than entertainment. Marsh (2011) also says that not all serious games can equally balance experience and entertainment and the understanding of the term is hard, especially when it is coupled with the “games” term. According to Marsh (2011), serious games are digital worlds that engage players to activities with responsive story, gameplay or encounters to influence and well-being. Additionally not all characteristics like challenge or fun and play match with all serious games.

In a summit from Stapleton (2004), he was stating that although video games were made for entertainment, it became evident that they were a great tool for learning. Game developers according to the writer are constantly developing complex and fun challenges for players, making them to create strategies and skills in an entertaining way. Therefore, gamers can be called learners. In video games, control is on players while they interact with the environment according to the author. The author thinks health care is an extremely strong market.

Colzato (2010) also wrote how First Person Shooter games require from the players to develop a flexible mindset in order to rapidly react to fast moving visual and auditory stimuli, and to switch back and forth between different subtasks that are set to them. The new generation of First Person Shooter games require from the players to construct a flexible mindset that helps them to engage in difficult scenarios, to quickly react to moving visual and acoustic events, and to switch back and forth between different tasks. She looked over the hypothesis that gaming is linked with a general and generalizable enhancement of cognitive flexibility. She found out that playing FPS games predicts performance on a relatively well-established diagnostic index of cognitive flexibility. She also claimed that her
observations fit with previous reports of beneficial effects of videogame experience on cognitive skills and abilities. However, it is interesting to note that she didn’t find any impact of videogame experience on visual attention.

Drachen et al. (2010) wrote how three popular first person games, Doom 3, Prey and Bioshock affected gamers. Sixteen participants had heart rate and electrodermal activity measured while playing those games, each for twenty minutes and after that they answered questionnaires and were interviewed. They found out that physiological measures correlate with gameplay experience components.

McMahan (2003) wrote a few words about the first person perspective point of view. She said that the first person point of view offers navigable spaces to the players in order to pan, tilt, dolly and track through the space in real time. She also said that the use of the weapons is not only to aim. It is also to make the players more incorporated through the space, a fact that set the standards for presence and transparent interface. This trend is moving on to the virtual reality since it seems to promise high level of engagement, immersiveness and presence in an affordable way.

Riva (2011) also said a few words about the first person perspective. He defined First Person point of view as the one that allows player to discover objects related to the center of his body. He also said that the perception is constantly changing, based on where the players watches, but the navigator remains spatial fixed in the center of the reference system.

Colzato et al. (2012) wrote about the first person perspective and how it helped. First it was stated that players in First Person need to develop a flexible mindset and react fast to quick changes, visual or auditory. In an experiment conducted by Colzato et al. (2012) it was noticed that regular players were faster and more accurate than the non-regular players. Regular players also showed an efficient distribution of visuo-spatial attention capability and smaller switching costs when it comes to cognitive flexibility. But switching between tasks and mental sets is only one part. Three are the major functions: shifting between tasks and mental sets, inhabitation of unwanted responses and the updating of working memory representations.

A study was conducted by Gregg and Tarrier (2007), regarding the virtual reality in mental health. They examined various conditions, including the case of acrophobia. They declared that virtual reality merges real-time computer graphics, sounds and different sensory input in order to generate a virtual world in which the player interacts. It is on a head mounted display (HMD), which is either goggles or helmet and contains two small screens and earphones. It is stated that VR technology is improved since the first health application. It can be easily used to recreate events that can’t be done again, like the World Trade Center attack and can help sufferers with Post Traumatic Stress Disorders. Even low tech environments now can have positive outcome. It was mentioned a study from Rothbaum, which contained 20 college students with acrophobia. This study was split in half, and the first half did seven weekly sessions of VR exposure therapy with increasing difficulty and three different situations, a footbridge, a balcony and an elevator. The other half was on a waiting list. The results were that the first half was vastly improved, especially in comparison with the other group of the waiting list. The authors also mentioned a study from Emmelkamp where VRET was compared to vivo treatment. Ten patients participated in two
sessions of VRET and two of vivo therapy. Both improved anxiety. VRET also improved avoidance and the attitude towards heights. The results were the same after six months meaning that VRET is as effective as vivo therapy. Authors recall a statement from Krijn that VRET is as effective as vivo in acrophobia.

Gamberini et al. (2008) tried to implement videogames, but this time on elder people. It is claimed that fast images and concentration on different objects can stimulate peripheral processing, benefiting the nerve system. The improvements of cognitive and perceptual capacities, in visual selective attention, in spatial and reflexes are positives that Gamberini et al. (2008) can’t overlook. In the end of the article, Gamberini et al. (2008) claim that entertainment and training can be combined, as their team managed to improve functional independence and social reactions, while collecting data about physical and cognitive conditions was feasible.

In 2007 Jennett et al. (641-661) were conducting a series of experiments and in one experiment they were investigating the effects of an individual’s responses with the interface. 36 people participated with a mean age of 24.6 years. They made twenty questions with the PANAS-X counting the affective states and biosensors for stress levels and cameras for body motions. The result was that as the game became faster and faster, the more immersive but also anxious it was.

An article that comes from Sweetser and Wyeth (2005) explains flow as a model of enjoyment that includes eight elements, concentration, challenge, clear goals, control, feedback, immersion, skills and social interaction. Sweetser and Wyeth (2005) say enjoyment is incredibly vital. Without it players won’t play the game. Sweetser and Wyeth (2005) say that there are three aspects of usability. Interface, meaning controls and display, the mechanics, which is the way players interact with the digital world and the gameplay, which contains the problems and challenges the players need to solve.

### 2.2 Exposure therapy and its effects

There are many questions over the efficiency of exposure therapy and if so, to what point. Over the last decades there are many reports and articles that search that matter and declare their own conclusions.

