Analysing the Connection Between the Strength of Emotional Reaction Invoked within a Video Game Player and the Presence of Virtual Reality Technology

MSc by Thesis – Computer Science

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Contents

Abstract

This thesis examines the potential connection between emotional responses in video games and the presence of virtual reality technology. This connection could establish whether video games can better affect their players' emotions via the use of the technology. A short video game prototype was designed and developed to invoke feelings of fear and anxiety in players which could be used both with and without virtual reality technology. A trial was then created to measure participants' emotional responses as they played both prototypes and the results were then compared and contrasted via one-way ANOVA tests. Alongside this, information about the participants' experience with video games, virtual reality and horror-based content was recorded to establish any potential connection between this experience and their reaction to virtual reality technology. The results of the trials would suggest that virtual reality can cause greater emotional reactions in video games and that certain groups of players are more susceptible to the technology than others, but these reactions are not always consistent and are not always statistically significant.

Chapter 1 - Introduction

Video games are known to be able to produce a wide variety of emotional responses from players and have done for many years. There are games that invoke the strongest range of emotion, be it happiness, fear or even guilt (Winch, 2015). This is not unique to the medium of interactive entertainment, as books, TV and film can also access the full spectrum of emotion within us, however they lack the potential that video games have when it comes to immersion and interactivity. New technology comes into the gaming industry every few years, be it the introduction of 3D graphics in the 90s, to the mainstream appeal of motion controls in the 2000s, and this shows no sign of slowing down (Chakhani, 2015).

The continuation of immersion and interactivity within video games comes from the increasingly mainstream market of virtual reality (Avila & Bailey, 2014). Combining the head-mounted display with a pair of motion controllers brings an increased level of feedback and interactivity not previously seen before in the modern market. While the technology has been available for some time in different forms, due to the recent popularity of more affordable virtual reality headsets such as the *Oculus Rift* (Oculus VR, 2016) or the *PlayStation VR* (Sony Computer Entertainment, 2016), the market for these games and experiences is continuously growing; this increases the value into any research done into their effect on players and their experiences. There has already been research into virtual reality on a number of topics, such as the ability to immerse a player (Bowman & McMahan, 2007), and this research would serve as an excellent starting point to look into how the differing immersion and presence helps or hinders a video game's ability to create emotion within a player.

This thesis will lay out the research performed into video games' connection with human emotion, and how the inclusion of virtual reality technology affects that connection. The thesis will include the following chapters:

- Chapter 2: Hypothesis & Objectives – This chapter will define the overall hypothesis of the project and how that will be proved or disproved through a series of objectives and sub-objectives.

- Chapter 3: Background Research – This chapter will analyse the pre-existing material on the topic of video games' connection with emotions, emotional responses to stimuli, virtual reality technology and an analysis of video games and interactive media that demonstrate relevant characteristics.

- Chapter 4: Trial Design & Development – This chapter will explain the design process for the video game prototype, trial and emotional measuring systems using the research laid out in Chapter 3.

- Chapter 5: Trial Review & Analysis – This chapter will analyse the data gathered through the trial, including how virtual reality affected not only the participants as a whole, but the series of sub-groups within them. This chapter will also include a review of potential further studies that could continue using the findings of this thesis.

- Chapter 6: Conclusion – This final chapter will take all of the research and results from all the previous sections to come to an overall conclusion for the thesis.

Chapter 2 - Hypothesis & Objectives

The project's overall aim is to prove the following hypothesis:

"The presence of virtual reality technology increases the strength of emotional reactions when playing video games."

In order to prove or disprove this hypothesis, a series of objectives must be completed, which are listed below:

2.1 - Objective 1 – Establish connection between video games and the emotions of players

In order to complete this objective, the connection between video games and the emotional reactions they can elicit must be understood. This consists of the type of techniques and mechanics video games implement that causes emotional reactions within players, as this knowledge will be integral in testing how virtual reality will then affect that connection.

2.1.1 - Sub-Objective 1.1 – Spectrum of Emotion

There are a multitude of different emotions that video games can attempt to trigger within their players, so it is important to identify any differences in approach to tackling different emotions within the spectrum, such as fear, happiness excitement etc.

2.1.2 - Sub-Objective 1.2 –Game Narrative

Narrative is an integral part of a lot of media's ability to establish an emotional connection, so it is important to identity how video game's implement and display narrative in an interactive setting and how that can affect the emotions of the player.

2.1.3 - Sub-Objective 1.3 – Gameplay & Mechanics

Gameplay elements and mechanics are what make video games interactive and what makes them unique compared to other media. Establishing if there are specific mechanics or techniques that are associated with strong emotional reactions could be integral to building a strong prototype for the project.

2.1.4 - Sub-Objective 1.4 – Graphics & Audio

The aesthetics and atmosphere of a video game can drastically affect the experience for the player, so information must be gathered on how they can be best utilised to create different emotions in order to implement those techniques within the prototype for the project.

2.2 - Objective 2 – Gather research on Virtual Reality & Motion Control Technology

In order to complete this objective, research must be performed to establish how the technology can be implemented and used within video games. When combined with the results from *Objective I*, it should form a solid knowledge base from which to try and create some testing scenarios in order to try and prove the hypothesis.

2.2.1 - Sub-Objective 2.1 – Effects of Virtual Reality

A virtual reality headset opens up a wealth of new possibilities in games, however research is required to investigate what changes occur when using the headset and if there are any drawbacks, or mechanics, that no longer function as strongly as before.

2.2.2 - Sub-Objective 2.2 – Motion Controls

Twinned with the virtual reality headset is the use of their connected motion controls. Using an alternative control scheme changes how player's interact with the world and how gameplay mechanics function, so research must be done on how best to implement motion controls for the best experience.

2.3 - Objective 3 – Develop prototype to test potential connection between virtual reality and a stronger link to player's emotions

In order to complete this objective, a prototype must be developed that will be used to test how the presence of virtual reality technology will affect the connection between video games and their players' emotions. This will form the cornerstone of the project and the analysis will help define the overall conclusion.

2.3.1 - Sub-Objective 3.1 – Virtual Reality vs. Standard Play

As stated earlier, in order to test the differences in emotion responses with and without virtual reality technology, the prototype must be able to support both with as few differences as possible to reduce the number of variables that could affect results.

2.3.2 - Sub-Objective 3.2 – Complexity & Ease of Use

In order to complete this objective, the prototype must be accessible to a player base with wildly varying experience and skill levels. Due to the lack of knowledge of the participants taking part in the study, the prototype must be designed to accommodate all possible players.

2.3.3 - Sub-Objective 3.3 – Emotional Implementation

In order to test any emotional responses, the prototype has to use all of the research gathered through *Objective I* to try and increase the likelihood of players engaging with the experience and having emotional responses to the material.

2.4 - Objective 4 – Measuring and Analysing Emotional Responses

In order to complete this objective, research must be performed into the emotional responses of humans and how they can be measured, otherwise it will be impossible to measure any differences caused by the presence of virtual reality technology.

2.4.1 - Sub-Objective 4.1 – Understanding Emotional Responses

Throughout this project, the understanding of how humans respond to different emotions and to what degree is absolutely integral. Research must be done to understand the background context and range of emotional responses and how or why they are triggered.

2.4.2 - Sub-Objective 4.2 – Measuring and Analysis Systems

As part of the prototype trials planned for this thesis, the emotional responses created by the prototype will need to be measured and analysed. A system must be mapped out and created to first measure the emotional responses during the trials and second analyse them to help form the overall conclusion of the thesis.

Chapter 3 - Background Research

At the beginning of this project, a solid base of knowledge had to be created. This knowledge base focuses on three main areas:

- Video Games and the Emotions of Players
- Virtual Reality Technology and Immersion in Video Games
- Emotional Responses and Psychology

These three areas contain the information that the project relied on at every stage.

Firstly, the connection between video games and emotions had to be understood. Before analysing how virtual reality can affect that connection, there is a requirement to establish how it can be manipulated in a variety of ways. For example, this includes looking into how video games may use specific mechanics or gameplay elements to try and create a specific emotional response from their players, or what the effect of different styles of games may have upon the player's emotions.

Secondly, the use of virtual reality both within and without a video game context had to be thoroughly researched. In order to design and develop a prototype using this technology, the differing levels of how this technology could be implemented had to be understood and what changes are brought about by using this technology for both players and developers, specifically focusing on their perspectives.

Finally, in order to accurately draw conclusions from any of this data, a way of measuring emotional impact had to be designed and implemented. This drew from psychological academic papers and studies, which have the potential to further the understanding between interactive media and the emotional changes that occur while experiencing video games.

This information was gathered primarily through two methods, the first being the study and analysis of published works, such as books, articles or other academically viable material and the second being the study of interactive sources directly, such as specific video game levels or mechanics.

3.1 - Video Games and the Emotions of Players

A variety of different forms of media are able to create emotions within humans, such as books or films. While video games are capable of doing the same, one of the central questions that needed to be answered was establishing how the emotional connection between a player and their video game experience differs from that of a film and its viewer. This research was then utilised in the creation of the video game prototype used in the trials, using these techniques to help invoke emotions in the participants.

3.1.1 - Video Game Narrative

To begin this analysis, an element was researched that books, films and video games all share: narrative. A narrative can be highly structured and prevalent, or it can be subtle and more open for interpretation. However, video games have the advantage of interactivity, which creates a whole new level when it comes to narrative and its usage. Erica Liszewski helps define this difference through the definition of "Linear Narrative vs. Self-Created Story" (Liszewski, 2008).

A linear narrative is one in which the content is structured and cannot change, which is seen in other media formats and within story-driven titles such as *To The Moon* (Freebird Games, 2011). In a video game context, these titles "lead the player through a pre-determined order of events in order to evoke the desired emotion. This can be implemented through dialogue, cut-scenes, or even more abstract methods such as the gameplay mechanics themselves changing. While this technique does create emotion, the game is not much different from watching a movie" (Liszewski,

2008). While this method is a valid technique for creating emotion, due to its passive nature and lack of interactivity, it is less associated with how video games create emotion in their own unique way, so it is not the focus of this thesis.

On the alternative side, there is the self-created story, or in other words, an interactive narrative. Mark Meadows defines this as "a narrative form that allows someone other than the author to affect, choose, or change the plot." (Meadows, 2002). Gifting the player the option of choice, creates a number of different effects. Firstly, self-created stories often connect with the player on a deeper level, due to the personal involvement in their creation (Liszewski, 2008). Secondly, in a concept very unique to video games, due to the potential flexible nature of the narrative, you will not necessarily get the same experience twice and could get an unrecognisable one compared to the initial experience.

There is also the third option of not focusing on narrative at all. If a game does not provide a concrete story or narrative, it does not necessarily mean the player will not create one for themselves, however the emotions that come through that experience will be wildly more varied than that of one with a more structured approach (Liszewski, 2008). For example, *Minecraft* (Mojang, 2011) does not have a distinct plot or structured objectives, however it allows players to create their own stories through having a wide range of mechanics that the player may use if they so choose, such as exploration, mining, combat or building.

3.1.2 - Video Game Graphics

In order to develop the video game prototype, a graphical style had to be chosen, so an analysis of possible techniques was conducted to assist in the decision. It cannot be denied that graphical fidelity of video games has evolved over the years (Stransky, 2018), along with the gaming industry as a whole. While the graphical style of a video game is not always associated with how video games create emotion, they do have an effect on how interesting or enjoyable a gaming experience may be (Keo, 2017). While this may not always be necessary, a player's ability to be invested in the aesthetics of a video game will sometimes tie in directly with their ability to enjoy the experience, such as with *Hitman* (IO Interactive, 2016). *Hitman,* as Kevin Murnane writes, is a "perfect showcase for superior graphics because your attention for much of the game is directed to careful study of the environment. Gameplay and graphics are mutually supportive and inextricably intertwined." (Murnane, 2018). This shows us that the graphical style of a video game can be incredibly important and linked to a game's mechanics, meaning the choice of a given game's graphical style can have large ramifications for its success. As this project requires a prototype game to be created, the visual style should be created to help bolster that experience, rather than hindering it. The first step in this process is understanding the differences in graphical or aesthetic styles and understanding their benefits and drawbacks.

3.1.2.1 - Realistic vs. Stylised Graphics

Video game graphics can be placed into two categories: realistic or stylised. Realistic graphics attempt to capture real life as accurately as possible, attempting to make the player feel like the game could take place in our world (Aava, 2017). The game's ability to do this is dependent on the technology at the time of the game's creation, so as time progresses, the closer the realistic method of graphics will be to mimicking reality. Stylised graphics do not have to attempt to mimic reality within the game's world, so they can play with shapes and colours in order to create unique aesthetics for the game. "The challenge of stylized game art is conveying to the player what the assets, environment, and characters are typical with fewer details and put emphasis on the shape, color and form" (Aava, 2017).

While the level of graphical realism may not always have a direct impact upon a player's experience, a study into how graphical fidelity effects a player's competence, autonomy, relatedness, immersion and intuitive control was conducted in 2013 (Gerling, 2013). This study suggests that higher levels of graphical fidelity can result in a positive effect on a player's experience. Unfortunately, higher levels of graphical fidelity can result in several drawbacks.

Firstly, the hardware required to successfully utilise high levels of graphical fidelity will be of a higher cost. In addition, the time taken to create artistic assets will increase if the level of detail required is higher.

However in the context of this study, Gerling's study also noted that for research purposes, "if researchers choose simple mechanics for the games in their studies, they do not need to devote significant resources to the development of high-fidelity graphics" (Gerling, 2013), showing that for this study, the results should not be significantly impacted if the level of graphical fidelity is relatively low.

3.1.3 - Video Game Genre

In order to design the video game prototype's central mechanics, goals and gameplay, an analysis of existing video game genres was conducted. The video game industry is rife with titles in numerous genres, each designed to give wildly different experiences. From titles focusing on strategy and logic all the way to quick-reaction times and fast-paced gameplay, there is such a wide variety of styles for video games to take. Video game genres can be quite loose, fluid or hard to define (Clearwater, 2011), but there are staple genres that have existed for decades and that remain popular today, such as the 'action', 'sport' or 'fighting' genres (TechNavio, 2018).

What is important to know is which emotions each genre is known for being able to create and what kind of experience each one can provide. A selection of genres was analysed to try and gather an accurate representation of the spectrum of emotional responses that can be experiencing using video games, however the focus remained on genres that can implement a 3D graphics engine and that have a higher potential to support virtual reality technology.

3.1.3.1 - Action Genre

The action genre is very broad and contains a variety of sub-genres, however these will generally focus on the core emotions of excitement, adrenaline and tension. This is epitomised by the first-person shooter sub-genre, which has remained popular since the 1990s with its original titles of *Wolfenstein 3D* (iD Software, 1992) and *Doom* (iD Software, 1993). It was these titles that were credited with first achieving what Mihaly Csikzentmihalyi refers to as '*flow*' (Csikszentmihalyi, 1975). Flow can be described as "A condition of absolute presence and happiness" (Konnikova, 2013), and it was the action genre that first captured the notion of flow for video games. Even with other sub-genres such as the hack-and-slash or third-person shooter, they still have the fast-paced gameplay with a high skill ceiling that still dominate the video game market today with titles such as *Fortnite* (Epic Games, 2017), which recently reached over 200 million players and made over $2.4 billion in 2018 alone (Hoggins, 2019).

3.1.3.2 - Adventure Genre

The Adventure genre now spans a vast majority of titles across the industry, but it has its origins in the original text-based story games of the late 1970s and early 1980s, such as *Zork* (Infocom, 1977). These titles consisted of a strong narrative along with puzzle solving that allowed players to progress through the story. These developed into the point-and-click games of the 1980s and 1990s, such as *The Secret of Monkey Island* (Lucasfilm Games, 1990), allowing for minimal action sequences and cut-scenes to enhance the experience.

As these fell out of fashion, the genre transformed into something new, as "developers have conjured up all manner of elegant solutions for handling narrative in games without falling back on the clumsy staccato rhythm of point-and-clicks" (Wales, 2017). Since then, the genre is used to describe games that take the player on a journey, with a mixture of puzzle solving and action along the way. This can be seen in many modern titles such as *God of War* (SIE Santa Monica Studio, 2018) or *Detroit: Become Human* (Quantic Dream, 2018), combining the feelings of exploration, satisfaction and immersion to create a strong, narrative-driven experience.

3.1.3.3 - Horror Genre

The concept of a human actively seeking the feelings of fear is not unique to video games, as scary books and cinema have existed for over a century, with audiences seeking the thrill and adrenaline of being made afraid (Butler, 2016). However, there is a difference between watching an individual in a perilous situation and feeling as if you are in one yourself, because "horror games were - and remain - so powerful because we're not merely being told a story by a third person, we're interacting with it" (Lamble, 2014).

The genre first starting appearing over thirty years ago with text-based games designed to scare their players, such as *Haunted House* (Atari, Inc., 1982), though this has continued to develop into many different styles, some aiming to disturb and unnerve players, such as *Soma* (Frictional Games, 2015) while others hope to shock and terrify them, such as *Dead Space* (EA Redwood Shores, 2008).

The tropes of the genre have also began to bleed into other genres, such as the role-playing genre with *System Shock 2* (Irrational Games, 1999), or the first-person-shooter genre with *Metro 2033* (4A Games, 2010). What these titles have in common is the attempt to invoke feelings of fear, shock, discomfort, anxiety or tension, which can induce some very strong emotional reactions due to triggering our natural 'fight or flight' response (Lamia, 2011).

3.1.3.4 - Role-Playing Genre

The original role-playing games were not video games but were instead played on a table-top with dice and character sheets in the form of *Dungeons & Dragons* (Gygax & Arneson, 1974). This game allowed for great customisation, not only in terms of a player's character and skills, but in the narrative and the overall story being told. Video games still cannot compete with the level of fluidity and depth, with "quest narratives of video games [being] similar but [not being able to] compete on the finer details" (Wadeson, 2015).

The first titles within the genre began shortly after during the mid-to-late-1970s, such as *Dungeon* (Daglow, 1975), but quickly developed over time, emphasising strong yet interactive narratives, strategic combat and exhilarating quests. The games themselves build strong ties to their worlds and to those who inhabit them, building emotional connections that the player is invested in. This can be seen in titles such as *Final Fantasy VII* (Square, 1997), where the death of a central character is often cited as being able to make players weep, despite its dated aesthetics (Schreier, 2012). It is due to the personalised nature of the customised characters and player choices that make the emotional connection so strong, therefore while the genre may not be defined so heavily by specific emotions, it can be defined by being able to affect players through their connection to the experience they help craft.

3.1.4 - Video Game Gameplay

While genres help define a series of basic video game tropes, every game has its own unique gameplay mechanics that makes it different. While narrative is a common tool for creating emotion, creating emotional responses through the game's mechanics alone is far more unique to the medium and thus far more appropriate to this project. Carnegie Mellon University's Entertainment Technology Center began a project called *'Emotionshop'* with this goal specifically in mind, writing 'Just like how there are art and music theory on the emotional effects of visual and audio choices, we hope to start a conversation on what kinds of interactions are more effective in evoking certain emotions, what kinds are not, and why' (Li, 2015).

Research was performed through the lens of one emotion at a time, attempting to identify how those emotions were created through a variety of methods, creating the list below:

3.1.4.1 - Fear & Anxiety

Fear and anxiety are commonly produced by horror or survival games (Butler, 2016), such as *Resident Evil* (Capcom, 1996), though elements can be seen in a variety of genres. Horror games

were originally more of a niche section of the gaming market, however these titles have become more and more popular with their success on *YouTube* and the release of titles such as *Five Nights at Freddy's* (Cawthon, 2014). These emotions can be invoked through audio, graphical and narrative techniques, a number of which are used in film (Sipos, 2014), as well as a number of gameplay mechanics. The common mechanics to try and invoke fear and anxiety are as follows:

- Limited Perspective – This technique utilises our fear of the unknown to make us "try to come up with any possibility as to what might be lurking in the shadows" (Obilisk, 2017). This can through the use of a limited light source such as in *Amnesia: The Dark Descent* (Frictional Games, 2010) or a restricted view such as the camera the player has to observe the world through in *Outlast* (Red Barrels, 2013). This technique has been used repeatedly to reliably create tension, anxiety or fear within games for years (Rouse III, 2009). A further example to this would be *The Nightjar* (Somethin' Else, 2011), where the player has no ability to see at all, instead relying on audio instructions to navigate through an abandoned space ship.

- Fear of Loss – This technique taps into a very natural reaction, which is simply feeling scared that something they player has will be taken away. This can take many forms, be it progress through the game, score, or whether the game will punish the player for performing badly. While other horror media can also utilise this technique, "the interactive dimension of horror games enables a *more* acute experience of losing control than that achieved by most horror films" (Krzywinska, 2002). As humans, we are more scared to lose what we already have rather than losing the prospect of gain (Pulsipher, 2014), which can be seen in action with games like *Dark Souls* (FromSoftware, 2011), where players can lose hours of progress with a single wrong move.

- Powerlessness – While there can be great fear and anxiety in attempting to fight whatever threats or enemies a video game is throwing at a player, additional levels of fear or anxiety can be added when you remove a player's ability to defend themselves. A prime example of this is *Slender: The Eight Pages* (Parsec Productions, 2012), which gives you only the limited ability to flee from your ever-threatening stalker. By taking giving only limited actions to the player, these games "actively work to produce the crucial sense of *being out of control* that is inherent to the experience of horror (Krzywinska, 2002). Games that make the player feel powerless are also gathering in popularity, suggesting this emotion response is resonating with audiences (Valentine, 2014).

- Removing Abilities – A combination of the previous two techniques, stripping a player of an ability they once had can increase their sense of vulnerability and thus heighten their fear or anxiety due to the contrast with what they once had (Valentine, 2014). This can be seen in *Life is Strange* (Dontnod Entertainment, 2015), where the players central mechanic of reversing time and correcting their mistakes is removed, forcing them to deal with all of the consequences of their actions.

3.1.4.2 - Satisfaction & Excitement

Satisfaction and excitement are not necessarily linked with specific genres, but some tropes or mechanics that invoke happiness or excitement can be found in a majority of titles. The common techniques to try and invoke satisfaction and excitement are as follows:

- Achievement or Rewards – A sense of accomplishment is often associated with satisfaction, and video games often lay out a series of objectives or goals for players to achieve. A common way of giving an extra sense of satisfaction is to apply a series of achievements or trophies that you get for completing certain goals, which not only grant players satisfaction, but it can also motivate them to continue (Wang & Sun, 2011). These allow a player to track their progress, as well as compare their progress to other players.

Alternatively, you have in-game rewards, such as obtaining equipment or items for defeating a boss in *World of Warcraft* (Blizzard Entertainment, 2004). However, the reward must be worth the effort the player engaged into in order to complete the task, as "the reward you dole out will be interpreted relative to the player's state at the time you hand it out" (Wang, 2008).

- Adrenaline – This is most commonly associated with violence in video games, such as *Mortal Kombat* (Avalanche Software, 1992), due to the controversies the topic has created in the past (Anderson, et al., 2007). However, creating a rush and a sense of adrenaline does not have to be violent, such as in *Tetris* (AcademySoft, 1984), which slowly builds its speed over time to increase the sense of tension and excitement within a player. Even if the rush is through violent means, it is not there merely for the sake of it, "the violence being displayed is a punctuation mark on a longer scene or is meant to make the player feel something, whether it's excitement, surprise or revulsion" (Kuchera, 2018).
- Power Fantasy – Part of what makes video games so appealing is the ability to become someone, or something, different to oneself. This often takes the form of becoming something better, be it a deity in *God of War* (SIE Santa Monica Studio, 2018) or a galaxy-saving hero in *Mass Effect* (Bioware, 2007). "Power fantasies are relatively easy to create in video games but have big emotional pay-outs" said virtual reality designer Shawn Patton, as being capable and powerful is a positive feeling in both real life as well as in a video game (Parkin, 2018). Making a player feel powerful or at least more powerful than they normally feel can lead to great feelings of satisfaction and excitement (Hammer & Baker, 2015).
- Challenge vs. Impossibility – In order for video games to be exciting, the player must stand a chance of being able to complete whatever tasks or levels the game presents to them. If a video game is too difficult, it will have a negative effect on the excitement a game is able to invoke in a player (Kumagai, 2008). On the flip side, making a game too simple will have the same effect, so a delicate balance must be reached in order to maintain excitement (Chanel, et al., 2008).

3.1.4.3 - Sadness & Hurt

While video games aim to be enjoyable, it is appropriate for some video games to aim to make the player upset. In the film industry, it is understood that watching films that invoke sadness can actually increase the audience's pain threshold and social bonding (Dunbar, et al., 2016), so it is possible that this is also true of video games. However, there are "problems video games have faced trying to elicit sadness from its players" (Zagalo, 2017), so it not always easy to invoke these feelings with players. The common techniques to try and invoke sadness or hurt are as follows:

- Loss – There are two differing aspects of loss that are often implemented in video games. The first is as part of a game's fail state, or simply put, players will feel the same emotions of defeat that they would in a non-digital game, such as chess. What happens when players fail can be designed to drive the player to try again, or to make their final victory more satisfying, which is a technique used in *Dark Souls* (FromSoftware, 2011). The other comes from removing a mechanic or aspect of the game that gave the player some comfort, such as extra lives or a special weapon. Once the players have got used to this comfort, removing it creates feelings of loss and panic, as we as humans will miss what we used to have (Pulsipher, 2014). This is used in *Resident Evil 7: Biohazard* (Capcom, 2017), where the player is unable to use their arms for a whole level, creating a new level of panic and driving the tension forwards.
- Guilt – Attempting to invoke feelings of guilt within players can be difficult, "simply because we [as players] are fully aware that there are not permanent consequences to our actions, we can quite literally get away with murder." (Davidson, 2017). In order to trigger those feelings, players can be forced to comprehend the consequences for their actions, often mimicking the reactions of how those consequences would play out in reality, breaking the façade that they can perform actions in a guilt-free manner. An example of

this would be *This War Of Mine* (11 Bit Studios, 2014), where players are forced into a survival scenario, but forced to witness the outcome of any of their aggressive actions.

3.1.4.4 - Relaxation & Calm

A lot of modern titles aim to fill the player with excitement and adrenaline, however some games can simply attempt to make the player feel calm, such as *Stardew Valley* (ConcernedApe, 2016). There is increasing evidence of games being excellent stress-relievers (Scott, 2019), so it may be important to analyse how you can achieve calm emotional states, especially as it is now being used for multiple kinds of therapy (Mader, et al., 2012). The common techniques to try and invoke relaxation and calm are as follows:

- Simplicity – "The simpler the game mechanics are, the more likely it is that players feel serene" (Chang, 2016). Simpler mechanics require less concentration and stress, but if this goes too far the game mechanics can become boring. As stated earlier, if a game becomes too easy, it will cause players to lose interest over time (Kumagai, 2008).
- Calm after the Storm – Contrast can allow players to notice emotions more clearly, just how panic can be invoked by taking away something a player has been relying on (Krzywinska, 2002). On the other side, to help players feel a state of calm, the attempt to invoke calm can follow on from a more turbulent experience, allowing the players to enjoy and fully experience the sense of calm (Chang, 2016).
- Lack of Defined Ending – The lack of any definitive ending can help remove pressure from players (Fulton, 2019) and "allow them to feel more at ease in when repeating the same action, lulling them into a sense of tranquillity especially when the setting of the world facilitates that feeling." (Chang, 2016). This can be found in popular games such as *Minecraft* (Mojang, 2011). Chang notes that this method "is subject to the type of player – some players want something to work towards and feel bored when they do not see the point of an action".

3.1.5 - Video Game Audio

Audio within video games "usually is used to communicate aspect of the narrative, convey emotion, and enrich the experience of the player." (Zhang & Fu, 2015). The main uses for audio in video games can be split into two categories: music and sound effects. Both can be considered important in modern game design but can be separated in terms of their utilisation. Music allows for the enriching of narrative and emotions in a similar way to the medium of cinema utilises music, whereas sound effects allow for improved feedback for player's actions and helps heighten immersion.

3.1.5.1 – Video Game Sound Effects

"Sound effects exist specifically to give feedback to players, immerse them inside the virtual realm, and provide an entertaining experience—all of which are key ingredients to a successful video game." (Marks & Novak, 2008).

3.1.5.2 – Video Game Music

The presence or absence of music within video games can potentially have a large impact upon player experience, forming an integral step in creating and maintaining immersion and flow for the player (Nacke, et al., 2010).

3.2 - Virtual Reality Technology & Immersion in Video Games

In order to understand how virtual reality can affect emotions within players, there must first be an understanding of how using the technology affects the player's overall experience with new mechanics, a heightened sense of immersion and presence on top of an alternative control scheme.

3.2.1 - Differences in Mechanics

Due to the differing perspective and the motion controllers, video games are certainly a different experience to that of standard play. In fact, even a concept such as movement that is well

understood and often simple in video games has become a challenge, with Kevin Carbotte citing at least 19 ways of implementing movement with the headset and motion controllers (Carbotte, 2018).

3.2.1.1 - Movement

Virtual reality has a huge issue in a syndrome called 'visually induced motion sickness'. "Visually induced motion sickness is a syndrome that occasionally occurs when physically stationary individuals view compelling visual representations of self-motion", writes Lawrence Hettinger (Hettinger & Riccio, 1992). This issue can cause the standard method of movement in a 3D world to cause great discomfort to players, so finding an alternative method is paramount.

There are several ways to get around this, such as the player teleporting between locations as seen in *Skyrim VR* (Bethesda Game Studios, 2017). This stops the issue of visually induced motion sickness, but it can lower the immersion of the whole experience and is not always viable depending on the core mechanics of a game, such as if precise or quick movement is involved.

A simple alternative is to design the game around no movement at all, such as in *Superhot VR* (SUPERHOT Team, 2016), which gets around the drawbacks of the technology and helps build a fully immersive experience. However, this is a very restrictive design choice and could be very limiting for what a designer or developer is trying to achieve.

If standard movement is a requirement, there are a couple of techniques that can be used to try and minimize the effects of visually induced motion sickness. The first of these is implementing a reduced field of view when moving, as this has proven to help prevent motion sickness in a percentage of players (Carbotte, 2018). Alternatively, the movement can attempt to mimic actual walking or running more directly, such as implementing a "head-bobbing" mechanic, to simulate the movement of a person's head as they walk. This attempts to bridge the gap between what is happening to the player in the game world and what is happening to them in the physical, real world.

3.2.1.2 - Viewing the World

While wearing a virtual reality headset is clearly different to simply viewing a monitor or TV screen, it does also affect the way that players' interact with the game world or space. In the most simple of examples, a player moving their head from left to right, especially with a slightly encumbering headset on, is slower than a flick of the mouse or analogue stick. This can have drastic effects on gameplay, especially in fast paced titles, as players simply cannot move or react at the same rate as they can in standard play.

Another difference is how the heightened sense of immersion or sense of presence can affect how players observe or explore environments. Barbaros Bostan writes "when people use special hardware such as head mounted displays and stereo headphones, they are almost totally immersed in a virtual world. This sense of 'being physically there' increases the interactivity of the mediated environment" (Bostan & Nalbant, 2019). While this will not affect all players, it means players may observe or explore their virtual environments more thoroughly than if they were playing without a virtual reality headset.

3.2.1.3 - Interacting with the World

The use of an alternative control scheme will always affect how a game is played, but motion controls are particularly different, meaning "most games do not translate well into motion controls - when a developer tries to force motion controls onto existing games, it regularly ends up feeling clumsy and a poor experience for players" (Rose, 2013). This means that games that implement motion controls have to be designed with these aspects in mind in order to utilise them correctly.

When paired with virtual reality, motion controls are a natural fit, as "just hooking up running to analogue sticks isn't the best feeling in VR." (Starkey, 2018). The use of motion controls in video

games can heighten not only the immersion, but also how rewarding the overall experience is to the player (Manuel, et al., 2012). The motion controls on the *Oculus Rift* (Oculus VR, 2016) or the *HTC Vive* (HTC, 2016) allow for accurate hand tracking, analogue movement and a variety of buttons, which in combination can allow for complicated control schemes to be mapped alongside the motion inputs. Despite this, motion controls are not as well-suited to traversing menus or incredibly precise movements, so the design of the user-interface and mechanics have to keep this in mind.

3.2.2 - Immersion, Flow & Presence

Immersion and flow, despite having few structural differences, are currently believed to refer to different mental phenomena, though there are a number of theories that exist for them that quantify the complexity of the underlying mental state (Michailidis, et al., 2018).

Immersion is generally identified by some common signifiers, such as a lack of awareness of events or people around you, increased heart rate during exciting sections or a feeling of empathy towards in-game characters (Stuart, 2010). This includes the phenomenon known as 'Real World Dissociation' (Jennett, et al., 2009), where the player's consciousness of the real world begins to fade as they become increasingly immersed within the world of the video game.

Flow, as stated earlier, is defined as a "a condition of absolute presence and happiness" (Konnikova, 2013), but it can also be linked with the "merging of action and awareness, clear goals, immediate and unambiguous feedback, concentration on the task, perceived control over the activity, loss of self-reflection, distorted perception of time and [an] intrinsic motivation toward an activity" (Michailidis, et al., 2018).

Presence, while a similar concept, is the sense of actually being in the world, regardless of any interaction, primarily seeking to "match the user's mental representations of the real world with the virtual world" (Michailidis, et al., 2018). Immersion is the most common term and is often used as a blanket term to cover flow as well, as Michailidis argues that they are intrinsically linked and hard to differentiate.

3.2.2.1 - Creating Immersion & Presence in Video Games

Video games that are attempting to create a sense of immersion or presence will need to use two different methods. These methods can be described as "those that create a rich mental model of the game environment and those that create consistency between the things in that environment" (Madigan, 2012). These 'mental' and 'consistent' models of immersion and presence can both lead to a more positive experience, but their methods of achieving this are rather different. They are best used in tandem, but some video games will prioritise one over another.

3.2.2.2 - The Mental Model

The mental model attempts to achieve immersion and presence through the following:

- *Multiple Channels of Sensory Information*
    - Simply put, the quantity and quality of all sensory inputs, encompassing visual, audio or motion inputs, will increase the level of immersion and presence within a video game. In virtual reality terms, this is called increasing the depth and breadth of information, and directly linked with high levels of immersion (Virtual Reality Society, 2017).

- *Completeness of Sensory Information*
    - Completeness refers to the look, sound and feel of a video game being what a player expects. For example, if a video game is set in a specific time period, such as *Red Dead Redemption II* (Rockstar Studios, 2018), the game cannot put objects, sounds or mechanics that do not belong within the player's pre-conceptualised view of what that world should be like, at least without potentially breaking the immersion.

- *Cognitively Demanding Environments*
    - If a video game requires a lot of concentration or skill, it is more likely to be immersive. Obviously this is not applicable to every experience, as there are simple or relaxing games that are immersive, but the point stands that "if brain power is allocated to understanding or navigating the world, it's not free to notice all its problems or shortcomings that would otherwise remind them that they're playing a game" (Madigan, 2012).

- *A Strong and Interesting Narrative, Plot or Story*
    - Finally, as discussed earlier, a video game's narrative can be a very powerful tool to create emotion responses, but it can also be integral to creating immersion, just as it is with books, TV or film.

3.2.2.3 - The Consistency Model

The consistency model attempts to achieve immersion and presence through the following:

- *Lack of Incongruous Visual Cues in the Game World*
    - This refers to any visual information that reminds the player that they are playing a video game. This can take the form of graphical glitches, user interface information, notifications or even adverts.
- *Consistent Behaviour from Things in the Game World*
    - Be it items, enemies or non-playable characters, the world needs to have consistency in how these items act. This can refer to the artificial intelligence controlling some of these elements and how agents behave with the world, but it can also refer to the wider issue of mechanics not making sense.
- *An Unbroken Presentation of the Game World*
    - Loading screens or badly designed cut-scenes can pull the player away from the experience and break the immersion or presence the virtual world provided. This can even be achieved by tutorials or over-bearing user interfaces. An example of this criteria being fulfilled is *God of War* (SIE Santa Monica Studio, 2018), which implements a consistent camera angle from the first scene of the game to the last, except for the use of player controlled menus.
- *Interactivity with Items in the Game World*
    - This criterion will be fulfilled if items within the game world function as they should. Glass should shatter, walking in sand should leave footprints, feathers should fall slowly etc.

3.2.2.4 - Outside Factors

The previous two models for creating immersion all referred to the elements of the game design that can be changed, however there are factors that exist outside of the game world and its mechanics that affect immersion and presence, such as hardware or graphical setup.

For example, a study has shown that the size or resolution of a screen can have a direct impact of the immersion of the player's overall experience (Thompson, et al., 2012). On one hand, this means older or less advanced devices will struggle to get the same experiences as more modern or expensive devices, but it does mean as technology improves the overall level of immersion capable from video games will rise.

Another factor that can affect a player's immersion is the graphical settings for the video game, such as the field of view. The correct field of view setting is dependent on the distance between the player's eyes and the screen, and when incorrect it can cause headaches and nausea (Fitzpatrick, 2017). This is particularly important in virtual reality due to the small distance involved, hence why the previously mentioned visually induced motion sickness occurs so regularly in players using the technology.

3.2.3 - Measuring Immersion & Presence

Measuring a subtle and precise feeling such as immersion or presence is difficult, especially due to the complex definitions for immersion, flow and presence. To tackle this, a seven-correlated-factor model questionnaire was created, designed specifically for measuring immersion levels of players when playing narrative-based video games (Qin, et al., 2009). This factor model assessed curiosity, concentration, challenge and skills, control, comprehension, empathy and familiarity, and using research on the criteria of game flow (Sweetser & Wyeth, 2005) created a questionnaire to assess the level of immersion within a computer game's narrative.

3.3 - Emotional Responses & Psychology

An integral part of this project was developing an understanding with the link between video games and emotions. There had to be a bedrock of psychological information in regard to emotional responses, such as how they were triggered and how they could be measured.

3.3.1 - Triggering Emotional Responses

There have been many studies done into emotions and how they can be triggered by various stimuli, including social, biological and artificial stimuli. There are many stimuli that can induce emotions in such a variety of different ways and at different strengths. For example, in a 2001 study it was found that the response to music uses the same similar neural systems of reward and emotion as that of biologically relevant stimuli, such as food (Blood & Zatorre, 2001). This was an incredible finding, as it proved that a stimulus as abstract as music could cause such a response as strong as the body's desire for food. It also proves that while it is not necessary for survival, a form of media could be of great importance to a person's well-being and can illicit such strong reactions.

3.3.2 - Measuring Emotional Responses

Attempting to understand what emotions another human is experiencing is a difficult process, especially when trying to turn those emotions into a measurable statistic. Many attempts have been made to try and solve this problem absolutely, but there is still discussion about the best method (Carmichael & Barooah, 2012).

3.3.2.1 - POMS (Profile of Mood States)

POMS is a psychological assessment to assess mood fluctuations which is used in both clinical and research settings (McNair, et al., 1971). It exists in the form of a questionnaire featuring 65 emotional adjectives that the participant rates on a scale of one to five. The emotional adjectives are grouped into a list of seven emotional dimensions that give you an overview of the participant's mood state. The dimensions are anger, confusion, depression, fatigue, tension, vigour and friendliness. The values are generated by questionnaires that unfortunately are not freely available and require a psychological professional to access them.

3.3.2.2 - Circumplex Model of Affect

The Circumplex model functions around the idea that you cannot have two directly conflicting emotions at the same time, such as sad and happy.

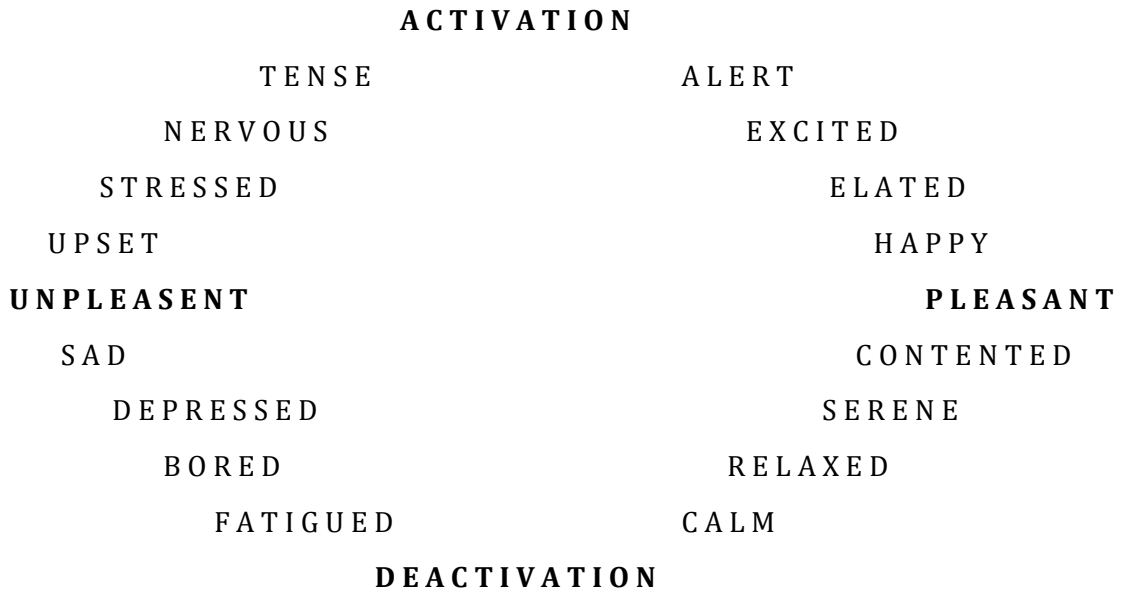

Figure 1 - Circumplex Model of Affect Diagram

To display this, the grid seen in *Figure 1* was created. This allows a participant to place a point on the grid that, in theory, should give an accurate representation of their overall mood. This is a contentious issue, as it is still widely debated that negative and positive emotions need to be measured separately, as a human being can feel both sides at once in certain situations (Carmichael, 2012).

3.3.2.3 - PANAS (Positive and Negative Affect Schedule)

The PANAS method is a self-reporting questionnaire that helps track positive and negative affect separately from each other (Watson, et al., 1988). It does this through asking the participant to respond to a series of emotional key words based on how much they currently relate to that keyword. Each keyword is then marked on a scale of one to five, where one means the participant did not relate to the keyword at all, and five suggests they relate incredibly strongly to the keyword.

PANAS has the issue of being a self-reporting questionnaire, as it requires the participants to be accurate to the emotions they feel themselves, which are often over or understated (Watson & Lee, 1999). The PANAS model has been shown to be reliable in multiple studies (Von Humboldt, et al., 2017) (Buz, et al., 2015), however the system "is fraught with problems that may lead to it failing to yield support for the role of affective processes as resulting from and being involved in psychological phenomena" (Harmon-Jones, et al., 2016). Due to these issues, Harmon-Jones, a post-doctoral fellow at UNSW Sydney, helped develop an updated self-reporting questionnaire called the DEQ (Discrete Emotional Questionnaire).

3.3.2.4 - DEQ (Discrete Emotional Questionnaire)

The DEQ was created to improve on the commonly used PANAS system, so its purpose still remains to test whether any test or trials that have been performed, influenced the participant's emotions. The DEQ runs a similar questionnaire to the PANAS but uses a different array of keywords and ranks each keyword on a scale of one to seven. The DEQ is able to measure state emotions and discrete emotional states, resulting in more accurate responses to both negative and positives scales when questioned. It is now being used in modern psychological studies (Warrenburg, 2019) (Lok, et al., 2019) as an alternative to the PANAS system.

3.3.3 – Data Analysis

Not only does the emotional data need to be gathered, it also needs to be analysed to either prove or disprove the hypothesis. In order to do an accurate analysis, the number of participants

involved will need to be decided. While there is no minimum number of participants required for a study of this nature, it is recommended to gather as many as possible in order to better identify which variables affect the data and which do not (Brysbaert, 2019).

Once the participants and their data has been gathered it will need to be analysed to test the significance of the variables being tested, such as the presence of virtual reality. One method is a T-Test, which can be used to identify whether a given mean value is significantly different from the sample mean or not. Another method is an ANOVA, which utilises F-testing to compare the two standard deviations of two samples and check the variability (Pallant, 2016).

Chapter 4 - Trial Design & Development

While utilising the research and information gathered in the previous chapter, a trial was designed to help produce data that might help form a conclusion on whether or not the presence of virtual reality technology affects a player's emotional responses. These trials were designed to use the information gathered to create a video game prototype that aimed to invoke a specific emotional subset or subsets, that can then be compared and contrasted with the presence of the virtual reality technology. This has been split into three main sections:

- Step One: The designing and developing a prototype video game that has a high probability of invoking a specific emotion or subset of emotions. This will use the research gathered into game design, games development and the emotional responses of humans to the stimuli.
- Step Two: The design of the trial format itself, including how data will be gathered and measured, the number and range of participants and the various stages of the trial.
- Step Three: The implementation of an emotional response measuring system, designed to measure the emotional responses of players when playing the prototype both when they are using and not using the virtual reality equipment, along with the recording of any relevant data. This will use the gathered research into emotions and psychology techniques for emotional response measurement.

4.1 - Prototype Design

4.1.1 - Prototype Criteria

In order to ensure the prototype is suitable to test the theory of this project, a list of criteria was created below in *Figure 2.*

Criteria	Description
#1: Virtual Reality Support	The prototype must support both virtual reality technology and standard play
# 2: Control Support	The prototype must be able to support both motion controls and either a keyboard and mouse or gamepad
#3: Motion Sickness Relief	The prototype must have been designed to limit the effects of motion sickness when played with virtual reality technology
#4: Invoking Emotional Responses	The prototype must be designed to invoke a specific emotion or subset of emotions
#5: Game Length	The prototype will be being used in a trial format, so it must be possible to finish it within 5 – 10 minutes
#6: Game Complexity	The prototype may be tested by a range of players with different levels of experience, so it must be as accessible as possible for players

Figure 2 – Prototype Design Criteria

4.1.1.1 - Virtual Reality Support

The base of the prototype was for the game to be playable both with and without virtual reality technology, otherwise a direct comparison would be extremely difficult. The two versions of the experience must be as identical as possible except for the presence of the technology in order to eliminate as many possible variables that may affect the results of the experiment.

4.1.1.2 – Control Support

Along with supporting the virtual reality headset, the prototype must also allow for the control scheme to change to accommodate the technology. When the prototype is utilising the virtual reality technology, the control scheme must use the motion controllers, whereas without the technology it can either use a keyboard and mouse or a gamepad. The control schemes should be designed to limit their differences, ensuring all commands and actions required in gameplay can be completed in full regardless of input device.

4.1.1.3 – Motion Sickness Relief

As noted by the research, virtual reality games can cause players to feel severe motion sickness if the movement in the headset is too fast, or if there is a disconnect between the visuals they are seeing and the physical movement of their own bodies. The prototype must attempt to negate this effect as much as possible, especially when linked to player movement, either through not moving the player's position at all or using one of the techniques listed in the previous chapter, such as teleportation.

4.1.1.4 – Invoking Emotional Responses

In order to test whether the presence of virtual reality technology increases the intensity of emotional responses, the prototype must be designed in a way to target a specific or several specific emotional subsets. The prototype must attempt to invoke these emotions using the techniques defined in the previous chapter.

4.1.1.5 – Game Length

In order to accurately gain results from testing the prototype, the prototype must be tested by a multitude of participants. Due to time constraints, the prototype must be short in length, especially if a participant is going to test it both with and without virtual reality technology, so effort must be made to complete all of the other criteria while only lasting five to ten minutes in length.

4.1.1.6 – Game Complexity

The prototype will be tested with a variety of different participants, potentially including those with little video game experience, so the gameplay must be designed to be accessible to all skill levels without sacrificing too much interactivity.

4.1.2 - Prototype Design Process

The prototype was designed using the list of criteria as a base. The design can be split into separate sections as listed below:

4.1.2.1 - Game Engine

In order to best utilise the virtual reality headset, the game should attempt to simulate a 3D environment. An array of 3D video game engines was identified as potential engines to develop the prototype within, with two credible options selected:

- Unreal Engine (Epic Games, 2019) - Unreal Engine is a versatile engine that has been used to develop a number of large budget professional games in recent years, such as *Darksiders III* (Gunfire Games, 2019). Utilising both C++ scripting and a blueprint system, game scripts can be created quickly and with a great level of depth. It also uses an extensive lighting and graphics system, including material management and in-engine 3D skeleton and model editing, resulting in excellent graphical fidelity. Unreal Engine also includes virtual reality support for a number of different headsets, including their motion controllers, making the engine an ideal choice for virtual reality development.
- Unity (Unity Technologies, 2019) - The Unity engine is used widely across the development of video games, especially with small to mid-range titles and the indie development scene, with titles such as *Kerbal Space Program* (Squad, 2011). It also has excellent cross-platform and mobile development, being used for major mobile titles such as *Deus Ex: The Fall* (N-Fusion Interactive, 2013). It utilises C# scripting and an easy-to-use component-based architecture making it a simple engine to develop with, allowing for a fast development process. The Unity engine also has a range of virtual reality headsets that it supports, also making it a viable candidate for virtual reality development.

When deciding which engine would be most appropriate, both Unreal Engine and the Unity engine would have been acceptable options. However, due to graphical fidelity being an

important part of immersion (Madigan, 2012), Unreal Engine's superior graphics and lighting engine made it a more viable choice.

4.1.2.2 – Emotional Focus

Before the prototype's game genre and mechanics could be selected, the emotional focus of the prototype had to be selected. During the research listed in the previous chapter, the following potential emotions were reviewed:

4.1.2.2.1 - Fear & Anxiety

Fear and anxiety are popular emotions evoked within videogames. Although both fear and anxiety are two different emotions, both are interlinked as fear can feed off anxiety and vice-versa. Fear and anxiety can also be achieved by a myriad of simple yet effective methods which means that it is easier to invoke these emotions within players, making the horror video game genre one of the most popular in the gaming market. A key method of invoking these emotions is via audio, as tense music conveys 'a range of atmospheres and engage[s] players through deep emotional connections to the terrifying environment' (Donnelly, et al., 2014). Video games can also include graphical elements to disorientate and surprise the player, such as *Slenderman's* use of static as seen in *Figure 3* (Parsec Productions, 2012).

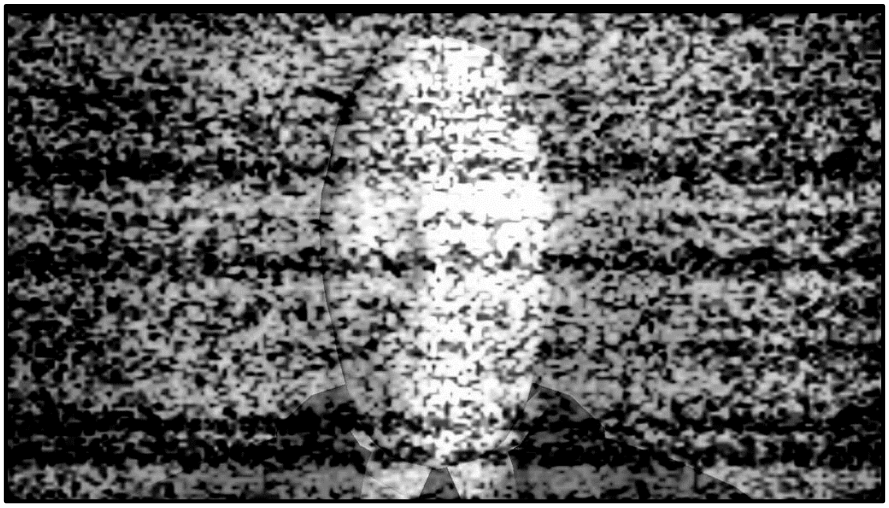

Figure 3 – Slenderman's use of static to invoke fear and anxiety (Parsec Productions, 2012)

When invoking fear or anxiety via narrative, gory, supernatural or thriller-esque storylines that allow the player to control the fate of their own character are more immersive than horror films which further heightens emotional response. As identified in the previous chapter, there are a number of mechanics for invoking fear and anxiety, such as limiting perspective and removing abilities. These can be coupled with gameplay mechanics such as timed activities and limited resources in survival games build anxiety as there is a sense of urgency.