One study that comes from the team of Miloff et al. (2016), testing if the gamified virtual reality exposure therapy for spider phobia is more preferable than the traditional exposure therapy. Their main theme was that although 3-hour one session exposure therapies were highly efficient, patients are hesitant in seeking help and treatment, plus access to help is short due to a vast number of difficulties. But virtual reality gaming may appear as an ideal solution, due to the improvement of existing techniques by facilitating access, minimizing costs and increasing accessibility and effectiveness. Now all these are feasible goals. According to Miloff et al. (2016), the method used in this specific research was the following: a group of one hundred people with spider phobia was split randomly in two different groups. The first group will be treated by the virtual reality exposure therapy and the second will be treated by the traditional exposure therapy. A behavioral approach test using vivo
spiders will be used as a primary outcome measure. Spider phobia questionnaires and self-reported anxiety, depression and quality of life will be included in secondary outcome measures. The outcomes will be assessed with the use of non-inferiority design at baseline and at timelines of one, twelve and fifty two weeks after treatment. As a result, the virtual reality subjects were vastly improved compared to traditional subjects, while after treatment in follow-up did not show great differences.

An article from Juan and Pérez (2010) writes down the findings in acrophobia, Augmented Reality (AR) and Virtual Reality Exposure Therapy (VRET). They state that acrophobia is treated either by imagination exposure, “in vivo” exposure or by applying VRET. They noticed that AR and VRET are equally efficient. VRET is an excellent idea since the design is exclusively for a particular problem and it creates same experiences as in the real world. They also define the sense of presence as the psychological perception of “being in” or “existing in” a digital world when the player is immersed. Writers recall Schuemie who saw a correlation between the level of fear and the feeling of presence during immersion, and Renaud who also correlated anxiety during immersion, sense of presence and motor behavior. Robillard in an experiment also found the same as Schuemie. Juan and Perez compared the levels of presence and anxiety on acrophobics with a use of Computer Automatic Virtual Environment (CAVE) and a Head mounted Display (HMD). In that world 25 volunteers experienced the walls rising and the floor fall away. They discovered that anxiety and presence are correlated and that VRET and AR are similar. T-tests and One-way ANOVA analyses showed no differences. The writers believe that AR can be an alternative for acrophobia treatment.

Another article coming from Horne-Moyer et al. (2014) explains the way that videogames can help in therapy. In this article, authors reviewed the use of videogames for a certain therapeutic purpose, for psychology and for entertainment. It is written that videogames are more similar to more traditional methods, plus they are more entertaining and accessible, at least for some consumers. Furthermore the field of therapeutic videogames seems promising, although more exact outcome studies are needed for more secure conclusions. Horne-Moyer et al. (2014) say that videogames for entertainment purposes are more accessible and more inexpensive to buy, they provide a large set of options and are more favored. The problem is though that control is not achieved easily and the therapeutic aspects of play are not that solid. The adoption of videogame therapy method is consisted of six challenges according to Horne-Moyer. First is to keep up with technological improvements. Additionally computer assistance can be likely harmful instead of therapeutic. Also, therapists possibly need some time in order to grasp an entirely different format. Plus, clients may face interventions not suitable for them. Furthermore, the personal contact of therapist and patient is significantly decreased, which means that the patient may not have a strong set of information for his condition. Finally there could be changes that affect completely the content of the therapy.

A different study revealed how through four different gaming interventions depression can be overcome (Li, Theng and Foo, 2014). These four types were psycho-education and training, virtual reality exposure therapy, exercising and entertainment. The result of this study was that all four categories had medium effect size, as supported by meta-analysis. These analyses were completed for the comparison of the effectiveness of these types of
games, the degree of therapist intervention, populations and comparison conditions. Unfortunately the small number of studies does not help for more secure outcomes, therefore additional research needs to be conducted.

In a paper from Lavender and Gromala (2012) there were notes about how health therapists tried to make virtual reality video games that help patient’s treatment over the recent years. But until then there was little use of video games or VR by researchers in treating speech impediments. What they realized is that excitement and anxiety are related to stress.

Meehan et al. (2002) published a paper with body measurements while in virtual environments. They said that a virtual environment is effective if there is a huge amount of presence evoked in gamers. They also declared that including in the Virtual Environment passive haptic element helps increasing vastly presence. According to them, the level of the subjective illusion of presence is the most ordinary metric of a Virtual Environment quality. They also defined reliability as the degree where the same test on random occasions has the same outcome and the orienting effect as a psychological reaction where the player considers something as novel. There are also definitions of validity as the degree where tests indeed measure what was needed to be measured and sensitivity as the possibility that an effect can be detected when it will occur.

Finally, a review from 2011 was released and compared exposure therapy and cognitive therapy (Ougrin, 2011). In this specific review, material from Psych INFO, EMBASE and MEDLINE was gathered and studies that compared exposure and cognitive therapy were included. Odds’ ratios (OR) or standardized means’ differences (Hedges’ g) were calculated. Outcomes were grouped based on specific disorders and were combined for meta-analysis for both short-term and long-term results. According to Ougrin the result that was revealed was that there is no major difference between exposure and cognitive therapy in terms of Panic Disorder, Post-Traumatic Stress Disorder and Obsessive Compulsive Disorder and there is a strong efficacy of cognitive therapy in social phobia. When these results came out, the importance of the inclusion of ERP in Obsessive Compulsive Disorder treatment looked like as a doubtful decision.

### 2.3 Acrophobia

There has been intense research over the case of acrophobia and the reasons that trigger it.

One review coming from the team of Coelho et al. (2009) was studying the approach of acrophobia and searched the improvements of technology over virtual reality and the way this specific technology helped the patients overcome this disorder.

Acrophobic behavior can be perceived as the refuse of being in high-related conditions, such as stairs, apartments, planes, terraces, bridges, elevators and offices in high buildings. It has been known that people with less fear of heights are the people who sustained once in their lifetime an injury because of a fall according to Coelho et al. (2009). Cognitive biases are being developed due to body interpretations that are related to body movement in height-related conditions and the individual senses in this situation as threatening. It has become notable that individuals with low fear of heights have grown postural balance to a remarkable degree. One experiment by Coelho et al. (2009) revealed that participants with
Acrophobia had raised levels of anxiety not only to the increments of height, but also in lateral movements in established height. A possible correlation between heights and movement can be observed.