Due to the number of methods that could be implemented into a prototype to invoke fear and anxiety, as well as the wealth of example titles that have proven the effectiveness of horror-based video games, the prototype was chosen to focus on these two emotions. Fear and anxiety are often targeted by video games as "games provoke these better than other media because there's actually something at stake for the player" (Rouse III, 2009).

4.1.2.2.2 - Satisfaction & Excitement

Satisfaction and excitement are common emotions invoked by video games of all types, however this results in the emotions not being directly linked to a specific genre or specific mechanics. While some mechanics were identified in the previous chapter, such as fast-paced gameplay to create adrenaline or rewarding players, they lack the simplicity and direct connection to the emotions that could be seen with fear and anxiety. Creating a prototype to invoke these emotions would have been feasible, however it would have required a longer testing period to ensure the

mechanics and gameplay was invoking the correct emotions and may have delayed the study as a whole, so these emotions were not chosen as the focus for the prototype.

4.1.2.2.3 - Sadness & Hurt

There were limited examples of video games that focus on creating feelings of sadness or hurt and it was difficult to ascertain the presence of any interactive mechanics that explicitly target those emotions. While sadness could be seen invoked during narrative segments or cutscenes, there were not many examples of the emotion being used through mechanics. While some games can invoke feelings of loss or guilt, it would be difficult to create a prototype to target sadness and hurt when then there are so few examples to observe.

4.1.2.2.4 - Relaxation & Calm

When analysing the methods for invoking feeling of relaxation and calm, there were a number of different techniques or gameplay mechanics that would be able to help relax the player. There were also a number of example games, such as *Stardew Valley* (ConcernedApe, 2016), that could be used as an basis for a prototype, as they implement the endless nature trope with some non-time sensitive objectives to try and keep players interested while maintaining their relaxed state. One of the issues with these emotions however is the amount of time they take to invoke, as well as balancing the sense of relaxation with boredom. As the prototype can only be 5 – 10 minutes in length, it could have been difficult to create a strong sense of calm within that time frame, without simply boring the player, which is a risk with games that attempt to invoke feelings of relaxation (Chang, 2016).

4.1.2.3 - Gameplay Genre

As the emotions of fear and anxiety were being used as the focus of the prototype, the prototype would be based on the horror genre of video games. A number of virtual reality horror-based titles have been released in recent years that have utilised the techniques listed in the previous chapters, such as *The Inpatient* (Supermassive Games, 2018) and *Resident Evil 7: Biohazard* (Capcom, 2017). Both of these titles also utilise the 1st-person perspective, which translates excellently to the virtual reality headset. In order to fully utilise the virtual reality headset, the camera must mimic that of a person's eye view, as that grants the best sense of immersion, which may be connected to the strength of the players' emotional reaction. The 1st-perrson perspective is also very common in modern video games, such as the rise of the *Call of Duty* franchise (Infinity Ward, 2003).

4.1.2.4 - Gameplay Controls

The controls for the prototype would have to implement two different schemes, one utilising the motion controls and the other utilising a keyboard and mouse. As participants could have no experience with these control schemes, the controls would have to be simple and easy to understand. The prototype had to be designed to have minimal mechanics to ensure participants would not be overwhelmed, especially as they only had 5 – 10 minutes to complete each prototype.

4.1.2.5 - Gameplay Narrative

Due to the prototype, only being 5 – 10 minutes in length and participants having ranging experiences with video games, the narrative of the prototype had to be designed to be simple, short and easy to understand. The narrative also had to implement horror-based tropes to attempt to invoke the key emotions of fear and anxiety.

4.1.2.6 - Game Graphics

The graphical style of the prototype would have to be simplistic to adhere to the time constraints of the study, but due to a study claiming that when video games are used for research purposes, there is little need for high-fidelity graphics and that the fidelity would not affect results (Gerling, 2013), this did not cause an issue. The selected game engine, *Unreal Engine* (Epic Games, 2019), contains a number of quick asset generation tools that would allow for those simple assets to be

created, as well as a number of free-to-use pre-made assets which were then available for use in the creation of the prototype.

4.1.2.7 - Game Audio

As described in the previous chapter, audio can be an integral tool in video games for invoking fear and anxiety. The prototype had to implement both sound effects and music throughout, which would have to be sourced online through the creative commons license or created from scratch.

4.1.3 – Prototype Development

Based on the research from the previous chapter and the analysis from section 4.1.2, the prototype was designed and developed in *Unreal Engine.* The prototype was based on the 'escape the room' style of games, as that allowed for the combination of a 1st-person perspective, horror-based content, timed elements and simple mechanics that all participants would be able to understand and use within 5 – 10 minutes.

4.1.4.1 – Prototype Premise

The prototype traps the player in a room, unable to move, as seen below in *Figure 4*. They are forced to answer questions designed to make the participant uncomfortable (Krishnakumar & Rymph, 2012) under timed conditions. Halfway through the experiment, they are plunged into darkness before a series of flashing lights and loud sounds surprise them. They are offered a chance to defy their captor if they refuse to answer the questions. Regardless of their choices, they are killed by their captor as the prototype ends with a 'jump-scare' style surprise.

Figure 4 – The Environment Used in the Prototype

4.1.4.2 – Prototype Mechanics

The prototype was built upon *Unreal Engine's* pre-existing VR template, which gives the basic hand coordination for the motion controllers and headset setup from which the details could then be fine-tuned. This included mapping the correct actions to the buttons on the motion controllers and altering the perspective and field of view for the headset to try and maximise comfort. The version without virtual reality had these components removed and had the controls reset to the basic keyboard and mouse setup.

As for the participants' interaction within the prototype, they can look around their cramped surroundings either by turning their head with the virtual reality headset or using the mouse. They can also interact with the items of the desk either by gripping their hand with the motion controller or clicking and dragging with the mouse. Finally, they can press either a 'yes' or 'no'

button located on top of the desk by pushing it with their hand with the motion controller or pressing either 'y' or 'n' on the keyboard.

4.1.4.3 – Prototype Narrative

The narrative was simple but designed to make the participant feel scared and anxious for what was going to happen. The narrative is delivered to the player via a distorted voice and a screen on the far wall of the room they are trapped in, that also delivers their instructions.

The narrative was delivered through *Unreal Engine's* blueprint system, allowing for the changes of text, audio and lighting to be timed or cued to a participants' actions.

4.1.4.4 – Prototype Audio

The audio for the prototype was created from scratch, including recording actors delivering lines, sound effects and a backing track all designed to try and create a horror-based atmosphere for participants to experience.

The background audio was delivered as a stereo track underneath all the other sounds, whereas the narration utilised *Unreal Engine's* 3D sound engine to give participants' feeling that the voice was coming from a specific location within the space they are occupying.

4.2 - Trial Design Process

4.2.1 – Trial Method Breakdown

The trial was designed to contain the following steps:

- Step One – The participant must listen to a pre-recorded message explaining the full contents of the trial, all health and safety issues and ensuring they know exactly what they are going to be asked to do during the trial. The message being recorded ensures consistency between participants and removes the risk of information being missed out by the researcher.
- Step Two – The participant is given a medical and consent form to complete, which certifies that the participant understands everything they are going to be asked to do and ensures they have no medical conditions that potentially endanger them during the trial. This is stored separately to the results, so their consent is kept on file without removing the anonymity of the results.
- Step Three – The participant completes a background information sheet which includes information about their history and experience with video games, virtual reality and horror content. This allows for trends to be identified between traits of participants and their emotional responsiveness to the prototypes.
- Step Four – The participant completes a discrete emotional questionnaire to assess their full range of emotions before the experiment begins. This forms the baseline emotional scores that will be used to compare how the prototypes have changed the participants' emotions.
- Step Five – The participant plays a version of the prototype. Whether they play the virtual reality or standard version first is randomised, but it is ensured that the split is kept at 50/50.
- Step Six – After the participant has finished their first playthrough, they are given a second discrete emotional questionnaire to complete to assess how the prototype has altered their emotional state.
- Step Seven – The participant the completes a second playthrough of the prototype, this time playing whatever version they did not play in their first playthrough.
- Step Eight – After the participant has completed their second playthrough, they are asked to complete a final discrete emotional questionnaire to assess how the second playthrough affected their emotional state.

- Step Nine – The participant is asked to fill out a final feedback sheet, identifying any key moments that affected their emotions and how they felt about the experiment overall. This will help identify elements that could be improved within the trial as well as potentially identifying which elements of the trial affected the participants the most.

This format has a couple of key issues that have to be addressed, the first being that a participant will have to play the same experience twice in a row, with the only difference being the presence of virtual reality technology. It is possible that this will result in the emotional scores for the second playthrough to be lessened, as a player could be less scared of something they know already, due to the fear of the unknown (Carleton, 2016). However, as long as the split between which version is played first is kept equal, it will allow for the theory to be tested and accounted for. It will also allow for an analysis on the effect of playing each version first or second and assessing the differences between the two versions of the prototype.

Secondly, while there is a small break between the first and second playthroughs, it is possible that a participant's emotional state may not have returned to its natural state before playing the prototype for the second time. This again may skew results for the second playthrough, but as long as the results from both playthroughs can be separated and viewed in isolation, they can be removed if necessary.

4.2.2 – Background Information Sheet

As stated in section *4.1.4.2*, participants would be required to fill out a background information sheet that includes some detailed information about their knowledge and experience of related media and technology. An example of this sheet can be seen in *Appendix S.* The answers were ranked on a 1 – 5 scale, allowing for simple comparison between the different sets of responses.

4.2.2.1 – Video Game Frequency

Participants were asked about how frequently they played video games currently on a 1 – 5 scale, where 1 equalled 'never' and 5 equalled 'daily'. This information was recorded to assess whether there was any correlation between how frequently a participant plays video games currently and their emotional responses to the prototypes.

4.2.2.2 – Video Game Experience

Participants were asked about how experienced they considered themselves with video games on a 1 – 5 scale, where 1 equalled 'not at all' and 5 equalled 'very well'. This information was recorded to assess whether there was any correlation between how experienced a participant is with video games and their emotional responses to the prototypes. This is subject to the participants' understanding and subjective view of the phrase 'experienced' regarding video games, and participants' personal view of how experienced they are may differ from other participants, which could potentially affect results.

4.2.2.3 – Virtual Reality Technology Frequency

Participants were asked about how frequently they used virtual reality technology on a 1 – 5 scale, where 1 equalled 'never' and 5 equalled 'daily'. This information was recorded to assess whether there was any correlation between how frequently a participant uses virtual reality technology and their emotional responses to the prototypes.

4.2.2.4 – Motion Control Technology Frequency

Participants were asked about how frequently they used motion control technology on a 1 – 5 scale, where 1 equalled 'never' and 5 equalled 'daily'. This information was recorded to assess whether there was any correlation between how frequently a participant uses motion control technology and their emotional responses to the prototypes.

4.2.2.5 – Horror-Based Content Frequency

Participants were asked about how frequently they consumed horror-based content, such as scary movies, games or books, on a 1 – 5 scale, where 1 equalled 'never' and 5 equalled 'daily'. This information was recorded to assess whether there was any correlation between how frequently a participant consumes horror-based content and their emotional responses to the prototypes.

4.2.3 – Final Feedback Sheet

The final feedback sheet was designed to gather some information on how participants felt about how the trial had gone and to identify any highlights or possible improvements that could be made in further studies. The participants were asked if they had enjoyed the experiment, their favourite moment, their least favourite moment and finally a chance to write down any additional comments that they had regarding the whole experience.

4.3 – Emotional Recording Method

The prototype formed the backbone of the trial, however the actual format was designed and laid out to try and gather as much data as efficiently as possible. One of the first challenges was identifying the most accurate and feasible way to measure a player's emotions during the trial. Due to availability, no external equipment could be used to gather extra data such as heart rate or blood pressure monitors, so the emotions would have to be gathered in either the verbal or written form.

Of the methods researched, POMS was considered accurate and valid (Grove & Prapavessis, 1992), as well as having various shortened versions which would have added some flexibility, but unfortunately it could not be accessed for research without a psychological professional, so it was not available for this study (Statistics Solutions, 2019).

The circumplex model could be viewed as a very quick and simple for participants to understand, but is not considered highly accurate due to the results being very open to interpretation (Larsen & Diener, 1992). This was due to the basic layout of the model, as well as the naming of the emotional dimensions it uses. Due to the criticism from Larsen regarding the accuracy of this model, the decision was made to not include it within the study.

As stated in the previous chapter, PANAS has been shown to be reliable by various studies, but does have short-comings that have been addressed in the more recent DEQ system (Harmon-Jones, et al., 2016). The decision was made to use the DEQ (Discrete emotional questionnaire) as it is an updated version of PANAS and is being used in current psychological studies by professionals within the industry.

The DEQs will allow for the emotional subsets of fear, anxiety, anger, disgust, happiness, sadness, desire and relaxation to be scored on a 1 – 7 scale, hopefully giving an accurate map of a participant's emotions at any one time. It does have a couple of drawbacks, as it can take up to five or more minutes to complete and as it is a self-reporting questionnaire is not 100% accurate, as the emotions scored by participants can be under and overstated. Despite these flaws, it is accepted with the psychology community as one of the accurate methods for reporting emotion, so it should suffice for this study.

4.4 – Statistical Analysis

When the results from the trial had been gathered, they required analysing to test the hypothesis. The analysis was in the form of several one-way repeated measures ANOVAs to compare each emotional subset's response to the presence of virtual reality. The results of the test determine whether the null hypothesis can be rejected, or in other words, whether the variable being tested had a statistically significant effect. This is achieved not just via comparing the means of two datasets, but rather comparing the variance within and between the two groups and completing a F-test upon them.

Chapter 5 - Trial Review & Analysis

The trial ran over three days and included a total of 16 participants, with 5 taking part of the first day, 7 on the second and 4 on the third. The trial took the format described in the previous chapter, with each participant completing a total of three discrete emotional questionnaires, two play-throughs of the prototype and a background information sheet.

5.1 - Initial Discrete Emotional Questionnaires

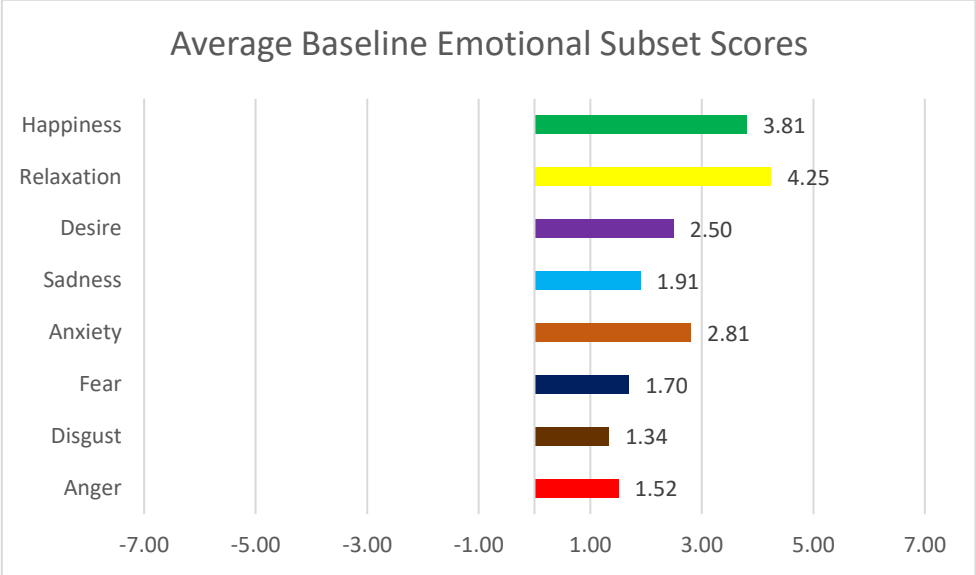

Figure 5 – The Averave Base Emotional Subsets

The first round of discrete emotional questionnaires identified the average scores for each emotional subset as the participant began, with the full results being displayed in *Appendix A* and *Appendix B.* These show how the average participant was feeling before playing the prototype in any form. As *Figure 5* shows, the emotional subsets of fear, anger, disgust and sadness all began low, all averaging below 2 on the 1 – 7 scale. This was specifically important for the fear subset, as having a low benchmark allows for any fear invoked by the prototype to be clear. Happiness and relaxation were comparatively high, both around 4 on the 1 – 7 scale. The anxiety subset was a slight outlier, as it started slightly higher at 2.81 and as it is one of the key subsets used in the prototype. This might make the origin of changes in the anxiety subset harder to pinpoint, as the participant has other factors affecting their anxiety than just the prototypes they are experiencing. However, as scientific studies have shown that 'game designers may be able to increase players' fear if the players are already anxious rather than in a state of calm… Because the player is already in a state of nervousness and worry, he or she may perceive a threat to be more dangerous than warranted, resulting in an elevated fear response' (Grimshaw, 2011).

These average emotional subset scores shall form a benchmark from which the later discrete emotional questionnaires can compare against.

5.2 - Analysing the Effect of the Presence of Virtual Reality Technology

After the full trial was completed, a critical statistic was comparing how the participant's DEQ scores changed when playing the VR version of the prototype against the standard version. The full results of these can be seen in *Appendix C* and *Appendix D.* The amount each subset changed for each participant was added together to create an average emotional shift value for each emotional subset, which can be seen in *Figure 6* and *Figure 7.*

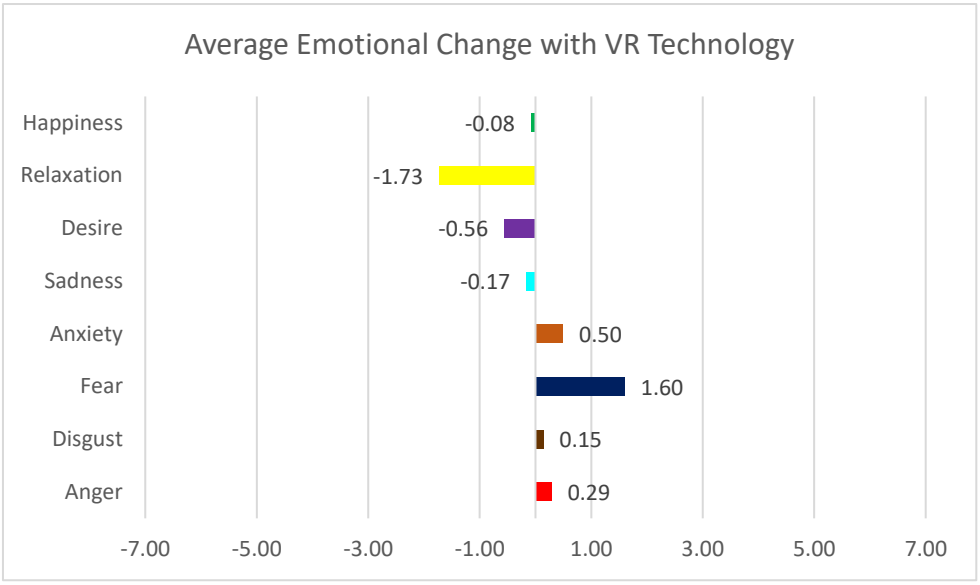

Figure 6 – The average change in emotional subset scores when the VR version is used

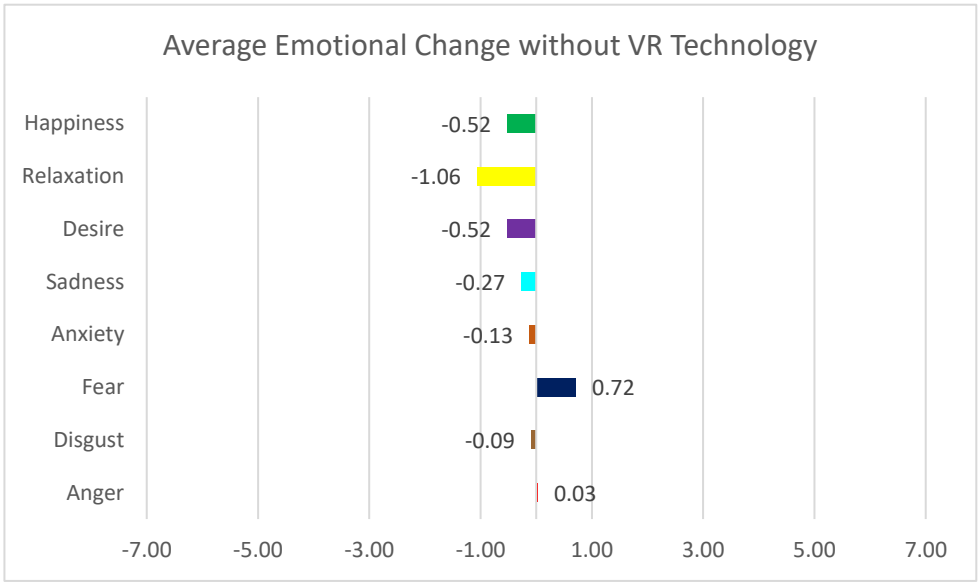

Figure 7 – The average change in emotional subset scores when the standard version is used

As *Figure 6* and *Figure 7* show, there was a difference in the mean of a number of emotional subset scores between the virtual reality and standard versions, so the ANOVA tests were carried out to see if those differences indicated statistical significance.

5.2.1 – Effect on Fear Levels

Avg. Change VR	Avg. Change Non-VR	Variance VR	Variance Non-VR	F-Value	P-Value	F-Crit	Significant?
1.67	0.72	2.97	1.97	2.94	0.10	4.17	No

Table 1 - ANOVA Test Results Comparing Virtual Reality's Effect on Fear Levels

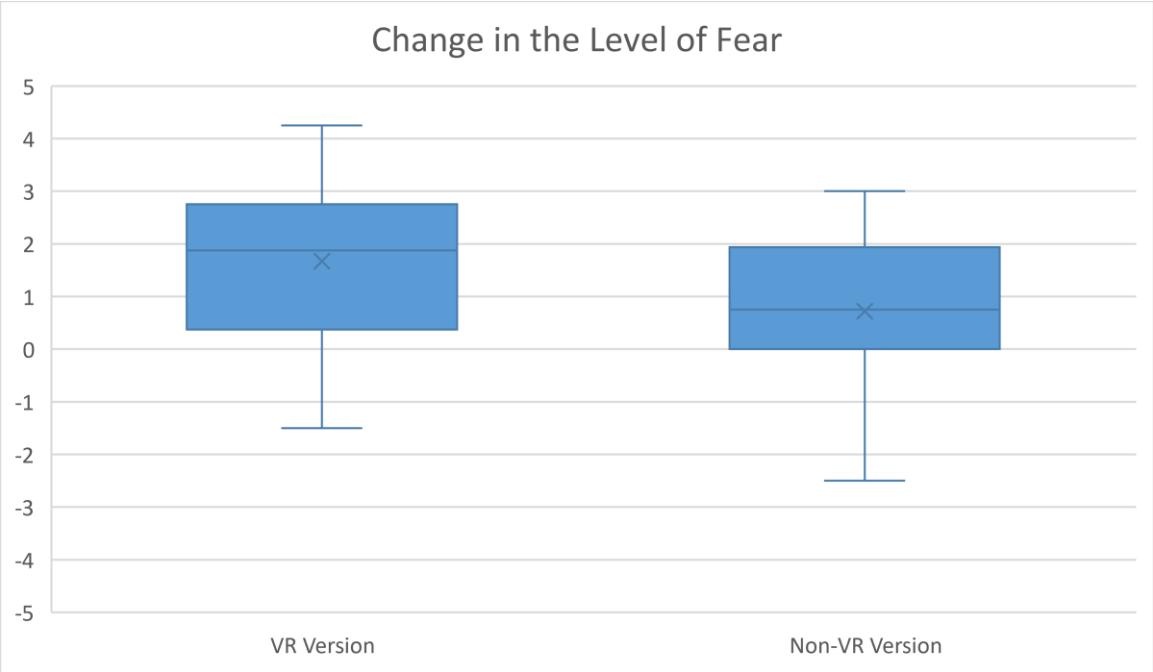

Figure 8- The Change in the Level of Fear

While using the virtual reality technology, the average participant saw their fear score increase by an average 1.67 points, 0.95 points more than the average participant not using the technology. The F-Value remained lower than the F-Crit value (2.94 < 4.17), along with the P-Value being higher than the stated alpha (0.10 > 0.05) meaning we cannot reject our null hypothesis and the groups are not statistically significantly different to each other. While there is a difference between the means, the variance within the groups means the results cannot be considered significant.