One paper that comes from Agras, Sylvester, and Oliveau (1969) declares that the phobia of doctors, injections, darkness and unknown persons indicate a strong declining trend, meaning that they don’t hold for long. On the contrary though, it is said that phobias of animals, storms, acrophobia, claustrophobia and agoraphobia indicate an incredibly slow decline which proves that they are long lived phobias. The third pattern of their results shows a slowly lessening occurrence which extends until the sixth decade of individual’s lives and a prevalence peak when the individuals are in the late adult phase.

In a paper that comes from Boyd et al. (1990), a very interesting statement is that phobias are considered the most ordinary disorder in the psychiatric society, even more ordinary than cases like major depression or alcohol abuse or dependence in the month. They also clarified that the most powerful risk cause connected to fears is the existence of another psychiatric disorder. It was also mentioned that fears normally show up during childhood or as adolescents and there is a strong downwards trend in new cases in time. They estimated that the mean age that traumas are caused is at 11 or 17 years old and they last from 24 to 31 years. Additionally, it was found that women tend to be more phobic persons than men, especially in the age group of 18 to 44 years old.

In a paper coming from Coelho et al. (2008), the definition of acrophobia is defined as a chronic, extremely crippling disorder which stops the patients from being in high heightened situations. The writers mentioned that the studies up to that point were focusing on the effects of a variety of therapeutic methods, cognitive processes and time and frequency of the exposure treatments, although etiologically it is obviously vital, motion is never declared as a key factor in exposure therapy. In the research writers conducted, the average Subjective Units of Discomfort scores are very alike in both horizontal movement and climbing up, but both are bigger than static exposure. Additionally, the variance in horizontal movement was less than in climbing, meaning that exploratory patterns of the environment produce greater fear than vertical climbing movements.

### 2.4 VR Research development in Acrophobia

Over the last few decades there were many scientists who conducted research in the case of Virtual Reality Exposure Therapy and Acrophobia, with the results being noticeable.

According to Coelho et al. (2009), scientists tried to realize what generates acrophobic behavior using VR. One is the visual sensor. People try to respond and move, depending on what they really see. Also postural triggers are very significant. In one experiment, non-acrophobic people while blindfolded they had more sway than when they could see, whereas the acrophobic people had less while blindfolded and more when they could see. Finally, body coordination with eyesight is essential. These two are connected and many participants are depending on that. There is a likelihood that self-motion can produce the fear of heights. Visual dependence is being raised with height and the patients can be highly dependent while they walk on narrow support.
An article was conducted in 2000 by Schuemie et al. (2000). In this article the outcome of a series of tests was made in order to observe the characteristics and possibilities of virtual reality exposure therapy with the purpose of deciding the requirements for a system which will assist therapists. In this article, the goal was to describe the traits of the virtual reality system. Also, the description of the virtual world where acrophobia would be treated is necessary.

In this series of experiments by Schuemie et al. (2000), three worlds were developed using a high-level VR development tool for that era. The worlds made were evaluated by the patients. The immersion of each world would be completed two times by each patient. The first time without questions and the second time questions and comments were approved and at the end everything would be measured by questionnaires. Six patients were included in this study. The measurements were taken by the Acrophobia Questionnaire, Altitude towards Heights Questionnaire and Fear and Presence Questionnaire.

The emulator was a Pentium Pro 200MHz computer with 64MB RAM and Matrox Mystique 220 graphics card with operation system of Windows 95. The software was Superscape VRT 5.0. Subjects must wear the I-glasses from Virtual-IO. The Heading Mounted Display had a three-degree of freedom motion tracker with narrow field of view of thirty degrees and resolution of 180,000 pixels. Stereographic projection was supported through interlacing. It also needed a VGA output. Odd horizontal lines were projected to the left eye and even on the right eye, so that the subjects will be able to see depth. The subjects could see a lot from the real world, even with HMD mounted, so a cloth was vital all around the virtual world, so that the real world was eliminated.

A metallic structure was essential to be built a few inches off the ground so that people will feel the important essence of height. The first world used for this series was a roller coaster where the player is in a mining car running on a track which contains loopings and barrel rolls. They could look around with the use of HMD. In the second world there was a swimming pool with two opposing diving towers and a bridge over it. In the third world there was a glass elevator. In the second and the third world the movement could be controlled by the therapist with the use of a joystick. The first evaluations revealed that the second world was the most effective, therefore the bridge was removed and the elevator was added there. The speech volume and wind was a variable based on the level of height. In low heights there was mild wind but intense speeches and in high heights there was intense wind but no talks. Additionally, an autopilot was added for the luxury of the therapist.

The outcome of the first world was that people were not that afraid, because of the fact that patients didn’t have any kind of control, the loopings were not that high to generate fear and the brown mountains did not trigger a feeling of reality.

In the second world the results were improved. The bridge was a bad idea due to the fact that subjects felt it was unrealistic. The sound of people was the same at every single height which was questionable. Additionally they thought that they could potentially fall which was frightening for all the patients. The third world was the most horrifying to all but one.

The influence of VE was measured as the acrophobia seems to be weakened. No connection is revealed between the level of presence and the effectiveness in lowering acrophobia but
the degree of fear is correlated to the degree of presence. In general, VR can be effective in the treatment of acrophobia, in spite of the low quality of generated worlds, which is extremely vital because of the fact that high quality VR systems can be high-priced.