5.2.2 – Effect on Anxiety Levels

Avg. Change VR	Avg. Change Non-VR	Variance VR	Variance Non-VR	F-Value	P-Value	F-Crit	Significant?
0.67	-0.13	3.12	2.08	1.95	0.17	4.17	No

Table 2 - ANOVA Test Results Comparing Virtual Reality's Effect on Anxiety Levels

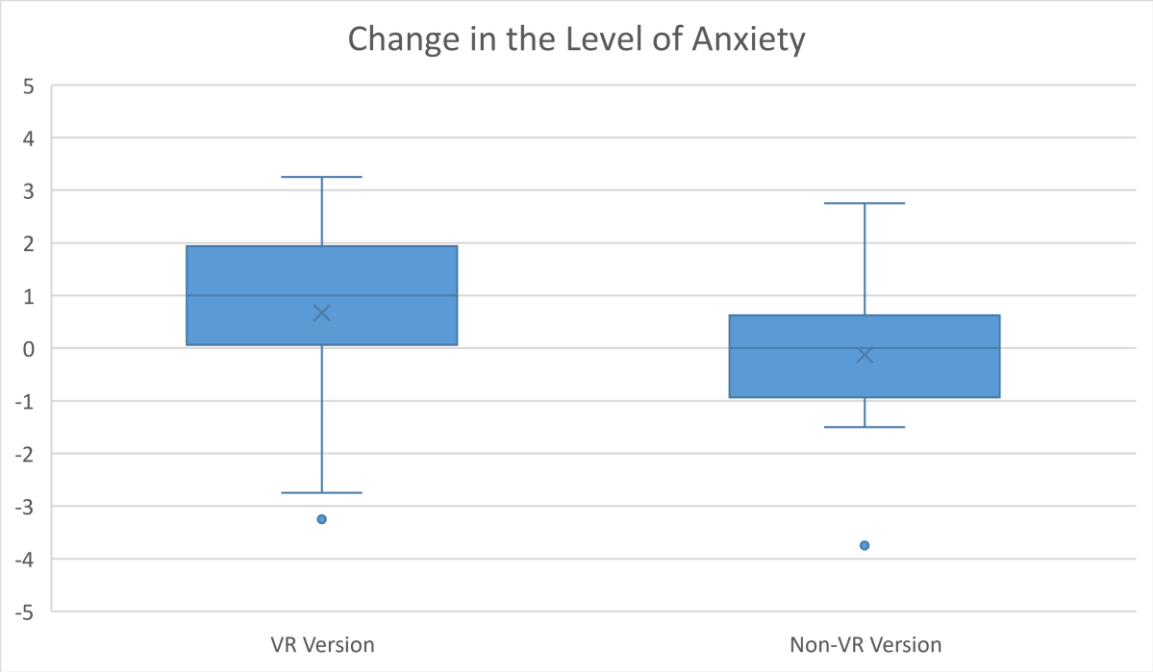

Figure 9 - The Change in the Level of Anxiety

While using the virtual reality technology, the average participant saw their anxiety score increase by an average 0.67 points, 0.8 points more than the average participant not using the technology, who saw their anxiety score actually decrease by an average -0.13. The F-Value remained lower than the F-Crit value (1.95 < 4.17), along with the P-Value being higher than the stated alpha (0.17 > 0.05) meaning we cannot reject our null hypothesis and the groups are not statistically significantly different to each other. There again remained a large variance within both datasets which limits the difference between the two groups.

5.2.3 – Effect on Relaxation Levels

Avg. Change VR	Avg. Change Non-VR	Variance VR	Variance Non-VR	F-Value	P-Value	F-Crit	Significant?
-1.80	-0.63	3.85	0.5	5.05	0.03	4.17	Yes

Table 3 - ANOVA Test Results Comparing Virtual Reality's Effect on Relaxation Levels

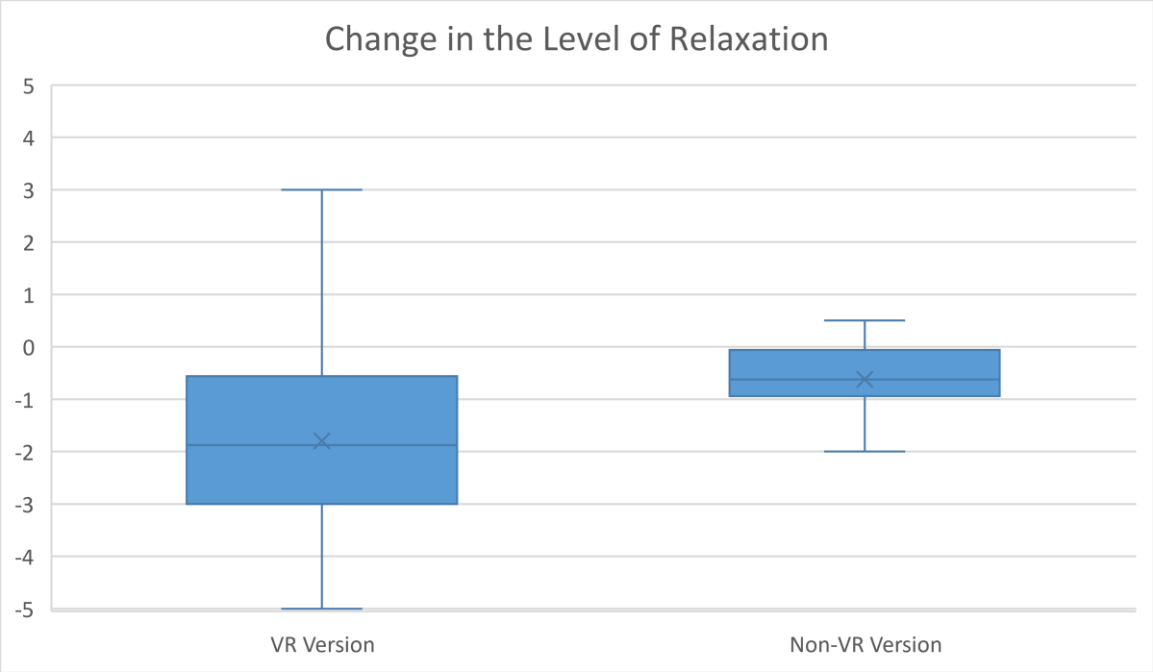

Figure 10 - The Change in the Level of Relaxation

While using the virtual reality technology, the average participant saw their relaxation score drop by an average 1.8 points, 1.17 points more than the average participant not using the technology. This difference is statistically significant with the F-Value being larger than the F-Crit value (5.05 > 4.17), along with the P-Value being lower than the stated alpha (0.03 < 0.05). In this instance we can reject the null hypothesis and accept that the presence of virtual reality did have a statistically significant difference upon the levels of relaxation within the participants. The notable statistic from this dataset was that while the results from participants using the virtual reality technology had a high variance, the participants not using the technology were far more consistent with a much lower variance which assisted in the difference between to two being statistically significant.

5.2.4 – Effect on Anger, Desire, Disgust, Happiness & Sadness Levels

Subset	Avg. Change VR	Avg. Change Non-VR	Variance VR	Variance Non-VR	F-Value	P-Value	F-Crit	Significant?
Anger	0.14	0.03	2.42	1.96	0.04	0.84	4.17	No
Disgust	0.11	-0.09	0.87	0.48	0.49	0.49	4.17	No
Sadness	-0.22	-0.27	0.78	0.75	0.02	0.88	4.17	No
Desire	-0.52	-0.52	-0.91	0.55	0	1	4.17	No
Happiness	0.05	-0.52	2.22	0.90	1.62	0.21	4.17	No

Table 4 - ANOVA Test Results Comparing Virtual Reality's Effect on Non-Targeted Subsets

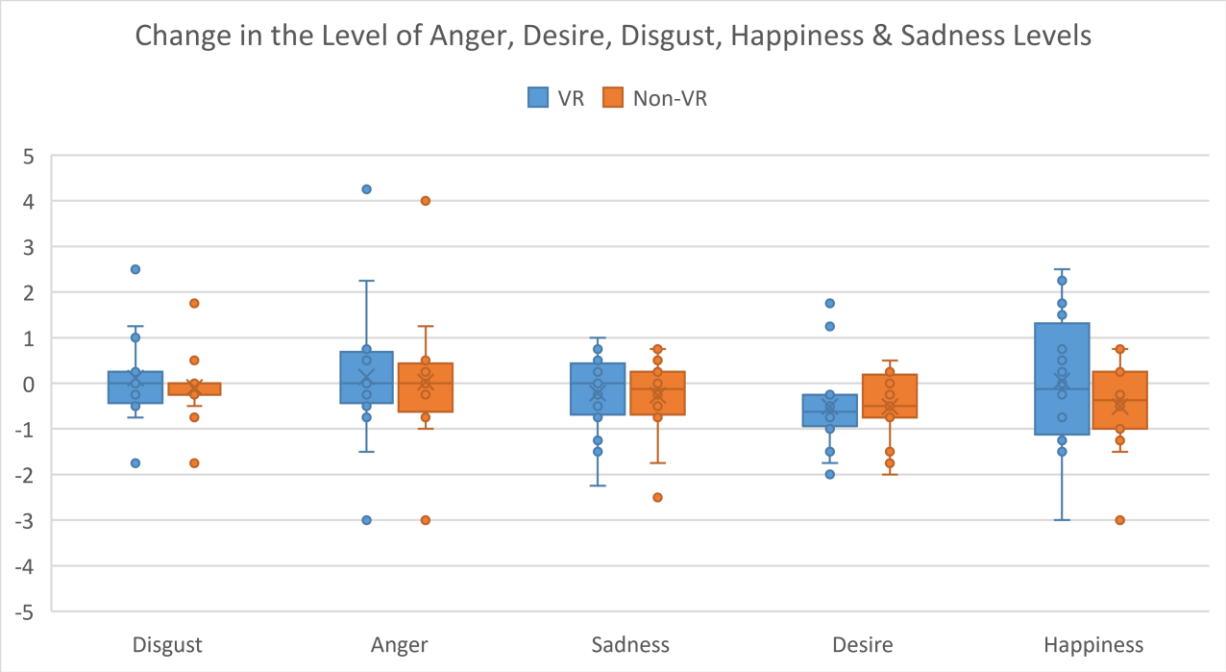

Figure 11 - The Change in the Levels of Non-Essential Emotional Subsets

For the emotional subsets that were not intentionally being invoked, none of the differences proved to be statistically significant as all F-Values were less than the F-Crit of 4.17 and none of their P-Values dropped below the required alpha level of 0.05. This was to be expected as none of these emotions were intentionally being affected by the trial.

5.3 - Analysing the Order of Playthroughs

As was stated in the previous chapter, there existed a potential bias during the second playthrough of the prototype for each participant. As the participant had experienced the prototype for the first time only minutes earlier, their emotional responses may have been altered due to the fact they had experienced it before rather than because the presence of virtual reality technology had changed. In an attempt to combat this potential bias, *Figure 12* and *Figure 13* display the average scores of only the initial playthrough of the prototype, with the full tables of data available in *Appendix E* and *Appendix F*.

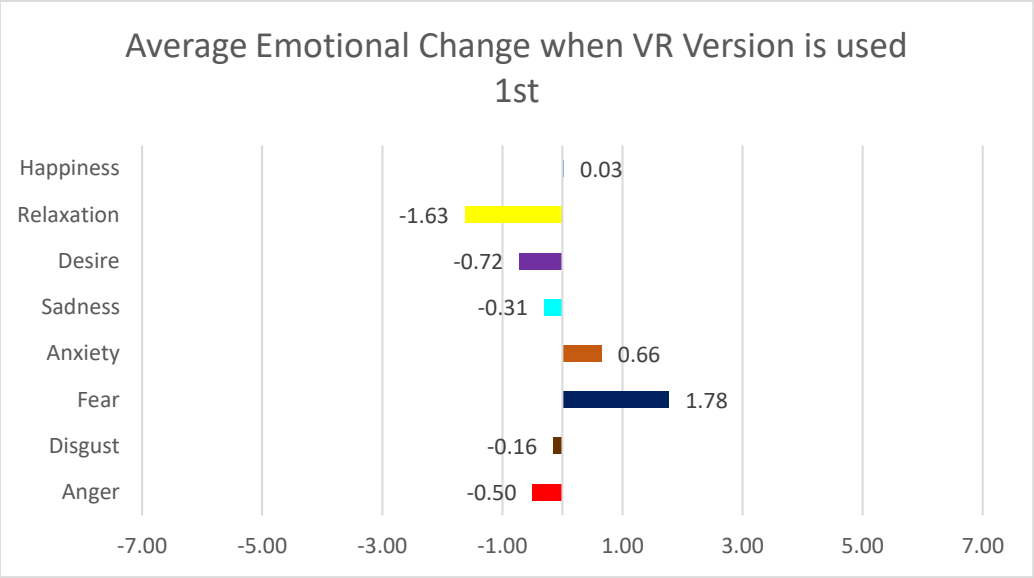

Figure 12 – The average change in emotional subset scores during the first playthrough when the VR version is used

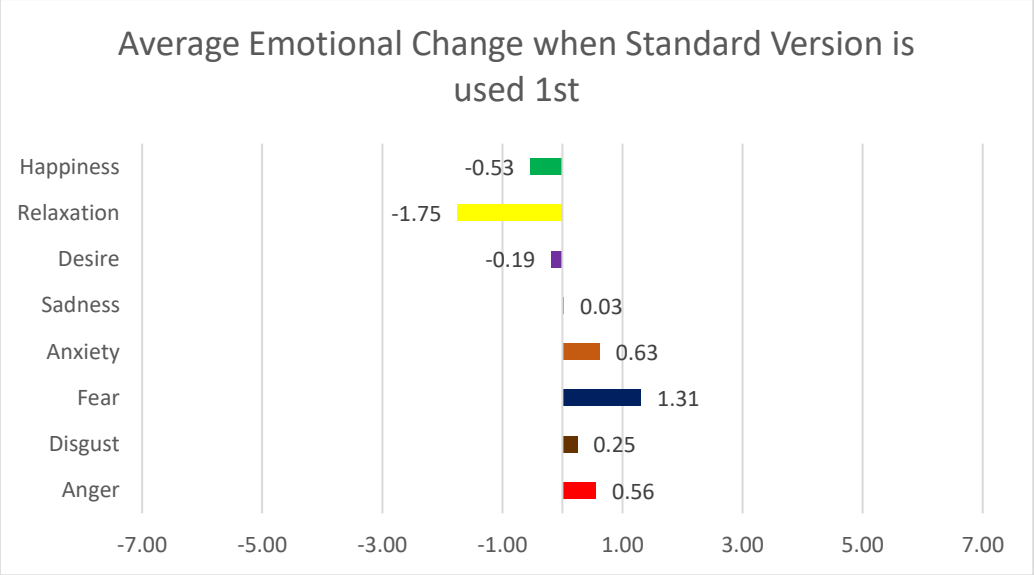

Figure 13 – The average change in emotional subset scores during the first playthrough when the standard version is used

Figure 12 and *Figure 13* suggest that when you remove the second playthrough entirely, the mean of the emotional reactions are similar between both versions. *Figure 12* shows only the results where the virtual reality prototype was used during the first playthrough, while *Figure 13* shows the results where only the standard version was used. For example, while using the standard version first resulted in a slightly larger decrease in relaxation, 1.75 rather than 1.63, it also resulted in a smaller increase to fear, 1.31 rather than 1.78. Based on these scores alone, it could be construed that the presence of virtual reality had little effect on the participant, as when only experiencing the prototype once, the scores were arguably similar. The larger difference in the

mean values can be seen when participants played the prototype again, this time alternating the presence of virtual reality technology.

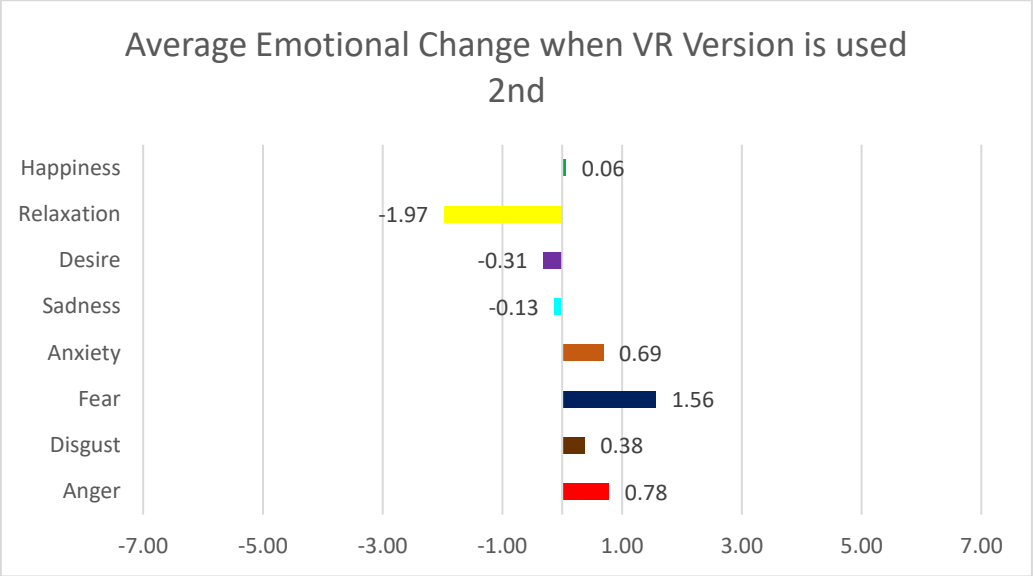

Figure 14 – The average change in emotional subset scores when the VR version is used 2nd

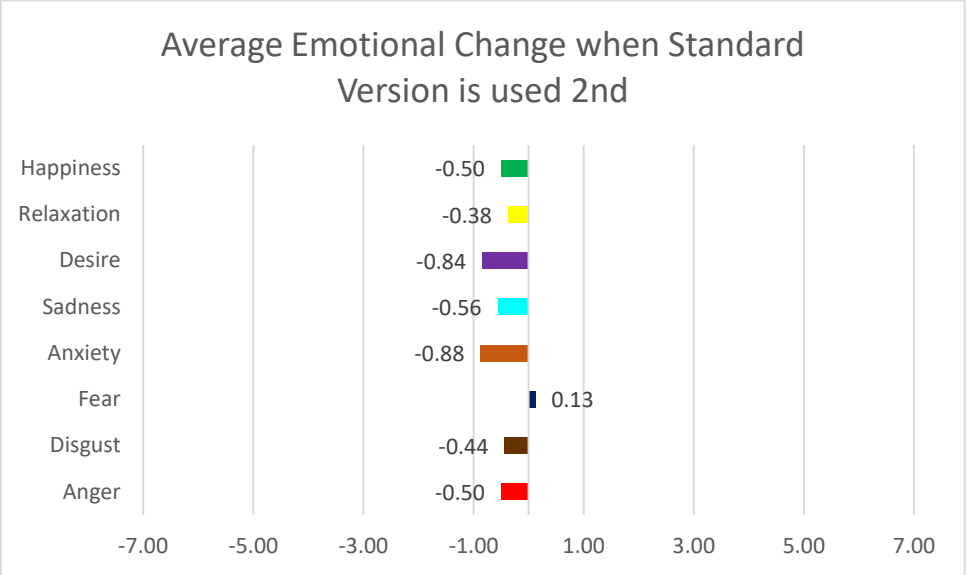

Figure 15 – The average change in emotional subset scores when the Standard version is used 2nd

Figure 14 and *Figure 15* show the results from the second playthroughs, after the participant had already completed the prototype once before. *Figure 14* shows participants who completed the standard version in their first playthrough, followed by the VR version, with *Figure 15* showing the reverse.

5.3.1 – Analysing the Prototype Order's Effect on Emotional Subsets

In order to correctly assess if the order of prototypes had any effects upon the results, the results from *Figure 12, Figure 13, Figure 14* and *Figure 15* were compared and contrasted via a one-way ANOVA test. The emotional subsets of fear, anxiety and relaxation were the focus of this analysis, as they were the subsets targeted by the prototype.

5.3.1.1 – Effect on Fear Levels

Playthrough	Avg. Change VR	Avg. Change Non-VR	Variance VR	Variance Non-VR	F-Value	P-Value	F-Crit	Significant?
1st	1.78	1.31	2.76	1.66	0.40	0.54	4.60	No
2nd	1.56	0.13	3.58	1.77	3.09	0.10	4.60	No

Table 5 – ANOVA Test Results Comparing Virtual Reality's Effect on Fear Levels during the First & Second Playthroughs

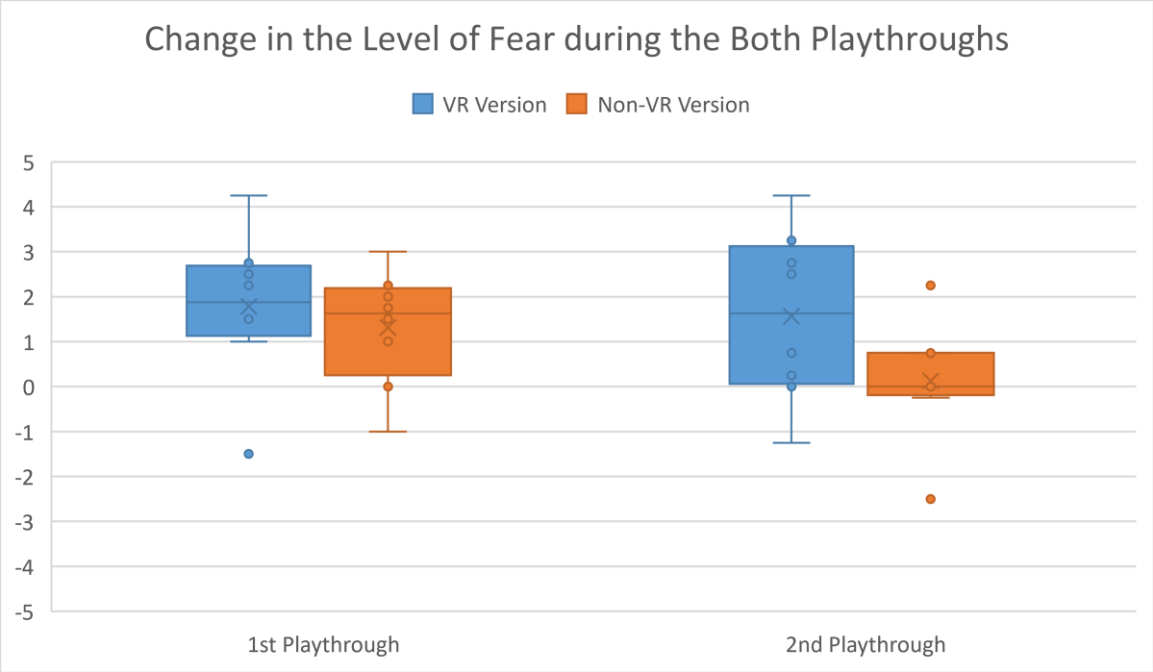

Figure 16 - Change in the Level of Fear during the First & Second Playthroughs

During the first playthrough, the average participant using virtual reality technology saw their fear score increase by an average 1.78 points, 0.47 points more than the average participant not using the technology, but not enough to be statistically significant. The F-Value remained lower than the F-Crit value (0.40 < 4.60), along with the P-Value being higher than the stated alpha (0.54 > 0.05) meaning we cannot reject our null hypothesis. There was a large variance within both datasets which limits the difference between the two groups, but the mean between the two was negligible at best.

During the second playthrough, the average participant using virtual reality technology saw their fear score increase by an average 1.56 points, 1.43 points more than the average participant not using the technology. This shows a much larger gap between the two dataset's mean values, but this did not result in the difference being statistically significant. The F-Value remained lower than the F-Crit value (3.09 < 4.60), along with the P-Value being higher than the stated alpha (0.10 > 0.05) meaning we cannot reject our null hypothesis. The high variance in both datasets lowers the significance, though the difference in mean may suggest this could be tested in further studies to confirm this hypothesis.

If we compare the results from participants using virtual reality first to those who used it second, we can see that the mean only differed by 0.22. Both datasets also had high variance, the F-Value was less than the F-Crit (0.06 < 4.60) and the P-Value was greater than the stated alpha (0.81 > 0.05). Because of this, there is no statistically significant difference between the two datasets, even though the participants using the virtual reality during the second playthrough had experienced the same prototype minutes before.

If we compare the results from the two playthroughs of participants who were not using virtual reality, we can see that the mean differed by 1.18. Both datasets still had a high variance however, which affected the significance of the results (F = 3.2947 < 4.60, P = 0.09 > 0.05), so the null hypothesis still could not be disregarded.

While there was a difference bigger drop in mean fear results from the participants not using the virtual reality technology, the high variance of the datasets again continues to limit the significance of the findings.

5.3.1.2 – Effect on Anxiety Levels

Playthrough	Avg. Change VR	Avg. Change Non-VR	Variance VR	Variance Non-VR	F-Value	P-Value	F-Crit	Significant?
1st	0.66	0.63	2.52	1.54	0.00	0.97	4.60	No
2nd	0.69	-0.88	4.17	1.64	3.36	0.09	4.60	No

Table 6 - ANOVA Test Results Comparing Virtual Reality's Effect on Anxiety Levels during the First & Second Playthrough

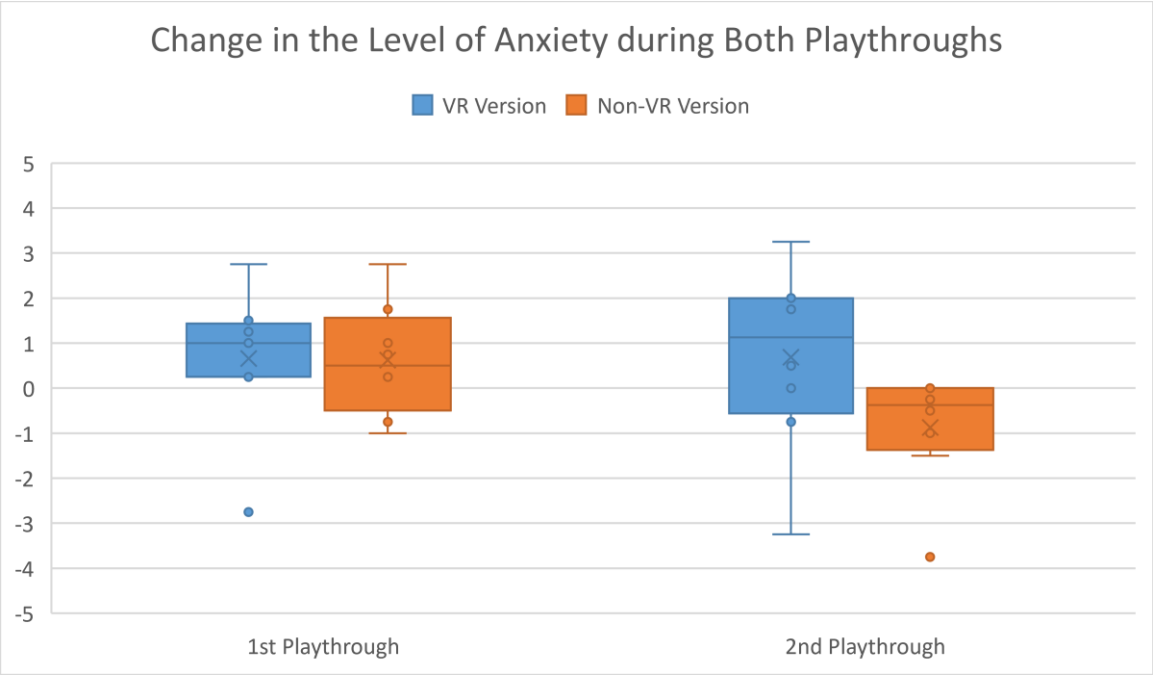

Figure 17 - Change in the Level of Anxiety during the Both Playthroughs

During the first playthrough, the average participant using virtual reality technology saw their anxiety score increase by an average 0.66 points, only 0.03 points more than the average participant not using the technology, not enough to be statistically significant (F = 0.00 < 4.60, P= 0.97 > 0.05).

During the second playthrough, the average participant using virtual reality technology had their anxiety score increase by 0.69, 0.81 more on average than a participant without the technology. This result is still not significant however (F = 3.36 < 4.60, P = 0.09 > 0.05), which may be again down to high variance, especially within the virtual reality dataset which had a variance of 4.17.

If we compare the results from participants using virtual reality first to those who used it second via another ANOVA test, we can see that the difference between the two was far from statistically significant (F = 0.00 < 4.60, P = 0.97 > 0.05) and the difference between the two means was only 0.03.

If we complete the same test comparing the two playthroughs of participants who were not using virtual reality, we can see that the mean differed by 1.18. While both datasets still had a fairly high variance which affected the significance of the results, the overall difference could be considered significant ($F = 5.66 > 4.60$, $P = 0.03 < 0.05$), so the alternative hypothesis could be accepted.

While the difference between experiencing the non-VR version first or second was significant, it is also important that the difference between experiencing the VR version first or second was not, which highlights a difference between the two.

5.3.1.3 – Effect on Relaxation Levels

Playthrough	Avg. Change VR	Avg. Change Non-VR	Variance VR	Variance Non-VR	F-Value	P-Value	F-Crit	Significant?
1st	-1.63	-1.75	4.73	1.52	0.02	0.89	4.60	No
2nd	-1.97	-0.38	3.45	2.45	3.44	0.08	4.60	No

Table 7 - ANOVA Test Results Comparing Virtual Reality's Effect on Relaxation Levels during Both Playthroughs

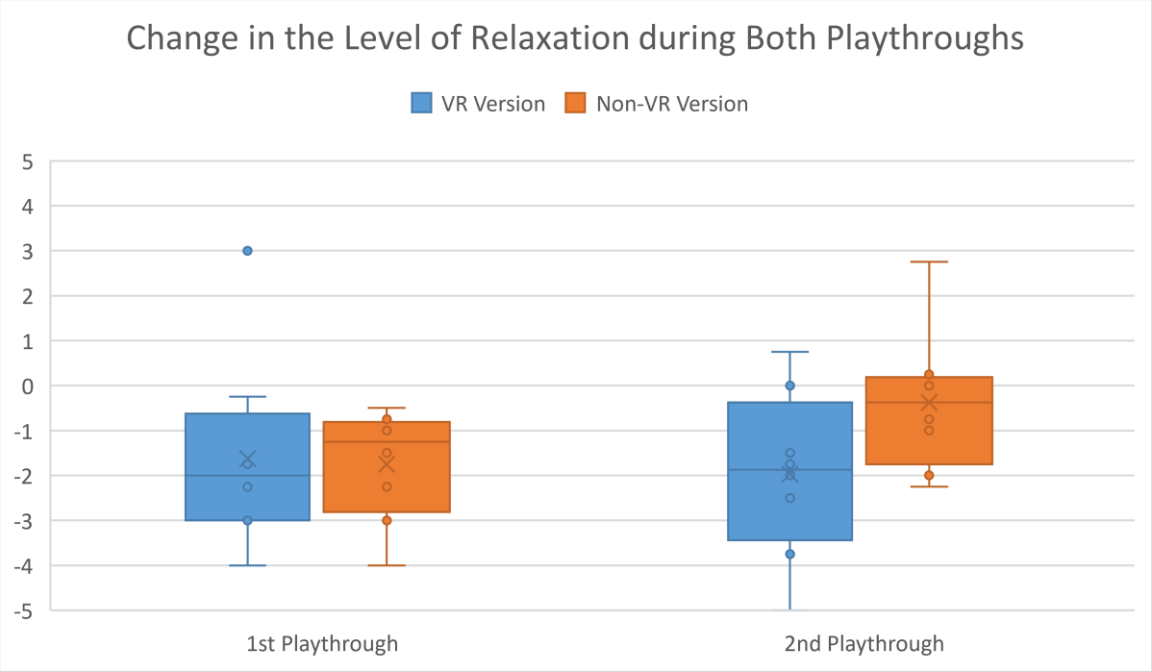

Figure 18 - Change in the Level of Relaxation during the Both Playthroughs

During the first playthrough, the average participant using virtual reality technology saw their relaxation score decrease by 1.63 points, 0.12 less than participants who were not using the technology, but the difference was not statistically significant ($F = 0.02 < 4.60$, $P = 0.89 > 0.05$).

During the second playthrough, the average participant using virtual reality technology saw their relaxation score decrease by 1.97 points, 1.59 points more than the participants not using the technology. This difference in mean was not the result of statistical significance however as the variance was still high (3.45 and 2.45) for both datasets, the ANOVA test could not find the null hypothesis to be worth rejecting ($F = 3.44 < 4.60$, $P = 0.08 > 0.05$).

If we compare the results from participants using virtual reality first to those who used it second, the difference in means was 0.03 and the ANOVA test confirmed that the difference was not significant ($F = 0.12 < 4.60$, $P = 0.97 > 0.05$). If we complete the same test comparing the two playthroughs of participants who were not using virtual reality, we can see that the mean differed by 1.40. Both datasets still had a fairly high variance (1.52 and 2.45) which affected the

significance of the results, so the overall difference could not be considered significant (F = 3.82 < 4.60, P = 0.07 > 0.05), so the null hypothesis could not be rejected.

5.3.1.3 – Effect on Non-Targeted Emotional Subsets

Subset	Play-through	Avg. Change VR	Avg. Change Non-VR	Variance VR	Variance Non-VR	F-Value	P-Value	F-Crit	Significant?
Anger	1st	-0.5	0.56	1.64	2.01	2.49	0.14	4.60	No
	2nd	0.78	-0.5	2.62	1.57	3.14	0.10	4.60	No
Disgust	1st	-0.16	0.25	0.70	0.41	1.19	0.29	4.60	No
	2nd	0.38	-0.44	1.00	0.35	3.90	0.07	4.60	No
Sadness	1st	-0.31	0.04	1.21	0.38	0.59	0.45	4.60	No
	2nd	-0.13	-0.81	0.45	0.76	3.13	0.10	4.60	No
Desire	1st	-0.72	-0.19	1.10	0.26	1.66	0.22	4.60	No
	2nd	-0.3	-0.84	0.76	0.68	1.57	0.23	4.60	No
Happiness	1st	0.03	-0.53	2.90	0.38	0.77	0.39	4.60	No
	2nd	0.06	-0.5	1.90	1.55	0.74	0.40	4.60	No

Table 8 - ANOVA Test Results Comparing Virtual Reality's Effect on Non-Targeted Subsets during Both Playthroughs

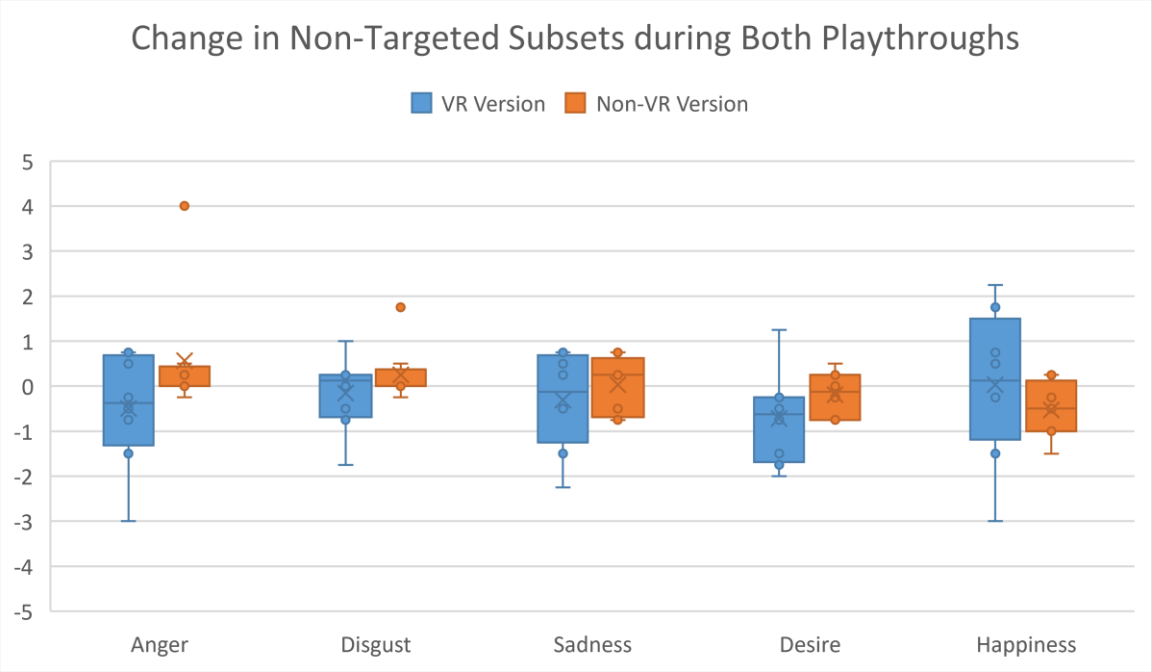

Figure 19 - Effect on Non-Targeted Subsets during Both Playthroughs

As *Table 8* and *Figure 19* show, the prototype did not have a significant effect on any of the non-targeted subsets, which is to be expected. While some of them saw some differences in mean, such as anger, the variance was high enough for this to be irrelevant.

5.4 – Analysing Participants' Video Game Frequency of Use

Alongside the tracking of emotional subset changes in the discrete emotional questionnaire, the participants were also queried about their experiences with similar media to see if there was any correlation between their emotional reaction to the prototypes and their prior experiences.

As described in the previous chapter, the frequency in which a participant plays video games was recorded and can be seen displayed below in *Table 9*.

Participant	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
Score:	5	3	2	5	4	5	5	4	5	5	2	2	3	3	3	3

Table 9 – The participant's frequency of playing video games on a 1 – 5 scale

In order to compare whether the frequency had affected the emotional responses of the participants, the results were split into two groups: high frequency and low frequency. Low frequency was classed as any participant who played video games once a fortnight or less, or in numerical terms, three or below on the one to five scale. High frequency was identified as any participant who played video game at least once week, or four or above on the one to five scale.

Classifying the results into these two groups split the results into two equal halves, which can then have their emotional responses compared via *Figure 20* and *Figure 21* below. The full breakdown of the individual results can be seen in *Appendix I* and *Appendix J.*

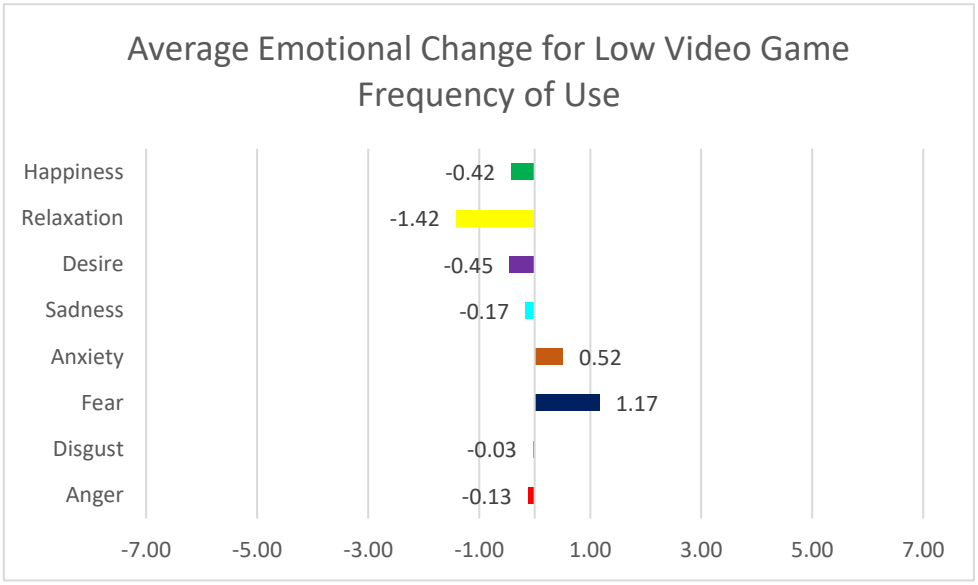

Figure 20 – The average emotional change when participants video game frequency was low

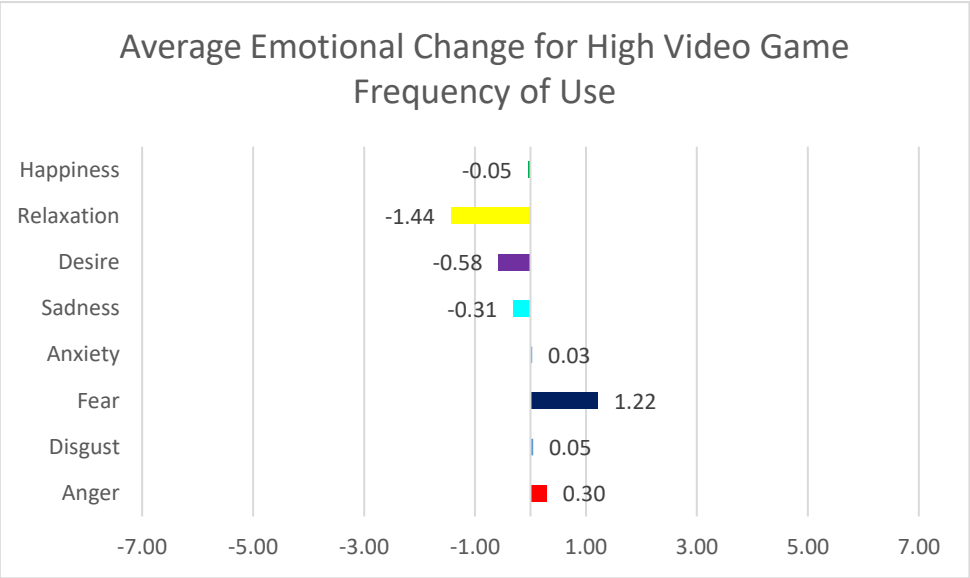

Figure 21 – The average emotional change when participants video game frequency was high

5.4.1 – Comparing video game frequency against emotional changes

When comparing *Figure 20* and *Figure 21*, the effect that video game frequency has upon the average emotional subsets scores can be seen. The emotional subsets of fear, anxiety and relaxation were the focus of this analysis, as they were the subsets targeted by the prototype.

5.4.1.1 – Effect on Fear Levels

Avg. Change Low Freq.	Avg. Change High Freq.	Variance Low Freq.	Variance High Freq.	F-Value	P-Value	F-Crit	Significant?
1.17	1.11	1.25	3.17	0.01	0.93	4.60	No

Table 10 – ANOVA Test Results Comparing Video Game Frequency's Effect on the Level of Fear

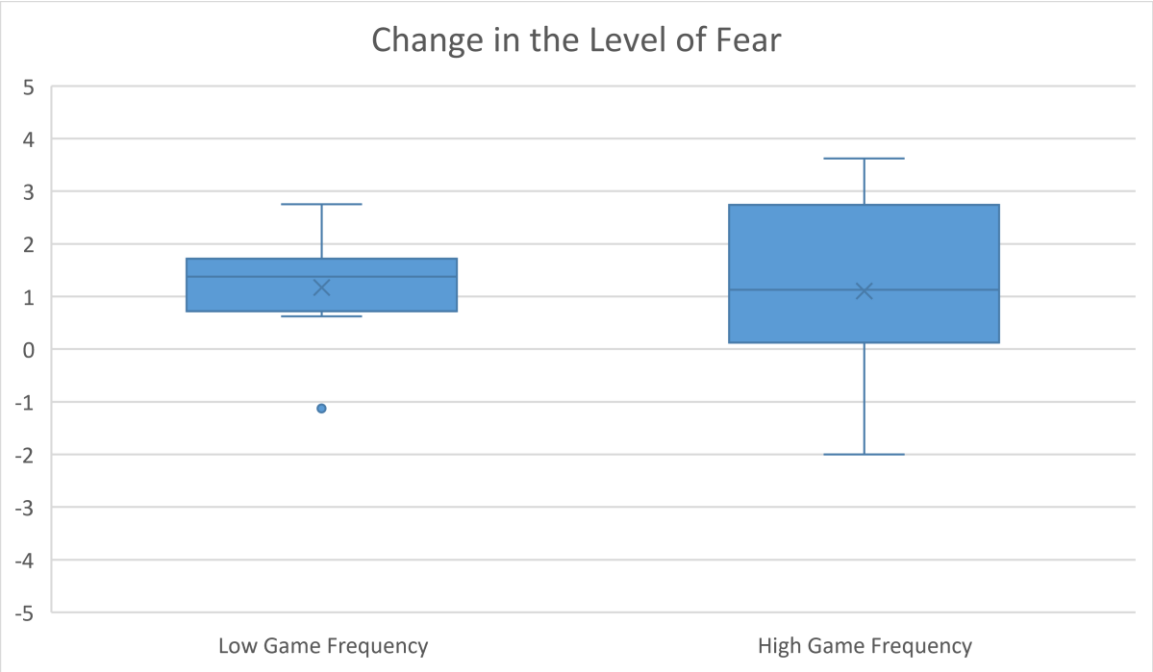

Figure 22 - Change in the Level of Fear

Comparing the means of the datasets, participants with a low game frequency saw their fear increase by 1.17, only 0.06 more than those who had a high game frequency. With high variance amongst both groups, especially the high frequency dataset, the difference between the two was not significant so the null hypothesis remains ($F = 0.01 < 4.60$, $P = 0.93 > 0.05$).

5.4.1.2 – Effect on Anxiety Levels

Avg. Change Low Freq.	Avg. Change High Freq.	Variance Low Freq.	Variance High Freq.	F-Value	P-Value	F-Crit	Significant?
0.52	0.03	1.38	2.93	0.44	0.52	4.60	No

Table 9 - ANOVA Test Results Comparing Video Game Frequency's Effect on the Level of Anxiety

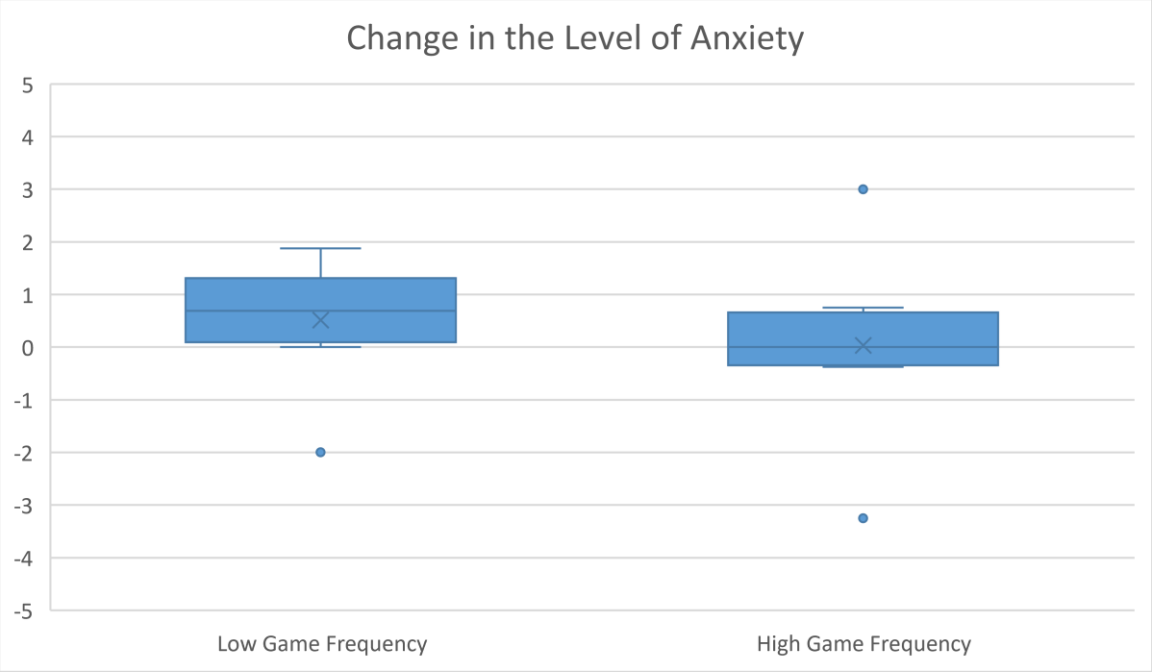

Figure 23 - The Change in the Level of Anxiety

Participants with a low video game frequency increased their average anxiety subset score by 0.52 points, 0.49 more than those with high video game frequency. This difference in mean alongside high variance in both groups was not enough to class their differences as statistically significant though ($F = 0.44 < 4.60$, $P = 0.52 > 0.05$).

5.4.1.3 – Effect on Relaxation Levels

Avg. Change Low Freq.	Avg. Change High Freq.	Variance Low Freq.	Variance High Freq.	F-Value	P-Value	F-Crit	Significant?
-1.42	-1.44	1.21	4.89	0.00	0.99	4.60	No

Table 10 - ANOVA Test Results Comparing Video Game Frequency's Effect on the Level of Relaxation

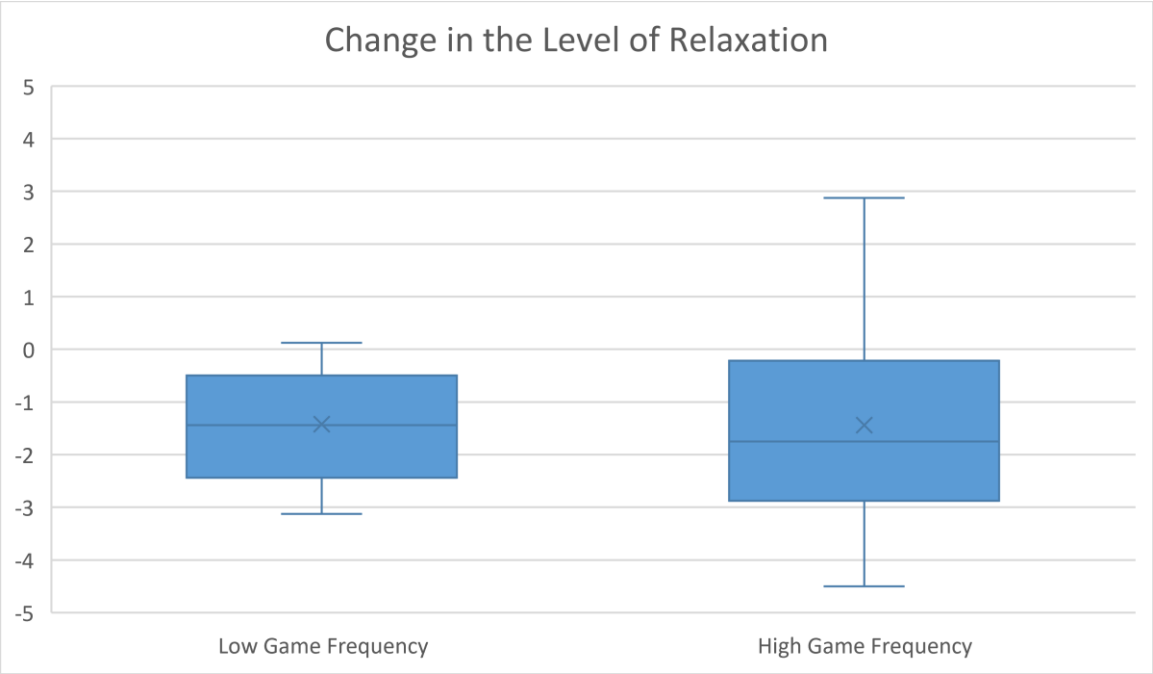

Figure 24 - Change in the Level of Relaxation

When comparing relaxation, the difference in mean between the two groups was only 0.02, the high game frequency group had an incredibly high variance of 4.89 and the resulting F value from the ANOVA test was 0.00, meaning the two were far from being significantly different ($F = 0.00 < 4.60$, $P = 0.99 > 0.05$).