In a report coming from Costa, Robb, and Nacke (2014), it was stated that VR environments are used for a long time to assist in the treatment of a variety of clinical conditions. Due to the fact that the patients are not in danger while they are exposed in situations, the VR is widely preferable. The authors claim that fears are extreme medical conditions that cripple people’s lives. The writers gave a definition for immersion, as the sense of diving in a computer application, where the player’s attention, thought and purpose is focused on the application and not in his surroundings. Immersion is critical and it can be developed or ruined by aesthetics. The authors say the levels of involvement are three, engagement, engrossment and total immersion. Engagement is the low barrier, like learning the controls. In engrossment, players and the game construction presented are getting linked. In total immersion players are cut off from the real world and only the game matters. Authors also say that immersiveness is able to change the way we realize the imagery in virtual worlds.

In a study from Jang et al. (2002), people with acrophobia were categorized as individuals with anxiety when it comes to height exposition, height avoidance and inefficiency. This malfunction has to do with the daily routine and personal relationships. VRET according to authors is relied on systematic desensitization, providing stimuli on patients with poor imagination. VRET has better control in the degree of exposure as long as it is more efficient and less pricy. Models must have small polygon data so that they will be more realistic. With VRET impossible or non-existing situations can be created, although in real life it is impossible to happen. Also for the authors, immersion is vital, otherwise there is a huge chance the whole therapy will fail.

In a paper from Roth et al. (2016) there is a description of an experiment on VRET in Acrophobia and their findings. What they stated is that full body motion capture for real-time VR, is a strong tool for simulating the body movement. This can be achieved by the use of single depth images. But it was mentioned that single camera utilization, usually show enormous latencies for pose estimation. Instead, optical tracking systems usually demand a suit with markers that need preparation time and are uncomfortable. They suggest that Inverse Kinematics (IK) can imitate human motions even with few sensors. In the past scientists realized that IK solutions are accurate and easy to apply in real time environments. The authors’ results reveal that simplified IK approach reduce latency and task load for users. They close their paper by saying that Rigidbody Inverse Kinematics is an excellent idea for single user applications.
3 Problem

This far, although a vast amount of research has been conducted in the area of acrophobia treatment, it was rarely focused on the field of Serious Games as it can be seen in the previous chapters. In most cases, there were simulators controlled by a third person or it was on rails, meaning that the beginning and the destination were pre-determined by the developer or the therapist. According to Schuemie et al. (2000), this can break the immersion, due to the fact that the patient does not have full control of his actions. This means that there is a lack of freedom, which can potentially break the immersion, an outcome which in any case should be avoided.

3.1 Aim

In this project, the goal was to test the immediate reactions and the short term effects of first person gaming in the case of acrophobia. In our study, in order to face the problem that was stated above, the control goes completely on the player, making the player responsible for his actions. Overall, the whole procedure of prototyping, planning and designing was conducted according to the standards set by Baskerville and Wood-Harper (2017). This article is chosen because it describes the process of conducting research in computer science. With this article as guideline, we made a prototype game on a paper and playtested it with friends and colleagues in order to see what was working well and what was needed to be fixed. Then we turned the paper prototype into a digital prototype which later on was enhanced with features and content. Then we playtested it with people who were not part of the sample in order to give our sample a solid game. And finally we presented the game to the sample with the questionnaire.

In our case we assume the following hypothesis:

- The full control of the character from the player makes the game more immersive.
- The more the patient plays the game, the more he feels comfortable with heights.
- Fast pace enhances immersion.

The first one comes as an assumption that people need to act on their own and analyze their surroundings, therefore the whole experience becomes more interactive, thus more immersive, as it was noticed by Schuemie et al. (2000). The second point comes as a belief that exposure therapy works and that our work follows the guidelines of previous tests in this field, Miloff et al. (2016). The last hypothesis is based on the paper from Jennett et al. (641-661) that declares this as a result, but it can be considered a great idea to reconfirm it since it appeared in only one paper and not in other paper works that were viewed so far.

3.2 Method

3.2.1 Procedure

In this paper the results of a small series of experiments is going to be presented. The procedure is based on the standards set by papers coming from Baskerville and Wood-Harper (2017) and the European Federation of Psychologist’s Associations (2005), which
describe how a research should be conducted. These articles were picked due to the fact that the combination of both describes how a research should be conducted in a fully trustworthy environment, an essential point in our research. Following these papers as guidelines, the series of experiments is going to be conducted in a closed room where silence and privacy will be the key in order to make the participants more comfortable. This means that everything should be private and no one else must have access to the player while he plays and answers the questionnaire, not even the researcher, so that the feedback will be honest and without influences. Here a small group of people are going to answer a pre-test questionnaire which is based on the results and conclusions that Coelho et al. (2009) declared, in order to see whether these people are acrophobic or not, and if so, to what degree. We needed to do that in order to group the players and to analyze their responses per group. Then they are going to experience the first person edition of the game that was developed for this purpose. This is vital, because if this part doesn’t work, our overall effort for phobia treatment will be insufficient, thus failed. Afterwards, the group will need to answer the questions written on a questionnaire given to them. This specific questionnaire is based on the conclusions made the Coelho et al. (2009). These results will be written down and presented for commentating and analysis of what went well and what went wrong.

3.2.2 Hardware
For the development of the game, the technology available was a computer with the following specifications: Core 2 Duo processor at 2.10 GHz, with 4GB RAM and NVIDIA GeForce 8400GS with 256 MB of memory. Unity 5.3.5f1 was employed in order to develop our digital worlds and a small pair of headphones in order to listen to the sound that is generated without any outside distractions.

3.2.3 Participants
There is going to be a sample of twenty participants, consisted of friends, colleagues and people who responded to an advertisement at “Skövde International Students” group page on Facebook. The methodology selected is the Purposive Sampling, according to the directions of Etikan (2016). We selected this article in order to realize which is the best way to do a research with balanced attributes. The Purposive Sampling is chosen due to the fact that the researcher knows already the sample’s attributes in order to keep the 50-50 ratio of gamers and non-gamers, acrophobics and non-acrophobics. This ratio is important, in order to have results that will not be significantly different from one group to another. The participation is voluntary. The separation between acrophobics and non-acrophobics is done so that we will be able to see how acrophobia can affect the outcome of the game. The separation between gamers and non-gamers is done, so that the outcome is going to be more clear and targeted and to see whether the gaming skills affect the outcome or not. To do so, before they answer the pre-test questionnaire, I will ask them privately if they consider themselves gamers and if they consider themselves acrophobics, so that I will keep the ratio as balanced as possible, in order not to have vastly diverse results in the questionnaire, which can potentially lead to difficulties in expressing conclusions.