5.4.1.4 – Non-Targeted Emotional Subsets

Subset	Avg. Change Low Freq.	Avg. Change High Freq.	Variance Low Freq.	Variance High Freq.	F-Value	P-Value	F-Crit	Significant?
Anger	-0.13	0.31	0.12	4.32	0.32	0.58	4.60	No
Disgust	-0.03	0.05	0.21	1.14	0.04	0.85	4.60	No
Sadness	-0.17	-0.31	0.23	1.28	0.10	0.75	4.60	No
Desire	-0.45	-0.72	0.05	1.27	0.43	0.52	4.60	No
Happiness	-0.42	-0.05	1.73	1.05	0.41	0.53	4.60	No

Table 11 - ANOVA Test Results Comparing Game Frequency's Effect on Non-Targeted Subsets

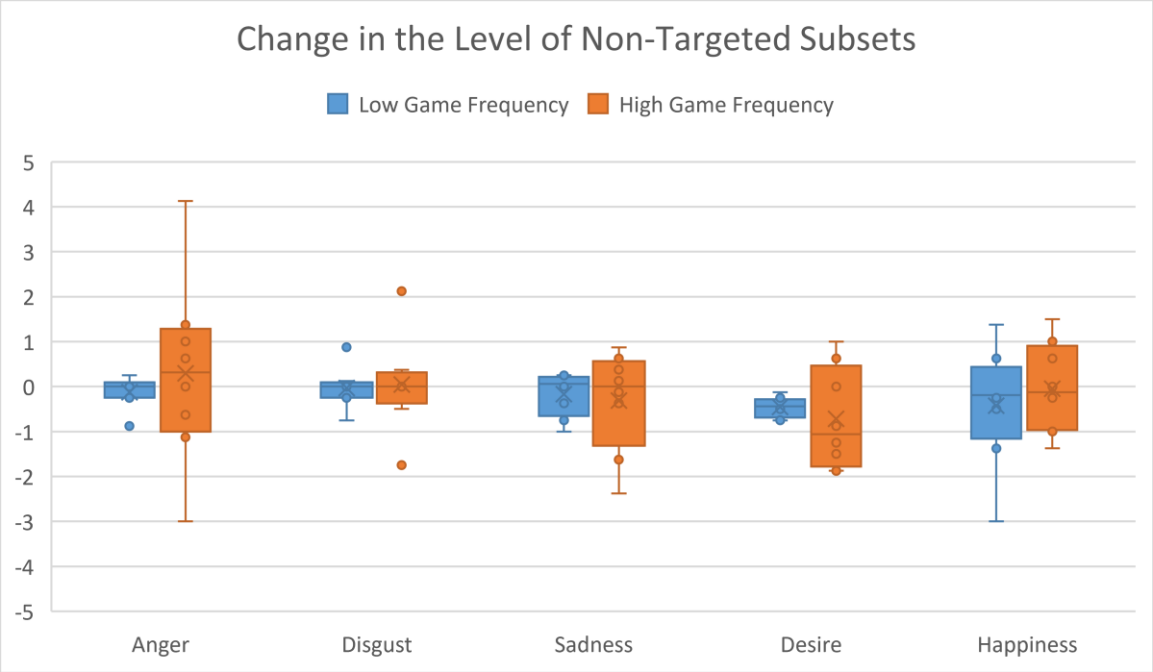

Figure 25 - Change in the Level of Non-Targeted Subsets

None of the non-targeted subsets differed significantly depending on how often the participant played video games as *Figure 25* shows. The variances of the datasets were comparatively low to the previous tests, however the means were generally similar which resulted in low F-Values and high P-Values.

5.5 – Analysing Participants' Video Game Experience

As described in the previous chapter, a participant's current usage of video games may not accurately describe their familiarisation with the medium, so the amount of experience they have historically with video games was also recorded so that it could be compared against their emotional scores in a similar fashion. The amount of experience participants had with video games can be seen below in *Table 14.*

Participant:	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
Score:	5	3	2	5	3	3	5	3	4	5	2	4	2	3	4	4

Table 14 – The participant's frequency of playing video games on a 1 – 5 scale

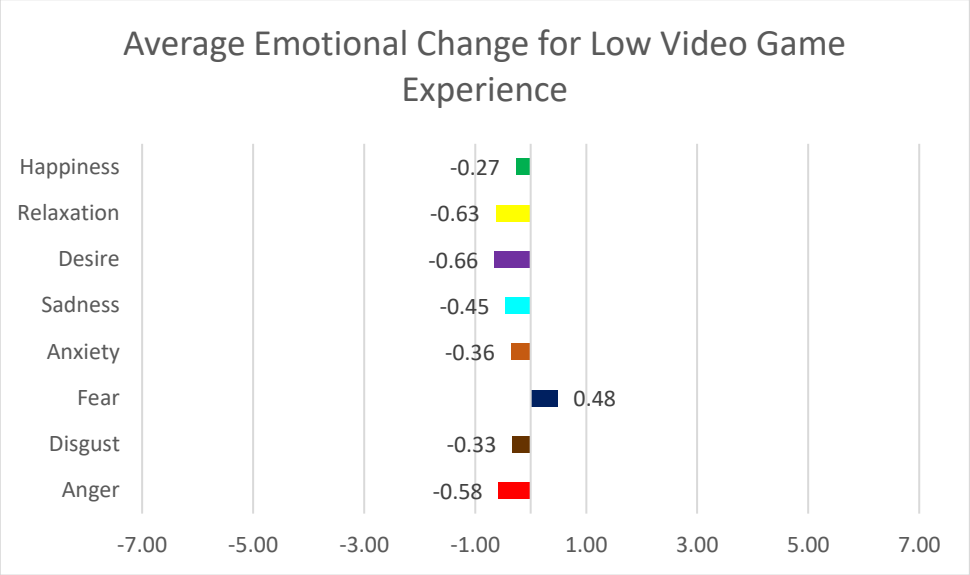

Figure 26 – The average emotional change when participants video game frequency was low

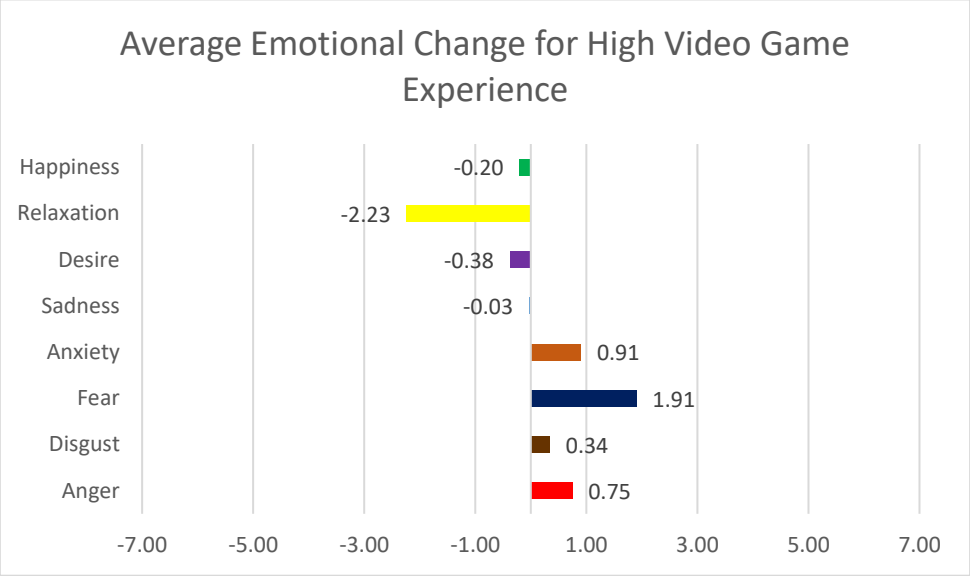

Figure 27 – The average emotional change when participants video game experience was high

The participant pool showed a variety of experience, however every participant had some previous experience with video games before, so the results ranged from two to five out of a possible five. Half of the participants selected either a 2 or a three, with the other half having selected four or five, so they were categorised as having low or high video game experience respectively. These groups can be seen below in *Figure 26* and *Figure 27,* or the full results for

each participant in these groups can be seen in *Appendix K* and *Appendix L*.5.5.1 – Comparing Video Game Experience Against Emotional Changes

When comparing *Figure 26* and *Figure 27*, the effect of video game experience has upon the average emotional responses to the prototypes among participants can be seen. These figures formed the base of the one-way ANOVA test to determine whether these changes in mean were statistically significant. The emotional subsets of fear, anxiety and relaxation were the focus of this analysis, as they were the subsets targeted by the prototype.

5.5.1.1 – Effect on Fear Levels

Avg. Change Low Exp.	Avg. Change High Exp.	Variance Low Exp.	Variance High Exp.	F-Value	P-Value	F-Crit	Significant?
0.48	1.91	1.76	1.63	4.77	0.046	4.60	Yes

Table 125 - ANOVA Test Results Comparing Video Game Experience's Effect on the Level of Fear

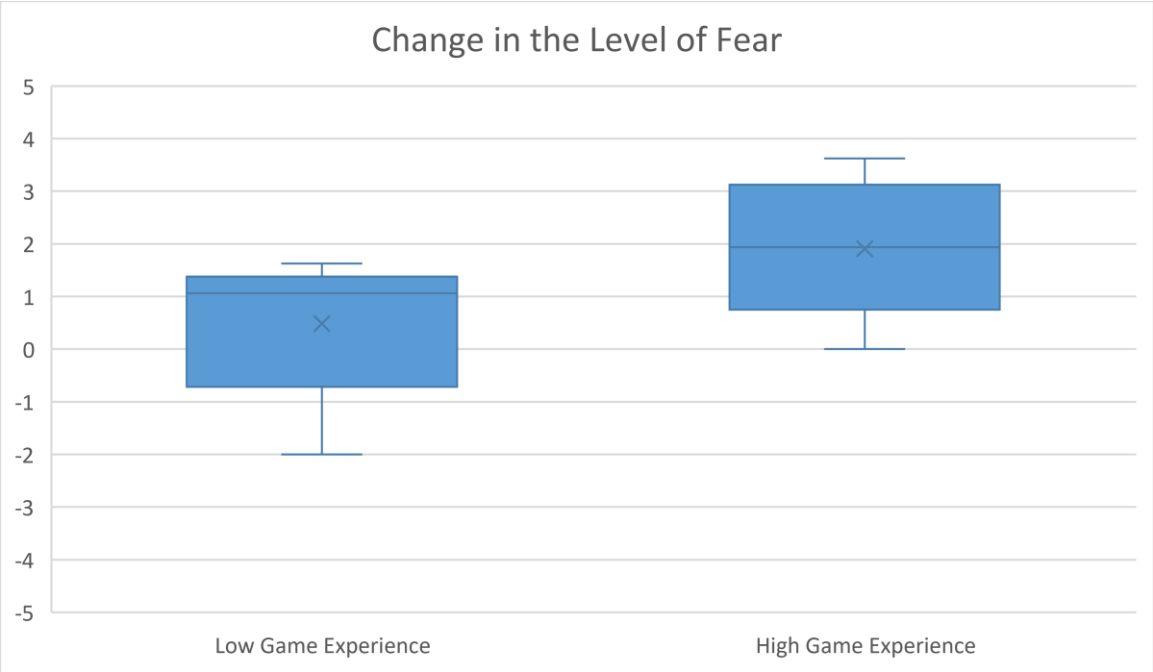

Figure 28 - Change in the Level of Fear

When looking at fear levels, the difference in mean between participants with less experience of playing video games and those with more experience was 1.43, with participants who had more experience with video games experiencing higher levels of fear on average. With the variance in both datasets not going above 2, the ANOVA test found the level of video game experience did had a statistically significant effect on the levels of fear experience during the prototype ($F = 4.77 > 4.60$, $P = 0.046 < 0.05$), meaning we can reject the null hypothesis and accept the alternate hypothesis instead.

5.5.1.2 – Effect on Anxiety Levels

Avg. Change Low Exp.	Avg. Change High Exp.	Variance Low Exp.	Variance High Exp.	F-Value	P-Value	F-Crit	Significant?
-0.36	0.91	2.35	1.17	3.64	0.08	4.60	No

Table 16 – ANOVA Test Results Comparing Video Game Experience's Effect on the Level of Anxiety

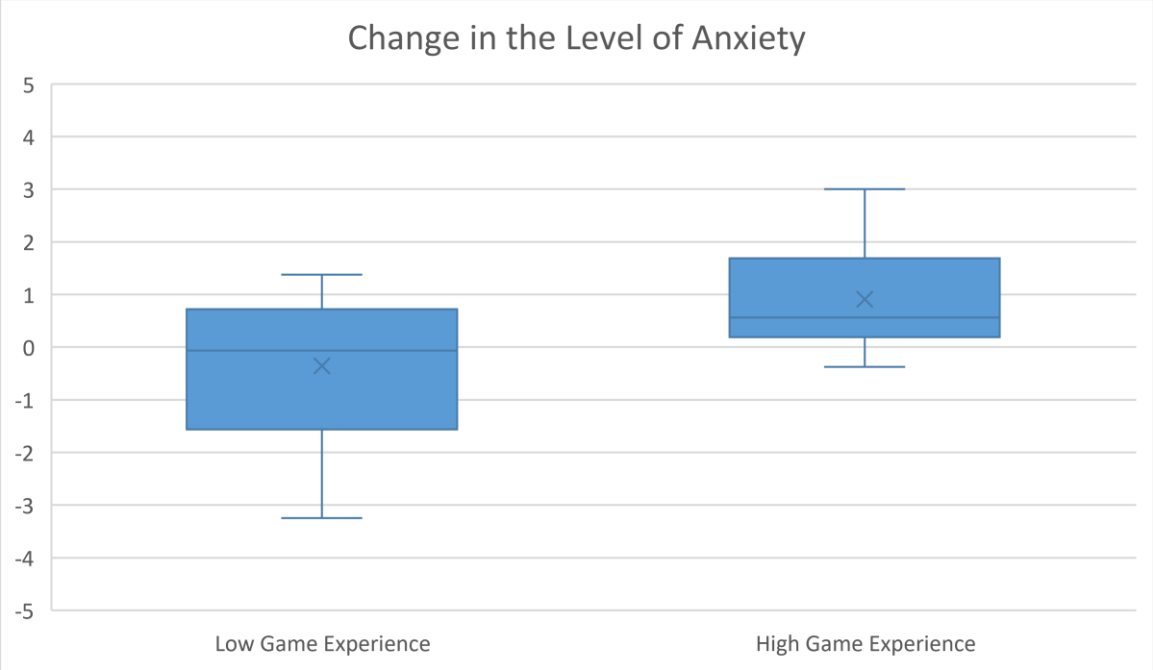

Figure 29 - Change in the Level of Anxiety

When comparing levels of anxiety, the difference in mean between participants with less experience of playing video games and those with more experience was 1.27, with participants who had more experience with video games experiencing higher levels of anxiety on average. While the variance for highly experienced participants was low, the higher variance amongst lower experienced participants limited the ANOVA test from finding a significant difference between the two datasets. Because of this, the null hypothesis could not be rejected ($F = 3.64 < 4.60$, $P = 0.08 > 0.05$).

5.5.1.3 – Effect on Relaxation Levels

Avg. Change Low Exp.	Avg. Change High Exp.	Variance Low Exp.	Variance High Exp.	F-Value	P-Value	F-Crit	Significant?
-0.63	-2.23	3.45	1.17	4.48	0.053	4.60	No

Table 17 – ANOVA Test Results Comparing Video Game Experience's Effect on the Level of Relaxation

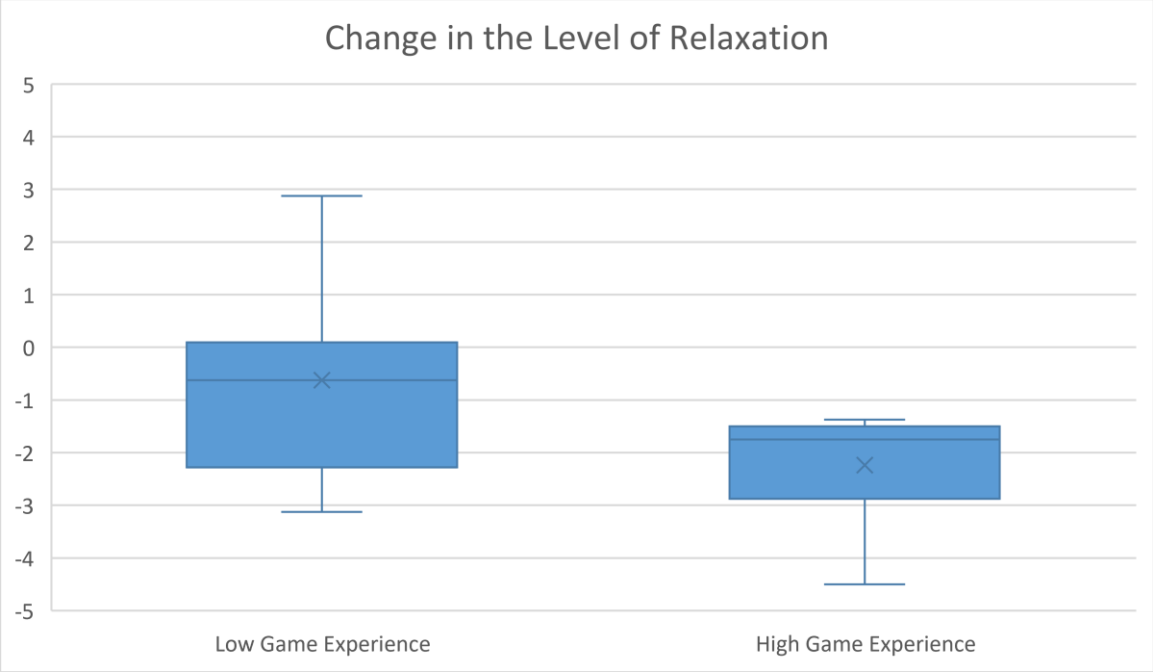

Figure 30 - Change in the Level of Anxiety

When comparing levels of relaxation, the difference in mean between participants with less experience of playing video games and those with more experience was 1.6, with participants who had more experience with video games experiencing larger drops in relaxation on average. While the variance for highly experienced participants was low, the higher variance amongst lower experienced participants limited the ANOVA test from finding a significant difference between the two datasets. Because of this, the null hypothesis could not be rejected, despite the large gap in mean and the F-Value only being 0.12 away from the F-Crit value ($F = 4.48 < 4.60$, $P = 0.053 > 0.05$).

5.5.1.4 – Non-Targeted Emotional Subsets

Subset	Avg. Change Low Exp.	Avg. Change High Exp.	Variance Low Exp.	Variance High Exp.	F-Value	P-Value	F-Crit	Significant?
Anger	-0.58	0.75	1.16	2.38	3.99	0.07	4.60	No
Disgust	-0.33	0.34	0.41	0.69	3.31	0.09	4.60	No
Sadness	-0.45	-0.03	0.99	0.43	1.00	0.33	4.60	No
Desire	-0.66	-0.38	0.58	0.69	0.50	0.49	4.60	No
Happiness	-0.27	-0.20	2.04	0.81	0.01	0.92	4.60	No

Table 18 - ANOVA Test Results Comparing Video Game Experience's Effect on Non-Targeted Subsets

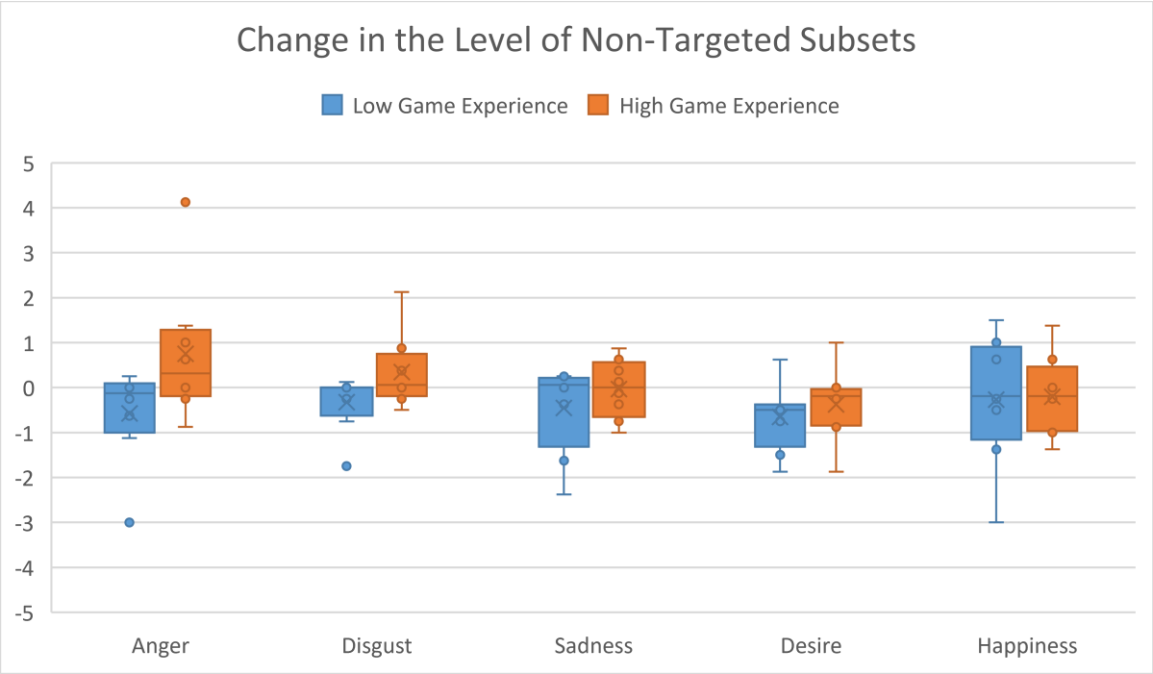

Figure 31 - Change in the Level of Non-Targeted Subsets

None of the non-targeted subsets differed significantly depending on how experienced a participant was with video games, as *Figure 31* shows. A variety of variance scores and mean differences appeared between the different subsets, but none of them were different enough for the ANOVA test to reject the null hypothesis.

5.6 – Analysing Participants' Virtual Reality Frequency of Use

In addition to assessing how a participant's exposure to video games may have affected their emotional responses to the prototype, the participants also stated how frequently they used virtual reality technology to attempt to assess any potential connection.

As described in the previous chapter, the frequency in which a participant uses virtual reality technology was recorded and can be seen displayed below in *Table 19*.

Participant	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
Score:	2	2	2	1	2	2	2	2	2	1	1	1	1	1	2	3

Table 19 – The participant's frequency of using virtual reality technology on a 1 – 5 scale

As *Table 19* shows, a lack of variety within how frequently the participant's used virtual reality technology was present amongst the participant pool. Six out of the sixteen participants had never used the technology, so they were placed in a 'low frequency of use' category for virtual reality. The ten remaining participants, nine of which stated they rarely use the technology and one who stated they sometimes use it, were placed in the 'high frequency of use' category for virtual reality. Due to the lack of variety, a correlation may be difficult to assert, as the difference between the two groups are simply whether they have used it before or not, rather than a variety of experiences and frequencies.

Classifying the results into these two groups allows their emotional responses to be compared and contrasted, as can be seen below in *Figure 32* and *Figure 33*. The full breakdown of each participant's responses in each group can be seen in *Appendix M* and *Appendix N.*

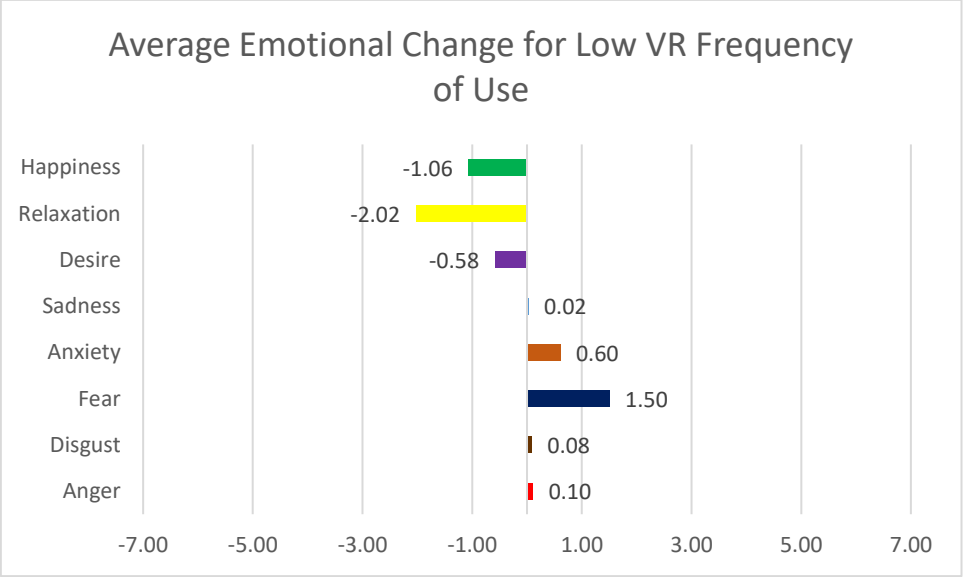

Figure 32 – The average emotional change when participants' virtual reality frequency was low

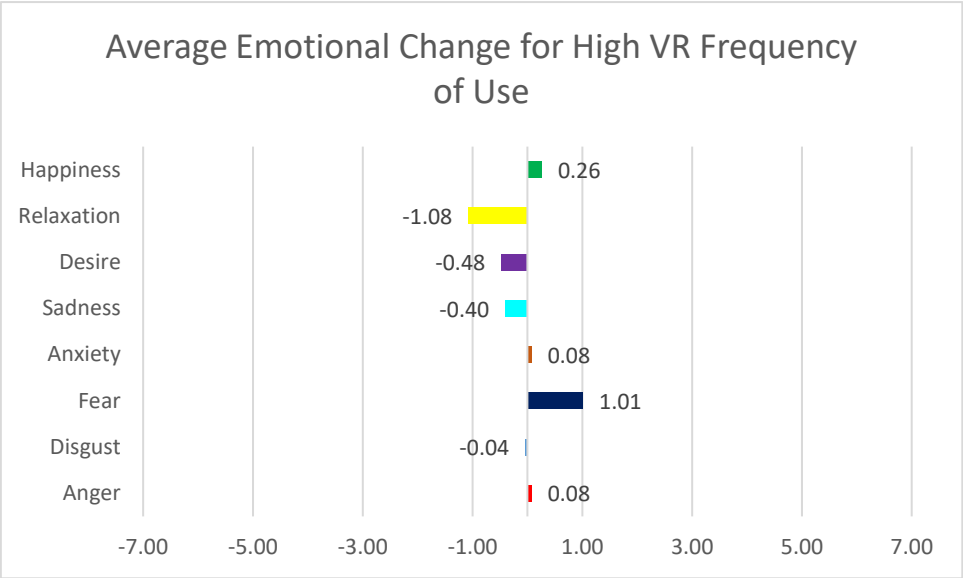

Figure 33 – The average emotional change when participants' virtual reality frequency was high

5.6.1 – Comparing Virtual Reality Technology Frequency against Emotional Responses

When comparing *Figure 32* and *Figure 33*, the effect of virtual reality technology frequency has upon average emotional responses to the prototypes among participants can be seen. The emotional subsets of fear, anxiety and relaxation were the focus of this analysis, as they were the subsets targeted by the prototype.