3.2.4 Ethical considerations
In this case, as stated by the European Federation of Psychologist’s Associations (2005), everything needs to be done in high confidentiality, integrity and respect for the patient’s
rights and dignity should be guaranteed in our study. This paper is mentioned in our study due to the fact that it states the basic fundamentals of a secure and isolated research without distractions and leaks of personal data. Following this paper as guideline, no one has access to sample's playtime and no one can see what specific patients answered, not even the researcher, because this will intimidate our patients and will force to false results. Patients have the right to stop at any moment, if they feel uncomfortable or nausea. Furthermore, the patients are going to be informed about the cause of the research and their rights before answering the pre-test. This is also essential, because we need honest responses and people need to respond based on the goals of this research.

3.2.5 Expected results
What is expected here is a slight improvement of our sample when it comes to acrophobic situations. The increasing difficulty will make players more intrigued by the game and the fast pace will force them into that direction.

On the other hand, some players might overlook the serious factor of the game and focus on the entertainment aspect of the game. That is an issue that needs to be worked on.

3.2.6 Limitations
There are some issues in this work here. In the sampling, the fact that many of the participants are friends and colleagues limits the variety of the sample and it is not as broad or random as it was expected, for example in the age variable. In other words, broader sample, like for instance extremely acrophobic people or elder people may have given significantly different feedback than the one that was actually received. Also some people believe that this method is less reliable than having a sample that is fully random and more vulnerable to biases as Etikan (2016) pointed out in his article about convenience sampling and purposive sampling. Here purposive sampling was preferred due to the fact that the researcher knows the attributes of his sample and can keep a ratio that the researcher wishes. This was a deliberate choice, due to the fact that a 50-50 ratio can ensure results that are not vastly different. Additionally, that method doesn’t fully ensure high confidentiality, due to the fact that in order to keep a 50-50 ratio of acrophobics and non-acrophobics, we needed to ask a few questions before the pre-test questionnaire, which should be avoided according to the European Federation of Psychologist’s Associations (2005) because violates the rules. This means that it would be more preferable to have a ratio that it is not balanced and would only answer to the questionnaires presented to them for more confidentiality, resulting to wide differences in the answers of the groups.
4 Prototypes

In this section there is going to be a description of what the prototypes were, the logic behind their development and the goal that needs to be achieved by making those prototypes.

4.1.1 Level 1

In this particular level, players have no time limitations or something that pushes them hard in order to reach their goal. It’s more of a tutorial level rather than a competitive level. Here players only get familiar with the controls of the game and the possible motion sickness that the system may cause to the players, while they try to reach the wooden platform which is the goal.

The level is simple. Players start here.

Then after walking over this narrow wooden walkway, the players need to pass through some twists and turns that the level has. The goal here is to reach the end as it was said before, which is a wooden platform at the end of the walkway. When the players do so, the next level begins.

4.1.2 Level 2

Here things become more difficult. In this specific level, players need to disarm all the ten bombs in the building in six minutes, otherwise they fail and the level restarts. To do so, the
players need to stand next to them and press the action button. Meanwhile, in order to reach them, the players have to walk through floors of the glass building and pass through tight terraces and narrow wooden ramps. The goal here is to slightly force players to rush from one quest to another, in order to be more familiar with the heights and be more immersed to the game for the purpose of realism.

The way the level goes is this. This is the starting position.

![Figure 2: Beginning of Level 2](image)

Afterwards, players need to find the bombs inside the floor, deactivate them and then go outside the floor through the terraces and ramps in order to find the new ones.

**4.1.3 Level 3**

This is the hardest level of the game. The logic behind it is exactly the same as in the second level, but with two twists. Now time is less and there are more bombs for the player to disarm. With these slight changes, the goal is to put the maximum pressure on players in order to complete the level and therefore the game itself. With these changes it is believed that immersion will be as deep as possible and players will be even more familiar with the heights.
5 Tests and Analysis

5.1.1 Part 1

The data that came out from the test are the following. As it can be seen in the graph below, one person was between 18-20 years old, nine people were between 21-25 years old, nine people were between 26-35 years old and one person was older than 36 years old.

![Age group](image)

Figure 1: Age group

From that sample, there were seven women and thirteen men as it is shown below.

The results from that sample in the question ‘I play frequently video games’ are depicted adown. From these results, it is safe to assume that we have a 50-50 gamers non-gamers ratio, which is really good for the purpose of the research over how gamers see the game and non-gamers see it.

![I play frequently video games](image)

Figure 2: I play frequently video games
In the question ‘I feel comfortable climbing a ladder’, the responses are the following. This question checks whether a person feels uncomfortable in this situation. Non-gamers can cope better with ladders as it seems.

![Graph showing comfort levels of gamers and non-gamers climbing a ladder.]

**Figure 3: I feel comfortable climbing a ladder**

In the question ‘I feel comfortable walking in narrow stairs’, these are the results. This question checks whether a person feels uncomfortable in this situation, which is typical for acrophobics. The results show that non-gamers are slightly more comfortable in walking in narrow stairs.

![Graph showing comfort levels of gamers and non-gamers walking in narrow stairs.]

**Figure 4: I feel comfortable walking in narrow stairs**

In the question ‘I feel comfortable being in glass elevators’, the answers are depicted. This question checks whether a person feels uncomfortable in this situation, which is a question in another experiment. Again the results show that this group is less acrophobic in this case.
In the question ‘I feel comfortable looking down in balconies’, the results we had are these. Again, this question checks whether a person feels uncomfortable in this situation, which is a question in another experiment. Results show that non-gamers feel more comfortable in balconies than the gamers.

In the question ‘I feel comfortable being in tall buildings’, the answers are depicted neither. Again, this question checks whether a person feels uncomfortable in this situation, which is typical for acrophobics. Results show that non-gamers feel more comfortable in tall buildings than the gamers.
In the question ‘I feel comfortable being in tall buildings’, the feedback we had is this. Again, this question checks whether a person feels uncomfortable in this situation, which is used in another research. Results show that non-gamers feel better in tall buildings than the gamers.

In the question ‘I feel comfortable being in narrow bridges’, we had these results. The question checks whether a person feels uncomfortable in this situation, which is standard question for acrophobics. Results show that non-gamers feel vastly better in high places than the gamers.
In the question ‘I could be in a rollercoaster’, the feedback we had is presented below. The question clarifies whether a non-acrophobic person is acrophobic and vice versa. The non-gaming group is feeling slightly more comfortable with rollercoasters.

In the question ‘I feel comfortable looking down in high places (cliffs etc.)’, the answers are the following. The question checks whether a person feels uncomfortable in this situation, which is standard question for acrophobics. Results show that non-gamers feel vastly better in high places than the gamers.
Figure 11: I feel comfortable looking down in high places (cliffs etc.)

5.1.2 Part 2

In the second part of the questionnaire, in the questions ‘I was afraid of heights before the game’ and ‘I am afraid of heights after the game’ the gamers subgroup had these results. This indicates an improvement in that target group. From the non-gamers subgroup, in the same question, the feedback is this. This suggests a vast improvement in that target group. This can be possible due to the fact that gamers see this game as such, while the non-gamers are more able to see the serious part behind it.

Figure 12: I was afraid of heights before the game & I am afraid of heights after the game

Overall, in the question ‘The fact that I controlled the player helped me to enjoy it’, results show that being able to control your own character is considered by many as a far superior idea than having the therapist or the developer move it, which supports my hypothesis.
Figure 13: The fact that I controlled the player helped me to enjoy it

5.1.3 Part 3

Now the next set of questions had to do with the first level, which was the tutorial level. In the question ‘The altitude was high’ the results are depicted neither. This question checks if people think that the altitude of the level was high. The explanation for the change between gamers and non-gamers is that in our sample there were more acrophobics in the gamers group than in the non-gamers. From our sample there was also a separation between acrophobics and non-acrophobics. This separation was based on the fact that the acrophobic group had answered more with 1 and 2 rather than 4 and 5. The changes between acrophobics and non-acrophobics make sense due to the fact that in the estimation of height, fear is also a major factor, making the height bigger that it normally is.

Figure 14: The altitude was high

In the question ‘The level was enjoyable’ these are the answers. This question checks if the first level was enjoyed by the players or not. The changes are not vast, but they are reasonable, since the gamers play other games and compare this game with the other games
on the market, while non-gamers are more focused on this game. Also an explanation for this significant change between acrophobics and non-acrophobics is that fear prevented acrophobics to enjoy the level.

![Figure 15: The level was enjoyable](image)

In the question ‘The level made me afraid’ the results are presented below. This question checks if the first level made the groups afraid or not. It seems like the first two groups were not afraid. An expected result is noticed in the comparison of acrophobics and non-acrophobics, since the acrophobics are still trying to overcome their fear.

![Figure 16: The level made me afraid](image)

In the question ‘I didn’t feel motion sickness’ the answers are depicted below. This question checks if people were feeling well or not. All groups felt quite well it seems. It is safe to assume that technically the level was good.
In the question ‘I would play the level again’ the feedback is this. This question checks the replayability of the first level. Both gamers and non-gamers groups are quite willing to replay the level as it seems. Also it seems that non-acrophobics are more likely to replay the level, rather than the acrophobic group.

In the question ‘I strongly recommend the level’ these are the responses. This question checks if the first level was a good idea or not. This level was slightly more appreciated by non-gamers. Overall the differences are not major, but all groups believe it is a relatively
good idea to have a tutorial level.

Figure 19: I strongly recommend the level

In the question ‘I got used to the heights’ the answers are presented below. This question checks if people think the height of the level was too high for them or not. More or less all groups coped with the height of this level.

Figure 20: I got used to the heights

In the question ‘I felt involved in the game due to pace’ this is the feedback. This question checks if people felt immersed in this level due to pace or not. The differences are minimal,
and it seems all groups felt quite immersed due to pace in this level.

Figure 21: I felt involved in the game due to pace

5.1.4 Part 4

The next set of questions had to do with the second level, which was the level with light pressure. In the question ‘The altitude was high’ the responses are these. This question checks if people think that the altitude of this level was high. The changes between gamers and non-gamers are slight. But the changes between acrophobics and non-acrophobics are vast. That is again reasonable due to the fact that in the estimation of height, fear is also a major factor, making the height bigger that it normally is.

Figure 22: The altitude was high

In the question ‘The level was enjoyable’ these are the results. This question checks if the

29
second level was enjoyed by the players or not. The changes are not significant with all groups but the acrophobic agreeing that it is a pleasant level.

![Figure 23: The level was enjoyable](image)

In the question ‘The level made me afraid’ the answers are presented below. This question checks if the second level made the groups afraid or not. The changes are very slight but all the groups were not really afraid. Also, here the acrophobic group was way more afraid than the non-acrophobic.

![Figure 24: The level made me afraid](image)

In the question ‘I didn't feel motion sickness’ the feedback is depicted below. This question
checks if people were feeling well or not during the level. Here all groups felt quite well during the walkthrough of the game. It is safe to assume that technically the level was relatively good.