5.6.1.1 – Effect on Fear Levels

Avg. Change Low VR Use	Avg. Change High VR Use	Variance Low VR Use	Variance High VR Use	F-Value	P-Value	F-Crit	Significant?
1.50	1.01	1.13	2.81	0.40	0.54	4.60	No

Table 20 - ANOVA Test Results Comparing Virtual Reality Frequency's Effect on Fear Levels

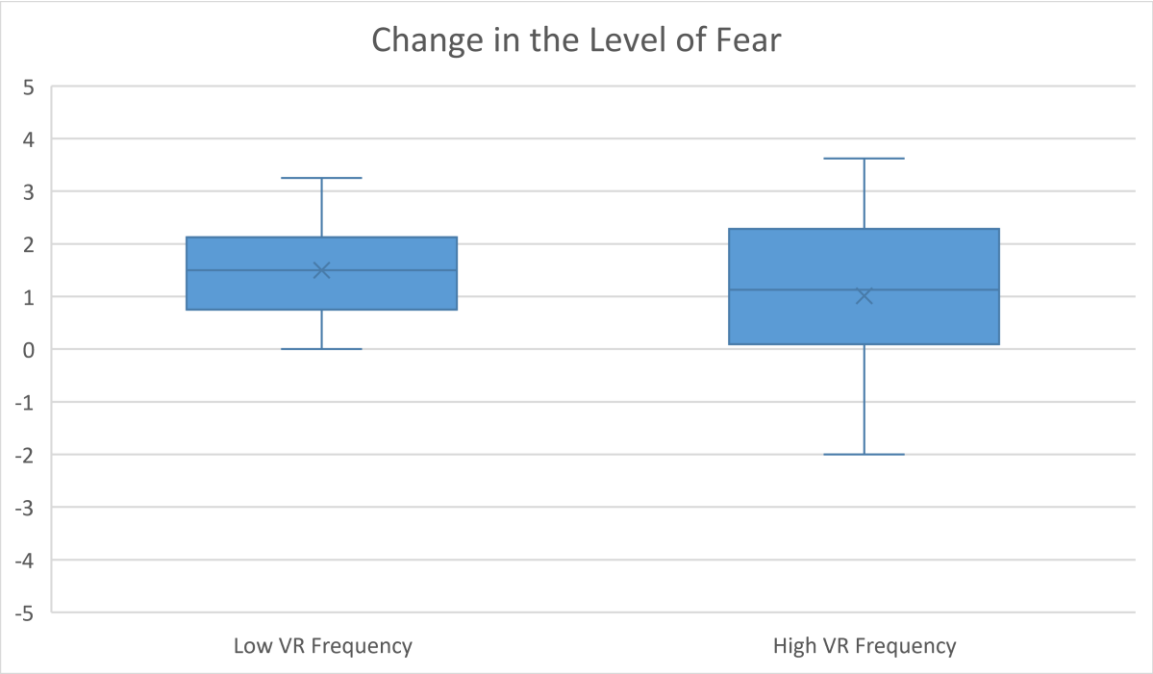

Figure 34 - Change in the Level of Fear

Participants with a low virtual reality frequency recorded an average increase in the fear emotional subset score of 1.50, 0.49 more than those participants in the high frequency category

who also had a high variance of 2.81. Due to both of these factors, the datasets could not be classed as significantly different so the null hypothesis could not be rejected ($F = 0.40 < 4.60$, $P = 0.54 > 0.05$).

5.6.1.2 – Effect on Anxiety Levels

Avg. Change Low VR Use	Avg. Change High VR Use	Variance Low VR Use	Variance High VR Use	F-Value	P-Value	F-Crit	Significant?
0.60	0.08	0.42	3.10	0.49	0.50	4.60	No

Table 21 - ANOVA Test Results Comparing Virtual Reality Frequency's Effect on Anxiety Levels

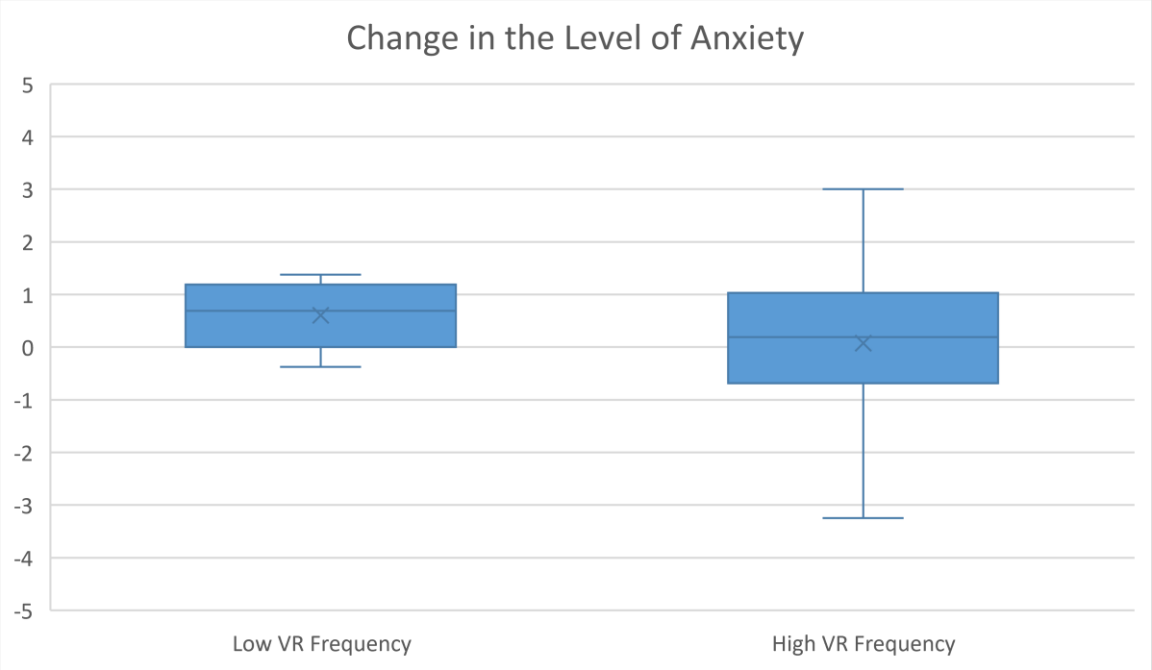

Figure 35 - Change in the Level of Anxiety

When comparing anxiety levels, participants with a lower frequency of virtual reality use saw their anxiety rise by 0.6 points, 0.52 more than those with a higher frequency of use. The higher frequency dataset also had a high variance of 3.10. The ANOVA test could not reject the null hypothesis based off these factors and these two groups could not be classed as statistically different ($F = 0.49 < 4.60$, $P = 0.50 > 0.05$).

5.6.1.3 – Effect on Relaxation Levels

Avg. Change Low VR Use	Avg. Change High VR Use	Variance Low VR Use	Variance High VR Use	F-Value	P-Value	F-Crit	Significant?
-2.02	-1.08	0.80	3.93	1.19	0.29	4.60	No

Table 22 - ANOVA Test Results Comparing Virtual Reality Frequency's Effect on Relaxation Levels

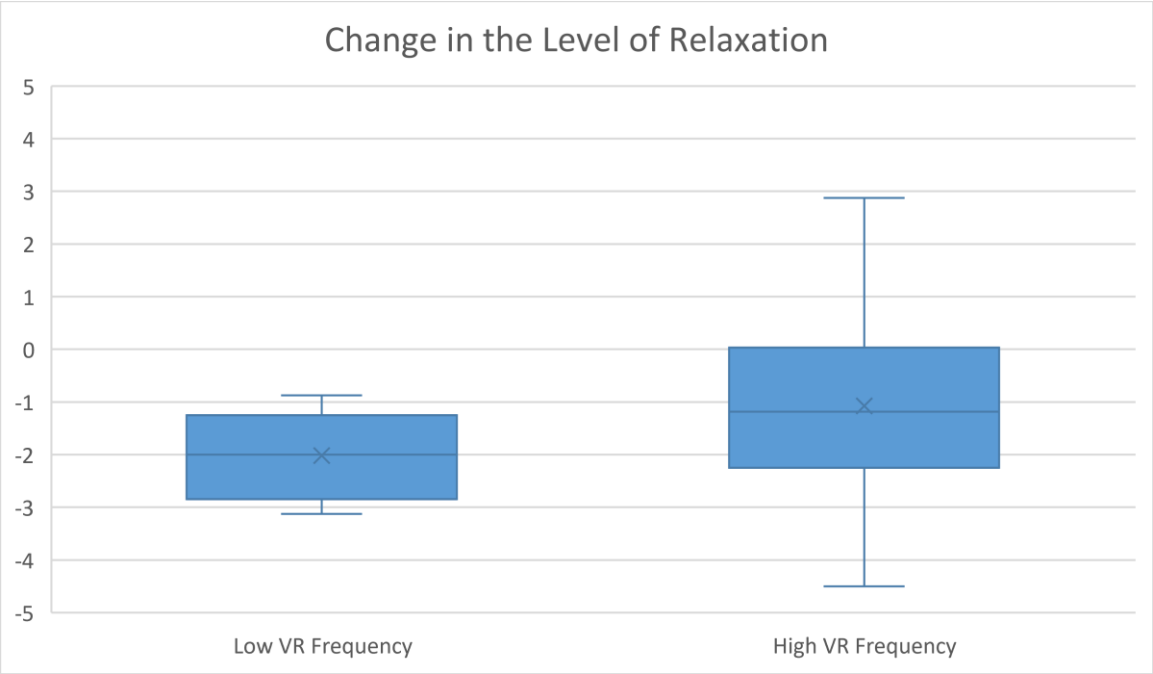

Figure 36 - Change in the Level of Relaxation

For relaxation, participants in the low frequency group saw their relaxation drop by 2.02 points, 0.92 points more than those in the high frequency group. The high frequency group again saw a high frequency, this time of 3.93, meaning the significance was affected ($F = 1.19 < 4.60$, $P = 0.29 > 0.05$). Because of this the null hypothesis could not be rejected and the difference between the two datasets could not be classed as statistically significant.

5.6.1.4 – Non-Targeted Emotional Subsets

Subset	Avg. Change Low Freq.	Avg. Change High Freq.	Variance Low Freq.	Variance High Freq.	F-Value	P-Value	F-Crit	Significant?
Anger	0.10	0.08	0.09	3.48	0.00	0.97	4.60	No
Disgust	0.08	-0.04	0.29	0.89	0.08	0.78	4.60	No
Sadness	0.16	-0.4	0.16	1.02	0.93	0.35	4.60	No
Desire	-0.58	-0.48	0.43	0.78	0.07	0.80	4.60	No
Happiness	-1.06	0.14	1.24	0.72	6.39	0.02	4.60	Yes

Table 23 - ANOVA Test Results Comparing Virtual Reality Frequency's Effect on Non-Targeted Subsets

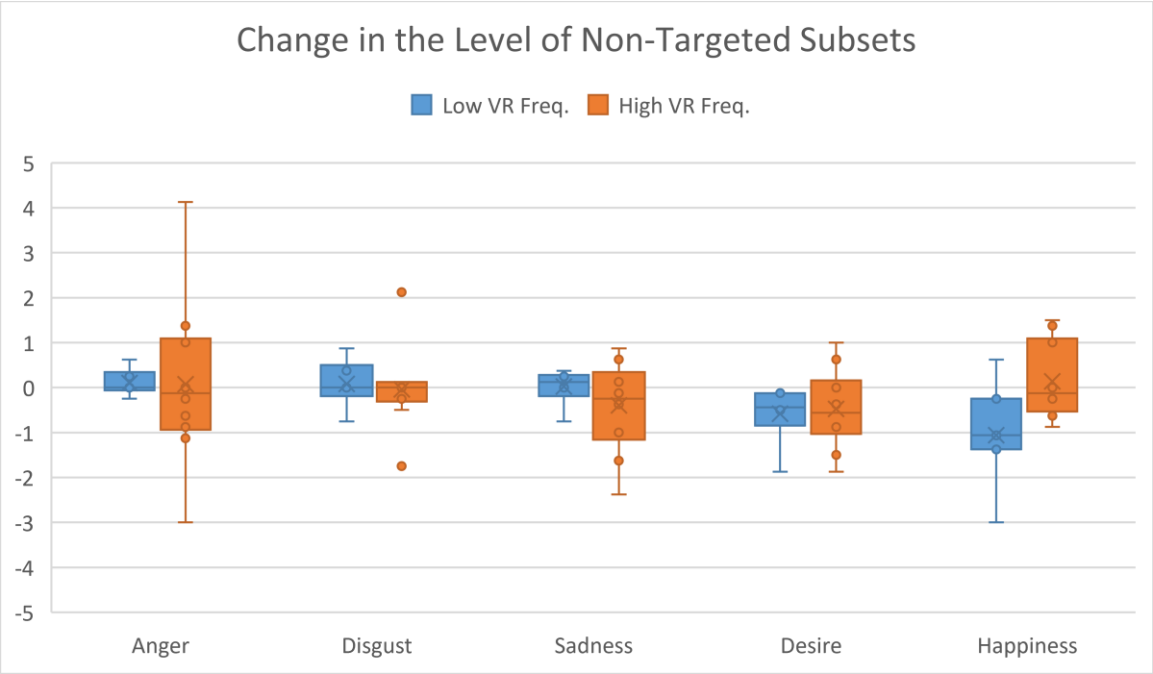

Figure 37 - Change in the Level of Non-Targeted Subsets

The non-targeted subsets of anger, disgust, sadness and desire all saw no significant difference, with limited differences in their means despite the low variances. However, the subset of happiness saw a significant difference with the low frequency group saw their levels drop by an average 1.06, whereas participants with higher virtual reality frequency saw their rise by 0.14, an overall difference of 1.20. The variance was under 2 for both datasets, resulting in the null hypothesis being rejected and the alternate hypothesis being accepted ($F = 6.39 > 4.60$, $P = 0.02 < 0.05$).

5.7 – Analysing Participants' Motion Controls Frequency of Use

In connection to assessing a participants' familiarity with virtual reality technology, participants also reported the frequency in which they use motion control technology.

As described in the previous chapter, the frequency in which a participant plays video games was recorded and can be seen displayed below in *Table 24*.

Participant	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
Score:	3	2	1	2	3	2	4	1	2	2	1	1	2	1	2	1

Table 24 – The participant's frequency of using motion control technology on a 1 – 5 scale

Table 24 shows again a lack of variety within the participants, with only three of the sixteen participants stating that they use the technology either 'sometimes' or 'fairly often', with the other thirteen participants using the technology either 'rarely' or 'never'. These two groups were classified as 'low frequency of use' and 'high frequency of use', however due to the higher frequency group only containing three participants, the results will be particularly responsive to outlying results and may not represent the group on a wider scope.

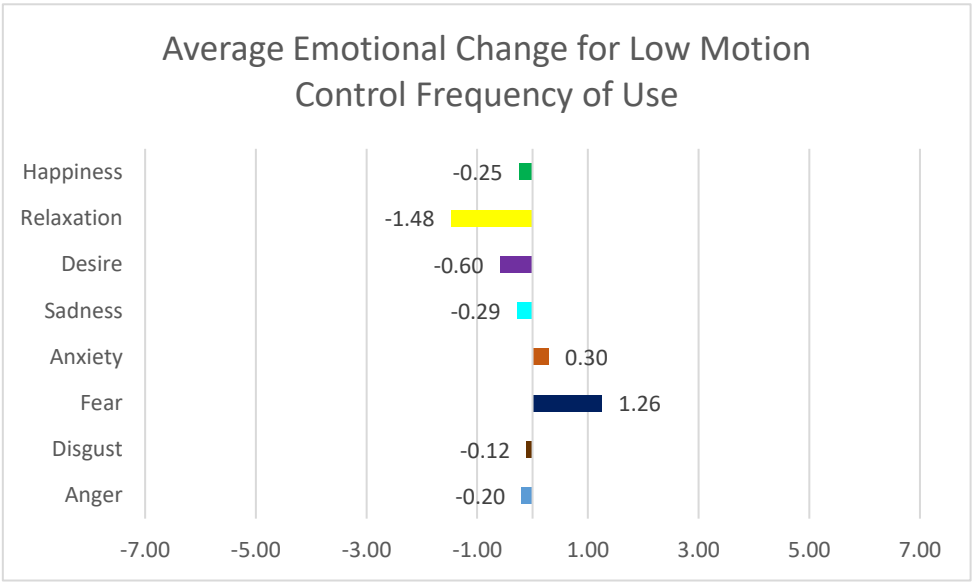

Figure 38 – The average emotional change when participants' motion control frequency was low

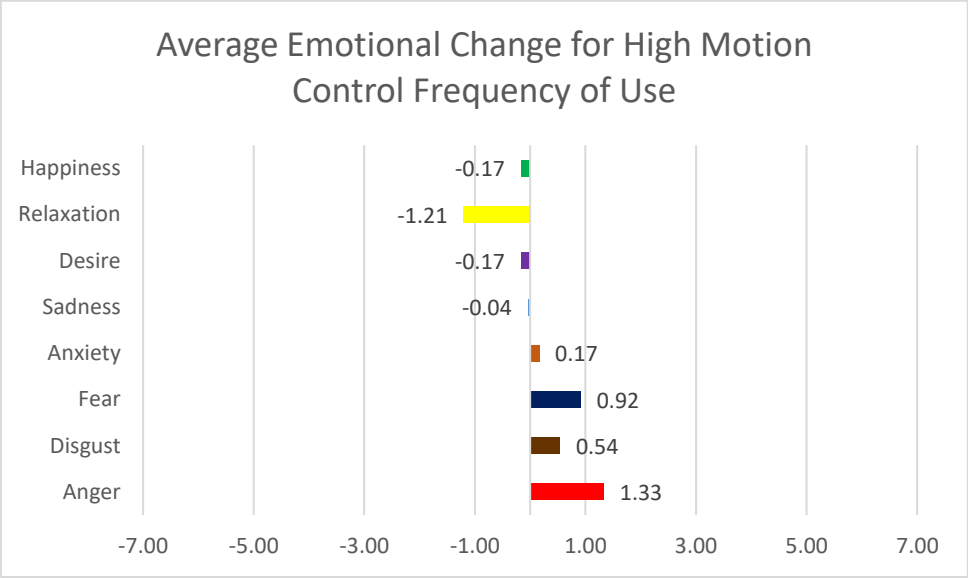

Figure 39 – The average emotional change when participants' motion control frequency was high

Classifying the results into these two groups allows their emotional responses to be compared and contrasted, as can be seen below in *Figure 38* and *Figure 39*. The full breakdown of each participant's responses in these groups can be seen in *Appendix O* and *Appendix P.*

5.7.1 – Comparing Motion Control Technology Frequency against Emotional Responses

When comparing *Figure 38* and *Figure 39*, the effect of motion control technology frequency has upon average emotional responses to the prototypes among participants can be seen. The emotional subsets of fear, anxiety and relaxation were the focus of this analysis, as they were the subsets targeted by the prototype.

5.7.1.1 – Effect on Fear, Anxiety & Relaxation Levels

Subsets	Avg. Change Low VR Use	Avg. Change High VR Use	Variance Low VR Use	Variance High VR Use	F-Value	P-Value	F-Crit	Significant?
Fear	-0.92	1.26	7.94	1.31	0.13	0.73	4.60	No
Anxiety	0.17	0.30	10.02	0.92	0.02	0.89	4.60	No
Relaxation	-1.21	-1.48	14.07	1.20	0.06	0.81	4.60	No

Table 25 - ANOVA Test Results Comparing Motion Control Frequency's Effect on Fear, Anxiety & Relaxation

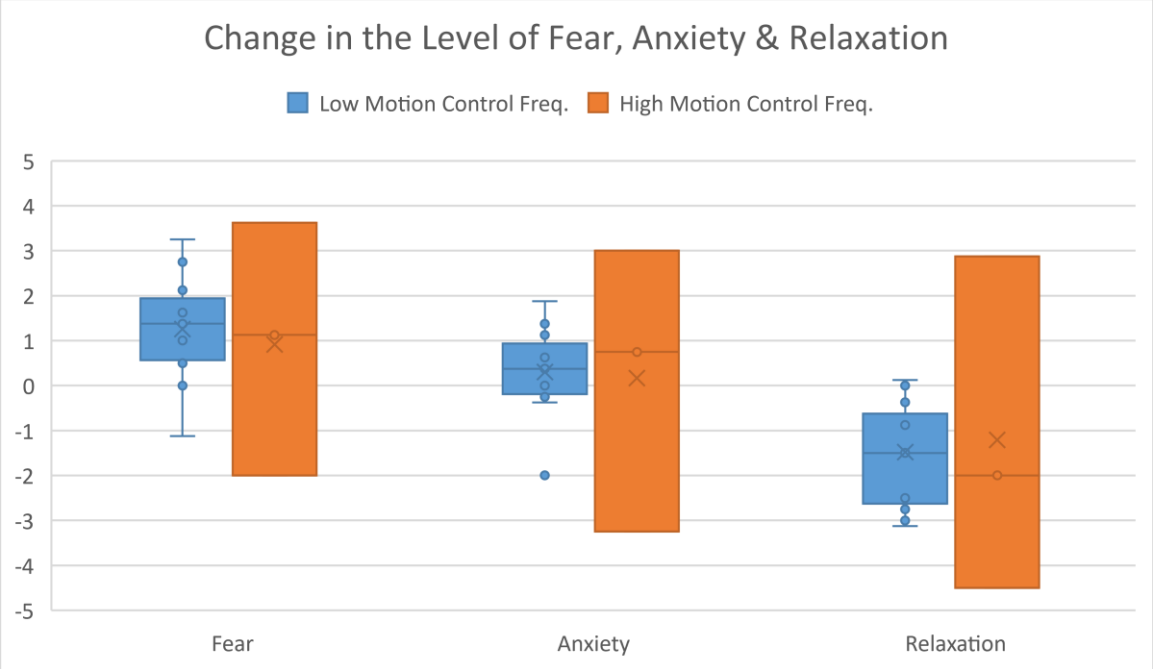

Figure 40 - Change in the Level of Fear, Anxiety & Relaxation

Due to the small pool of participants who fitted the higher frequency bracket, the variance in the ANOVA tests for the motion control datasets was too high to find any groups statistically different. This made the differences in mean irrelevant, as the pool was just to small for the ANOVA to find any statistically significant difference between the groups.

5.7.1.4 – Non-Targeted Emotional Subsets

Subsets	Avg. Change Low VR Use	Avg. Change High VR Use	Variance Low VR Use	Variance High VR Use	F-Value	P-Value	F-Crit	Significant?
Anger	1.33	-0.20	6.97	1.01	3.09	0.10	4.60	No
Disgust	0.54	-0.12	1.94	0.38	1.75	0.21	4.60	No
Sadness	-0.04	-0.29	1.90	0.56	0.20	0.66	4.60	No
Desire	-0.17	-0.42	1.58	0.51	0.24	0.63	4.60	No
Happiness	-0.17	-0.25	0.57	1.57	0.01	0.91	4.60	No

Table 26 - ANOVA Test Results Comparing Motion Control Frequency's Effect on Non-Targeted Subsets

As it was with the targeted subsets, the non-targeted subsets saw little to no significant difference. While the variance was lower, the differences in mean were also negligible resulting in none of the ANOVA tests coming back with significant differences.

5.8 – Analysing Participants' Horror Content Frequency of Use

As the content of the prototypes was designed based off several horror tropes, the participants were asked to record how familiar they were with horror-based media content, be this through films, video games or books. A participant's familiarisation with this genre of media may have affected their emotional responses to the prototypes, so the frequency in which each participant experiences horror-based content was recorded and can be seen displayed below in *Table 27*.

Participant	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
Score:	3	4	1	3	1	3	3	3	2	3	3	3	2	2	4	3

Table 27 – The participant's frequency of experiencing horror-based content on a 1 – 5 scale

Table 27 showed that the average participant recorded a 2.69 on the one to five scale, with five participants selecting either one or two out of five, and the other eleven selecting either three or four. This would show that a large majority of the participants consume horror-based content on a semi-regular basis. In order to establish the presence of any correlation between a participant having more experience with horror-based content with heightened emotional responses to the prototypes, the participants were split into two groups: low frequency of horror-based content and high frequency of horror-based content. The high frequency bracket contains any participant who ranked as a three or a four out of five, whereas the low bracket contains any participant who ranked as a one or a two out of five.