![Figure 25: I didn't feel motion sickness](image)

In the question ‘I would play the level again’ the results are these. This question checks the replayability of the second level. Looks like non-gamers are more willing to replay the level than the gamers. From the results below, all groups agree that there is a small replayable value in the game.

![Figure 26: I would play the level again](image)

In the question ‘I strongly recommend the level’ the responses are depicted below. This question checks if the second level was a good idea or not. Here the differences are not
major. All groups believe it is a relatively good idea to have a low difficulty level.

In the question ‘I got used to the heights’ the answers are depicted below. This question checks if people think the height of the level was too high for them or not. In all groups the majority of the participants got used to the height of this level

In the question ‘I felt involved in the game due to pace’ this is the feedback. This question
checks if people felt immersed in this level due to pace or not. The differences are minimal, and it seems all groups felt immersed due to pace in this level.

Figure 29: I felt involved in the game due to pace

5.1.5 Part 5

The final set of questions had to do with the last level, which was the difficult level. In the question ‘The altitude was high’ the results are these. This question checks if people think that the altitude of the last level was high. There is a gap between acrophobics and non-acrophobics, which is reasonable due to the fact that in the estimation of height, fear is also a major factor, making the height bigger that it normally is. Additionally, slightly fewer people found the altitude higher than the second level, even though it is the same level, due to the fact that fast pace makes people skip details of the level.

Figure 30: The altitude was high
In the question ‘The level was enjoyable’ this is the feedback. This question checks if the final level was enjoyed by the players or not. In the first two groups there is a change. An explanation is that gamers found the level challenging and the non-gamers difficult. In the last two groups there are differences, but again both groups agree that the level is pleasant. In comparison to the previous level, this was slightly more pleasant, due to the fact that it was more challenging.

![Figure 31: The level was enjoyable](image)

In the question ‘The level made me afraid’ the answers are presented below. This question checks if the last level made the groups afraid or not. The changes are very slight but all groups were not really afraid. It is noticed that the acrophobic group was way more afraid than the non-acrophobic. Furthermore, a few people were more afraid in this level than the previous, due to the fact that they were more reckless because of the timer, ending up to more possibilities to fall.

![Figure 32: The level made me afraid](image)
In the question ‘I didn’t feel motion sickness’ the responses are depicted below. This question checks if people were feeling well or not during the level. In the first and the second group there are changes. One explanation can be that non-gamers are not used to play under pressure. It is safe to assume that technically the level was relatively good. No major differences are appearing between this level and the previous.

**Figure 33: I didn’t feel motion sickness**

In the question ‘I would play the level again’ the results are these. This question checks the replayability of the final level. It seems that non-gamers liked the level more. From the results above, all groups agree that there is a small replayable value in this level as well with no major changes over the previous level.

**Figure 34: I would play the level again**
In the question ‘I strongly recommend the level’ the answers are depicted below. This question checks if the final level was a good idea or not. It appears that non-gamers appreciated more the idea of limited time. Here all groups believe it is a relatively good idea to have a pressuring level. Furthermore, there is a slight more appreciation for this level, rather than the previous.

Figure 35: I strongly recommend the level

In the question ‘I got used to the heights’ the feedback is depicted below. This question checks if people think the height of the level was too high for them or not. In all groups the majority of the participants got used to the height of this level. Plus, results in this level were better, possibly because of the repetition.

Figure 36: I got used to the heights
In the question ‘I felt involved in the game due to pace’ these are the answers. This question checks if people felt immersed in the last level due to pace or not. The differences are minimal, but the non-gamers group felt more immersed due to pace in this level. All groups felt quite immersed due to pace in this level. In comparison to the previous level, no differences were noticed due to pace change.

Figure 37: I felt involved in the game due to pace
6 Conclusions

6.1 Summary

To sum up, in our research, there were twenty people, of whom ten were gamers, ten were not gamers, nine were acrophobic and eleven were not. Their age was mainly between 21 and 35, thirteen of them were men and seven were women.

As the analysis shows, the majority of the participants were feeling better with heights after the game, even though the procedure was done only once. In most cases the participants have multiple sessions. In this fifteen minute session, as the gameplay goes on, the players were getting more comfortable and keen with the game. The creation of many levels that were relatively similar was the reason to achieve that. This supports the hypothesis which states that the more the patient plays the game, the more he feels comfortable with heights. Additionally the majority of the participants felt that owning the controls of a player is a good idea, another thing that supports the hypothesis which states that the full control from the player makes the game more immersive.

In the first level, the height was relatively low according to all groups but the acrophobic group. Also it was quite enjoyable to all but the acrophobic group and also very few people from both groups were afraid from the level. Furthermore, almost everyone didn’t feel motion sickness, and most of them might like to replay the level. Additionally in all the groups, the majority believes that it is quite good idea to have a level of no pressure and they also got used to the altitude of the level. Finally the immersion due to pace was medium.

In the second level, the height was higher than before and it was more enjoyable than the first level. Also gamers and acrophobics were slightly afraid from the level. Furthermore, more people felt a little motion sickness, but that comes as a result from the pressure, and apart from gamers all of the groups were more willing to replay the level. Additionally apart from the acrophobic group, the majority believes that it is a better idea to have a level with little pressure and again the majority got used to the altitude of the level. Finally the immersion due to pace was bigger than in the first level.

In the final level, the height was relatively lower than the second level according to the participants, even though it was the same. That’s because pressure makes people skip many details. Also it was the most enjoyable level but also the scariest. That is happening again due to the fact that pressure makes people do mistakes and be reckless. Furthermore, almost everyone didn’t feel motion sickness apart from the non-gamers group. That happens because of the fact that they are not used to play so stressful games. To add up, the replayability value was exactly the same as in the second level. Additionally in all the groups, the majority believes that it is a good idea to have a level of high pressure and they also got used to the altitude of the level. Finally, the immersion due to the pace was the same as in the second level, a fact that overall relatively supports the hypothesis that fast pace enhances immersion.

6.2 Discussion

All in all, the hypotheses of this research were almost validated as the feedback from our
sample indicates. The fact that we based the whole procedure of prototyping, planning and designing according to the work of Boyle, Connolly, and Hainey (2011) was extremely helpful. The paper prototype game helped us to see what was working well and what was needed to be fixed. Then the transition from a paper prototype into a digital prototype was a solid step, because we already had a stable idea and good basic fundamentals. Later on, the playtesting helped to see if there were bugs and glitches that could possibly destroy the game for our patients, a result that could be possibly catastrophic. Also the fact that we followed the guidelines of Baskerville and Wood-Harper (2017) and the European Federation of Psychologist’s Associations (2005), helped to conduct a research in an isolated environment as possible. Silence and privacy helped the participants to feel more comfortable to answer without any doubts and it also assisted them to focus to the game even more. During that time, no one was able to disturb them, not even the researcher. The pre-test questionnaire which is based on the results and conclusions that Coelho et al. (2009) declared, was extremely helpful. The categorizing of the sample to acrophobics and non-acrophobics, gamers and non-gamers, helped us to realize how the game affected each group and the reasons for it. Additionally, the overall positive feedback on the first person edition of the game was a good outcome, meaning that there was nothing that could ruin the overall experience of the game. Finally, the last questionnaire which is based on the conclusions made the Coelho et al. (2009) helped us make the previous conclusion and showed us how every group was influenced by the game and to what degree.

As it can be seen by the Tests and Analysis section, the game had a slight positive effect with only one session according to our responses, whereas the majority of the tests that were mentioned in the background were done in multiple successions. The study shows that the number of different levels is a probable reason for this positive effect. Possibly, a bigger and more random sample would establish this statement even more, because this twenty people sample with similar attributes can be considered by many as small and not diverse, thus inadequate. A sample, like for instance extremely acrophobic people without gaming abilities or young people with gaming abilities may have given significantly different feedback than the one that was received here. As it was stated in the Limitations chapter, the fact that many of the participants were people known to the researcher, limits the variety of the sample. This fact can make the research look less reliable than having a sample that is utterly random as Etikan (2016) pointed out in his article about convenience sampling and purposive sampling. If we chose a random sample, the answers would be significantly diverse, but harder to analyze and explain. Also more sessions would strengthen the hypothesis, meaning that we would be able to see how the multiple sessions would help the patients. Furthermore, the innovation of having the player move the character and not the therapist, or having the character on rails as in other researches, is a great idea that most of the people think it was favorable according to their answers in the question “The fact that I controlled the player helped me to enjoy it”. Therefore, it is true that controlling your own character, making decisions and taking into account the limitations set by the game itself makes the game more interactive, thus more immersive. Finally, the effect of pace which was nonexistent in the most researches in acrophobia is up trending with the immersion as the analysis shows, meaning that the faster the pace is, the bigger the immersion, as Jennett et al. (641-661) found out. But, after a while, as the pace increases, the immersion increases slower. This matter should be a focus of further investigation in the future, but it makes sense since in our game initially there was no mechanism of pressure, therefore no reason for the players to
remain focused. Later on, there was a timer which forced players to rush themselves, thus to remain focused. Finally, that timer got smaller in the same level with more objectives, parameters that forced players to remember how they passed the previous level in order to succeed. Overall, it is safe to say that all the hypotheses were almost confirmed, with the possibility to investigate these factors even more in the future and with more participants and more sessions. Also an issue that readers can see as problematic is the fact that the sample was approached before the pre-test questionnaire. This violates the rules of integrity and anonymity, which is essential when it comes to research procedures as the European Federation of Psychologist’s Associations (2005) indicated. People need to answer exclusively on the questionnaires given to them and not to the researcher in person. No one is allowed to know sensitive personal data, including the researcher, even if this might result to a broad variety of answers from our participants.

6.3 Future Work

In the future, the implementations for Virtual Reality are going to be employed. Once a Virtual Reality system like HTC Vive or Oculus Rift SDK2 is available, the testing on those environments will be the next step. After that testing, there is going to be a comparison between the results of the first person approach and the Virtual reality approach. Next, we’ll discuss which approach is better and the reasons behind it. As it was mentioned before, there is going to be a bigger sample and more random than the current sample for even safer results and bigger variety. Finally, multiple sessions will take place, in order to make our second hypothesis even stronger.
References


URL: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4736108/


Appendix A - Pre-test questionnaire

Age: 18-20  □
21-25  □
26-35  □
36-older  □

Sex: Male  □
Female  □
Other:

From a scale 1-5 (1 I disagree, 5 I agree) rate your answers with a cross

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>I play frequently video games</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel comfortable climbing a ladder</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel comfortable walking in narrow stairs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel comfortable being in glass elevators</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel comfortable looking down in balconies</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel comfortable being in tall buildings</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel comfortable being in narrow bridges</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel comfortable being in high places</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I could be in a rollercoaster</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel comfortable looking down in high places (cliffs etc.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Appendix B - Post Test Questionnaire

From a scale 1-5 (1 I disagree, 5 I agree) rate your answers with a cross.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>I was afraid of heights before the game</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am afraid of heights after the game</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The fact that I controlled the player helped me enjoy it</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Level 1**
- The altitude was high
- The game was enjoyable
- The game made me afraid
- I didn't feel motion sickness
- I would play the game again
- I strongly recommend the game
- I got used to the heights
- I felt involved in the game due to pace

**Level 2**
- The altitude was high
- The game was enjoyable
- The game made me afraid
- I didn't feel motion sickness
- I would play the game again
- I strongly recommend the game
- I got used to the heights
- I felt involved in the game due to pace

**Level 3**
- The altitude was high
- The game was enjoyable
- The game made me afraid
- I didn't feel motion sickness
- I would play the game again
- I strongly recommend the game
- I got used to the heights
- I felt involved in the game due to pace

**Notes:**
Appendix C - Game Manual