Classifying the results into these two groups allows their emotional responses to be compared and contrasted, as can be seen below in *Figure 41* and *Figure 42*. The full breakdown for the individual participant's responses in these groups can be seen in *Appendix Q* and *Appendix R.*

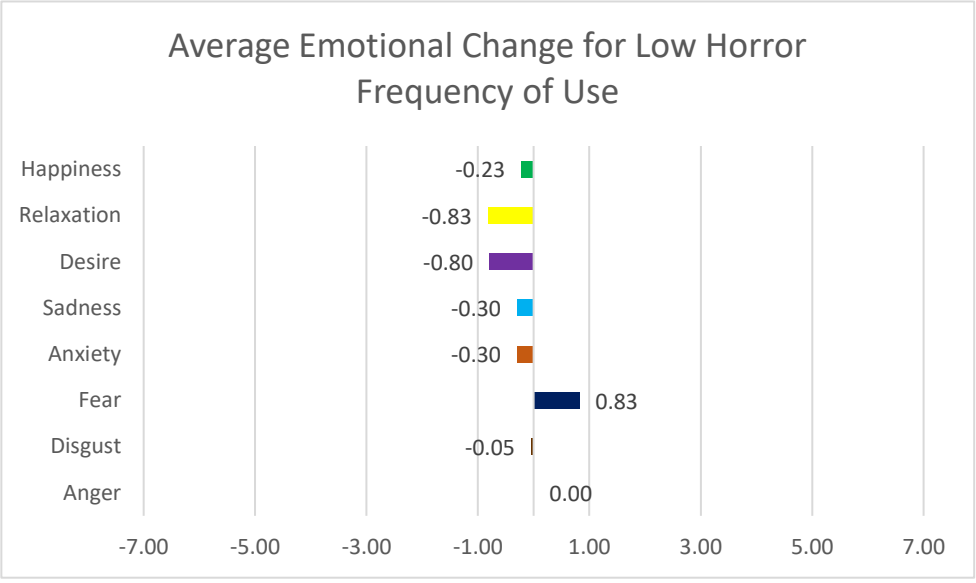

Figure 41 – The average emotional change when participants' horror-based content frequency was low

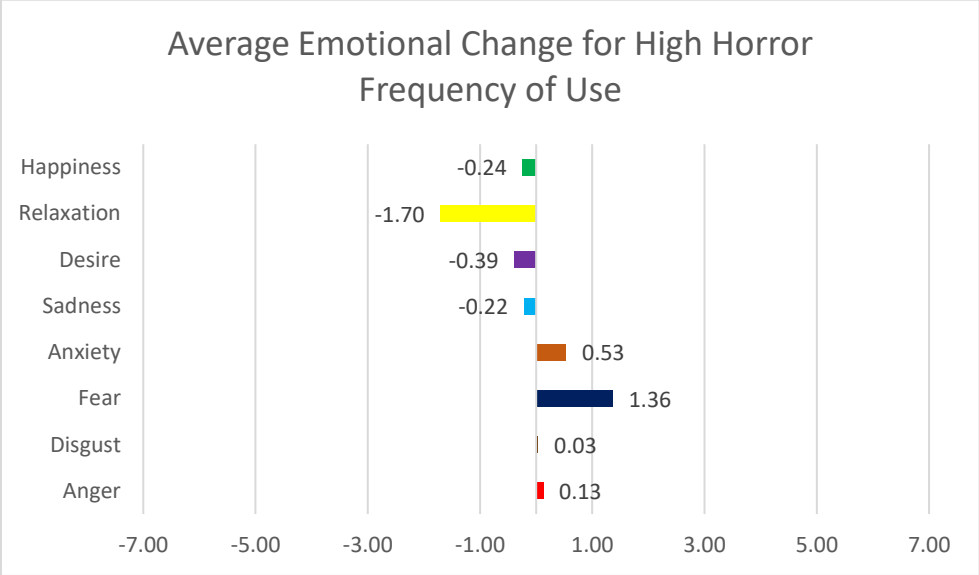

Figure 42 – The average emotional change when participants' horror-based content frequency was high

5.8.1 – Comparing Horror-Based Content Frequency against Emotional Responses

When comparing *Figure 41* and *Figure 42*, the effect of horror-based content frequency has upon emotional responses to the prototypes among participants can be seen. The emotional subsets of fear, anxiety and relaxation were the focus of this analysis, as they were the subsets targeted by the prototype.

5.8.1.1 – Effect on Fear Levels

Avg. Change Low Horror	Avg. Change High Horror	Variance Low Horror	Variance High Horror	F-Value	P-Value	F-Crit	Significant?
0.83	1.36	2.66	2.02	0.45	0.51	4.60	No

Table 28 - ANOVA Test Results Comparing Horror Frequency's Effect on Fear

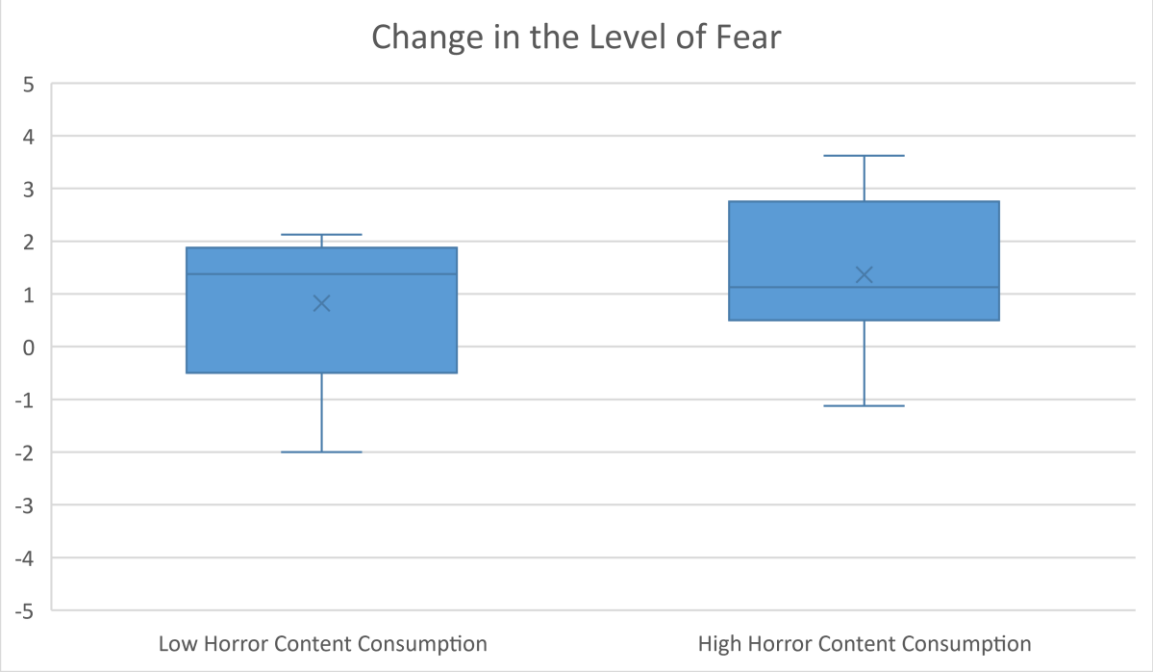

Figure 43 - Change in the Level of Fear

When comparing fear, participants who consumed horror-based content less frequently saw their fear levels rise by an average 0.83 points, 0.53 points less than those participants with a higher frequency. Both datasets also saw variance higher than 2, which caused the ANOVA test to prove that the differences between the two were not statistically significant ($F = 0.45 < 4.60$, $P = 0.51 > 0.05$).

5.8.1.2 – Anxiety

Avg. Change Low Horror	Avg. Change High Horror	Variance Low Horror	Variance High Horror	F-Value	P-Value	F-Crit	Significant?
-0.30	0.53	2.80	1.75	1.17	0.30	4.60	No

Table 29 - ANOVA Test Results Comparing Horror Frequency's Effect on Anxiety

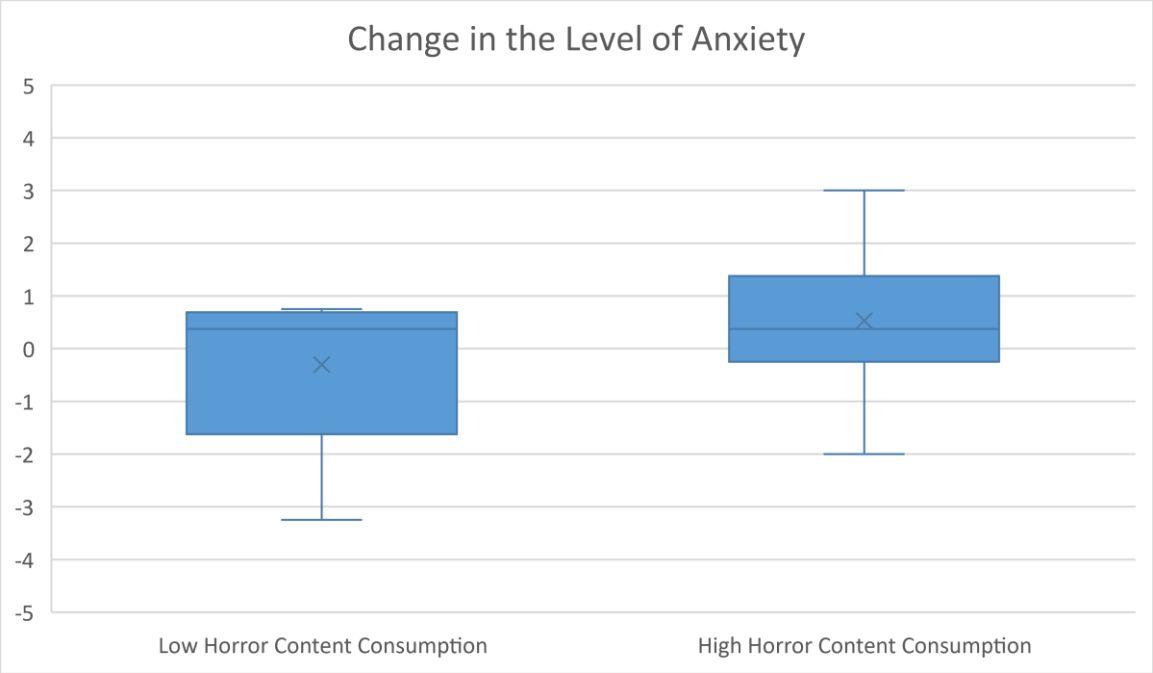

Figure 44 - Change in the Level of Anxiety

Participants with lower horror content consumption frequency saw their anxiety score drop by 0.30 points, while participants with a higher frequency saw theirs rise by 0.53, an overall difference of 0.83. Both variances were fairly high however, so the differences between the two could no be classed as statistically significant ($F = 1.17 < 4.60$, $P = 0.30 > 0.05$).

5.8.1.3 – Relaxation

Avg. Change Low Horror	Avg. Change High Horror	Variance Low Horror	Variance High Horror	F-Value	P-Value	F-Crit	Significant?
-0.83	-1.70	5.58	1.77	0.93	0.35	4.60	No

Table 30 - ANOVA Test Results Comparing Horror Frequency's Effect on Relaxation

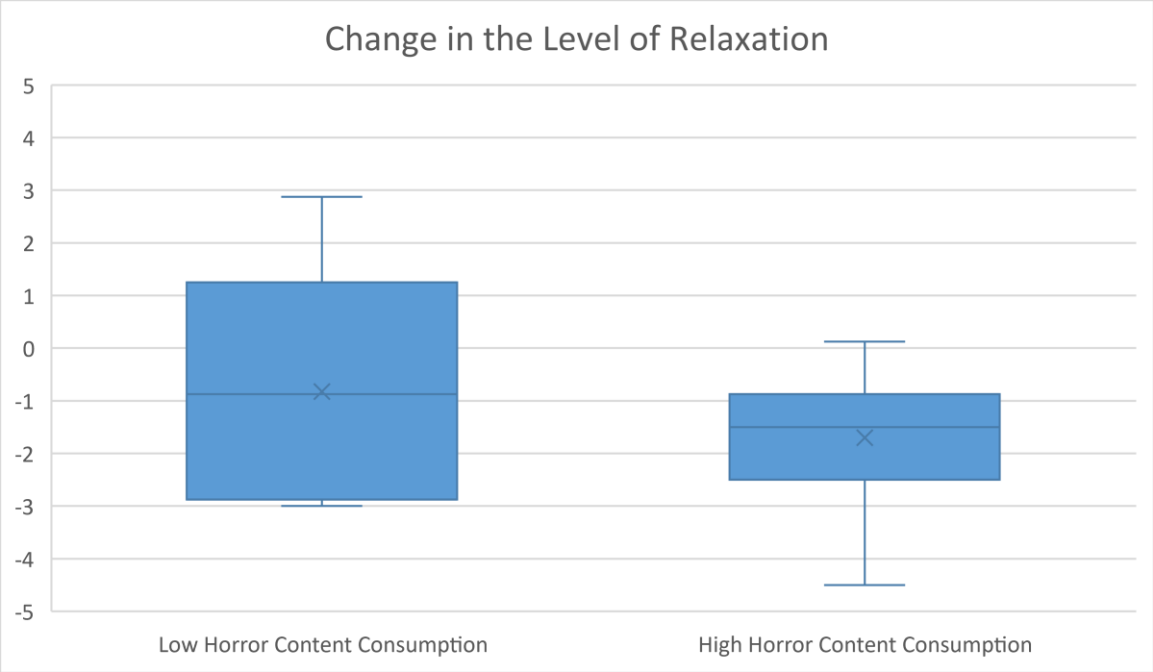

Figure 45 - Change in the Level of Relaxation

For the final targeted subset, relaxation, the average participant with a lower frequency of horror-content consumption saw their score drop by 0.83 points, 0.87 points less than those participants with a higher frequency. The variance however, especially in the lower frequency bracket (5.58), was still very high. The difference between the two groups was found by the ANOVA test to be not statistically significant ($F = 0.94 < 4.60$, $P = 0.35 > 0.05$).

5.8.1.4 – Non-Targeted Emotional Subsets

Subsets	Avg. Change Low VR Use	Avg. Change High VR Use	Variance Low VR Use	Variance High VR Use	F-Value	P-Value	F-Crit	Significant?
Anger	1.33	-0.20	6.97	1.01	3.09	0.10	4.60	No
Disgust	0.54	-0.12	1.94	0.38	1.75	0.21	4.60	No
Sadness	-0.04	-0.29	1.90	0.56	0.20	0.66	4.60	No
Desire	-0.17	-0.42	1.58	0.51	0.24	0.63	4.60	No
Happiness	-0.17	-0.25	0.57	1.57	0.01	0.91	4.60	No

Table 31 - ANOVA Test Results Comparing Horror Frequency's Effect on Non-Targeted Subsets

All of the non-targeted emotional subsets saw no significant change depending on whether the participant had an either high or low frequency of consuming horror-content. There was some fluctuation in mean difference and variance, but not enough for the ANOVA test to flag any of the groups as having significant differences.

5.9 – Overall Analysis & Further Studies

The results from the ANOVA tests would suggest that virtual reality can have an effect on targeted emotional subsets, but this connection is not consistent as it only significantly affected one of the three subsets that the prototype was aiming to invoke. When using the technology, participants' saw an increase in their average fear and anxiety scores, but the variance amongst participants stopped the alternate hypothesis being accepted for those subsets. However, as relaxation was affected significantly, it seems technology can have an significant effect. Similar results could be seen within the other tests too, with the variance being too high to class the targeted subsets as significantly affected.

5.9.1 – Further Study #1: Participant Pool Size & Diversity

While this study has suggested that virtual reality technology does affect the strength of emotions, due to the small participant pool size of 16, this could be re-affirmed by conducting a similar study with a larger pool of participants. The study could also be benefitted via a wider range of participants, due to this study being conducted with all 18 – 35 year olds, all having video game experience but having very little virtual reality experience. This would assist in establishing whether different groups within the participant pool are affected differently, such as highly experienced video games players, or participants who use virtual reality regularly.

5.9.2 – Further Study #2: Increased Prototype Reactions

This study allowed to see the difference between the emotional responses with and without virtual reality technology, however the average fear, anxiety and relaxation levels that the prototype was designed to invoke rarely changed by over 2.0, suggesting that while the prototype was successful in invoking those emotions, it did not succeed at invoking them to a higher degree. A further study could be performed using a prototype that was proven to cause stronger emotional reactions, regardless of the presence of virtual reality, as this may potentially affect the results.

5.9.3 – Further Study #3: Alternative Targeted Emotional Subsets

This study focused on the two emotional subsets of fear and anxiety, as well as looking at how the subset of relaxation dropped as a result. However, while this study suggests there may be a connection between virtual reality and the strengths of emotional responses, only these emotional subsets were tested. A further study could be performed that looks into the other emotional subsets and whether those are also affect.

5.9.4 – Further Study #4: Testing Sub-Group Emotional Responses

Finally, a further study could be performed investigating the potential link between the sub-groups and how they react to virtual reality. This study highlighted a potential connection between high video game experience and stronger emotional responses, so a trial focused on discovering more information in this area could prove beneficial.

Chapter 6 - Conclusion

This thesis attempted to prove the following hypothesis:

"The presence of virtual reality technology increases the strength of emotional reactions when playing video games."

After analysing the results from the trial in Chapter 5, it could be argued that there is a connection between the strength of emotional reactions invoked by video games and the presence of virtual reality, at least within the tested emotional subsets. However, the consistency of this connection is still unproven as the prototype only significantly affected one of the three targeted subsets and the overall high variance amongst the data. This combined with the small emotional reactions across the board limited the ANOVA tests finding more datasets significantly different. In order to confirm the consistency of this connection, the further studies laid out in Chapter 5 would allow for an increased participant pool which may improve the consistency of results and an improved prototype could increase the strength of emotional reactions to better identify trends. These studies would assist confirming how strong the change is when using virtual reality and could allow game developers to implement virtual reality technology into their video games to create stronger emotional reactions than before.

Appendices

Appendix A – Baseline Discrete Emotional Questionnaire Scores

Base DEQ	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
Nervous	2	5	4	2	6	2	2	5	3	3	3	1	2	2	3	2
Sad	2	2	2	1	4	1	1	5	2	2	2	2	2	1	4	2
Anger	1	1	1	1	3	2	1	5	1	1	1	1	2	1	1	3
Nausea	2	1	3	1	2	1	1	1	1	3	3	1	1	1	2	1
Liking	3	5	3	5	3	5	5	1	4	6	5	4	2	4	1	3
Satisfaction	4	5	2	3	3	3	6	1	4	5	6	5	2	5	2	3
Mad	1	1	1	1	4	2	1	3	1	1	1	1	1	1	1	2
Lonely	2	1	1	1	4	1	1	2	3	2	1	2	1	1	2	2
Rage	1	1	1	1	3	1	1	3	1	1	1	1	1	1	2	1
Happy	5	6	3	5	3	4	6	1	4	6	6	4	3	6	2	4
Easygoing	7	7	4	5	2	5	7	2	6	3	3	6	3	6	3	4
Grossed Out	1	1	2	1	1	1	1	1	1	1	2	1	1	1	1	1
Anxiety	2	6	4	2	5	2	2	5	3	4	1	2	3	2	3	2
Grief	1	1	1	1	5	2	1	3	1	1	1	1	1	1	2	1
Worry	2	5	4	2	6	2	1	4	4	5	2	2	2	2	3	2
Panic	1	5	3	1	6	1	1	4	1	3	1	1	2	1	2	2
Revulsion	1	1	1	1	1	1	1	3	1	2	1	1	1	1	1	1
Wanting	5	4	2	3	2	2	2	3	3	3	2	2	2	2	2	3
Desire	4	4	2	2	5	2	7	3	3	5	3	2	2	2	1	3
Relaxation	5	4	1	4	3	4	6	1	5	6	6	5	3	6	3	4
Craving	2	5	1	1	2	3	3	3	1	4	1	1	1	2	1	2
Enjoyment	4	5	2	4	3	3	5	1	3	5	6	5	2	4	2	4
Dread	2	5	2	1	5	1	1	3	4	5	1	1	1	1	2	2
Very Annoyed	2	1	1	1	4	2	1	5	1	2	1	1	1	1	1	2
Longing	3	2	2	3	4	1	5	3	1	4	2	1	1	1	1	1
Calm	6	3	1	5	3	3	6	1	7	6	6	5	3	5	2	4
Scared	1	3	3	1	6	1	1	3	1	1	2	1	1	1	2	1
Chilled Out	6	2	2	5	1	4	7	1	6	6	6	6	3	7	2	3
Fear	1	4	2	1	4	1	1	3	1	1	2	1	1	1	2	1
Terror	2	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1
Empty	1	1	1	1	2	2	4	7	1	5	1	2	1	1	4	2
Sickened	2	1	1	1	1	1	1	6	1	3	1	1	1	1	1	1

Appendix B – Baseline Discrete Emotional Questionnaire Scores in Subsets

Base DEQ	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Avg.
Anger	1.25	1.00	1.00	1.00	3.50	1.75	1.00	4.00	1.00	1.25	1.00	1.00	1.25	1.00	1.25	2.00	1.52
Disgust	1.50	1.00	1.75	1.00	1.25	1.00	1.00	2.75	1.00	2.25	1.75	1.00	1.00	1.00	1.25	1.00	1.34
Fear	1.25	3.25	2.25	1.00	4.50	1.00	1.00	2.75	1.00	1.50	1.50	1.00	1.25	1.00	1.75	1.25	1.70
Anxiety	2.00	5.25	3.50	1.75	5.50	1.75	1.50	4.25	3.50	4.25	1.75	1.50	2.00	1.75	2.75	2.00	2.81
Sadness	1.50	1.25	1.25	1.00	3.75	1.50	1.75	4.25	1.75	2.50	1.25	1.75	1.25	1.00	3.00	1.75	1.91
Desire	3.50	3.75	1.75	2.25	3.25	2.00	4.25	3.00	2.00	4.00	2.00	1.50	1.50	1.75	1.25	2.25	2.50
Relaxation	6.00	4.00	2.00	4.75	2.25	4.00	6.50	1.25	6.00	5.25	5.25	5.50	3.00	6.00	2.50	3.75	4.25
Happiness	4.00	5.25	2.50	4.25	3.00	3.75	5.50	1.00	3.75	5.50	5.75	4.50	2.25	4.75	1.75	3.50	3.81

Appendix C – Average Emotional Shift in Virtual Reality

Avg. Emotion Shift in VR	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Avg.
Nervous	1	-4	-1	0	-4	0	2	0	4	2	2	3	1	0	2	1	0.56
Sad	0	-1	0	0	-2	0	0	-4	0	1	0	-1	0	0	-2	-1	-0.63
Anger	1	0	0	0	-1	-1	4	-4	1	1	1	0	-1	0	0	-1	0.00
Nausea	-1	0	-1	0	1	1	0	0	0	1	-2	0	0	0	-1	1	-0.06
Liking	0	0	0	-2	-2	1	-1	0	-2	-1	-4	2	-1	-2	0	0	-0.75
Satisfaction	-1	-1	0	-1	1	3	1	4	-1	-2	-5	1	-1	-1	3	2	0.13
Mad	1	0	0	0	-2	-1	4	-2	4	1	0	0	0	0	0	-1	0.25
Lonely	1	0	0	0	-2	0	5	1	1	1	0	-1	1	0	-1	0	0.38
Rage	1	0	0	0	-1	0	4	-2	3	1	0	0	0	0	-1	0	0.31
Happy	-1	-1	0	-2	1	0	-3	0	-2	-3	-1	2	-1	-2	2	-1	-0.75
Easygoing	-4	-1	-1	-2	3	-3	-5	-1	-3	-1	-2	-3	-1	-2	-2	-2	-1.88
Grossed Out	0	0	-1	0	0	0	2	0	0	1	-1	2	0	0	0	0	0.19
Anxiety	2	-3	0	0	-2	1	4	1	3	1	3	1	1	1	1	1	0.94
Grief	1	0	0	0	-1	-1	2	-2	0	2	0	0	0	0	0	0	0.06
Worry	1	-3	-2	0	-3	0	4	1	-1	-1	3	2	1	0	1	2	0.31
Panic	1	-3	0	0	-3	2	3	1	2	3	3	3	2	0	3	0	1.06
Revulsion	0	0	0	0	0	0	5	-2	0	1	0	2	0	0	0	0	0.38
Wanting	-1	-1	-1	-1	0	2	5	-2	-2	-1	0	-1	-1	-1	-1	-2	-0.50
Desire	-1	0	-1	-1	-3	2	-1	-2	-2	-3	-2	-1	-1	0	0	-1	-1.06
Relaxation	-2	0	0	-2	2	-2	-5	0	-3	-4	-5	-1	-2	-3	-2	-3	-2.00
Craving	1	-4	0	0	-1	0	1	-2	0	-2	0	0	1	-1	0	-1	-0.50
Enjoyment	1	2	1	-1	2	3	0	5	4	0	-2	1	2	0	5	2	1.56
Dread	2	-3	0	0	-2	0	3	2	1	-1	3	2	2	1	4	0	0.88
Very Annoyed	0	0	0	0	-2	0	5	-4	1	0	1	0	0	0	0	-1	0.00
Longing	0	2	-1	-1	-2	1	2	-2	0	-1	0	0	0	1	0	1	0.00
Calm	-3	2	1	-2	3	0	-4	0	-6	-3	-5	-1	-2	-1	-1	-3	-1.56
Scared	2	-1	0	0	-3	0	4	2	3	5	3	2	3	1	4	2	1.69
Chilled Out	-3	2	0	-2	4	-2	-6	0	-3	-4	-4	-2	-2	-4	-1	-1	-1.75
Fear	2	-1	1	0	-1	1	5	2	3	5	3	3	3	0	2	2	1.88
Terror	1	0	2	0	1	1	5	4	3	4	2	2	2	0	4	2	2.06
Empty	1	0	0	0	-1	-1	-3	-4	0	-1	2	-1	0	0	-2	-1	-0.69
Sickened	-1	0	0	0	0	0	3	-5	0	1	0	1	0	0	0	0	-0.06

Appendix D – Average Emotional Shift in Non-Virtual Reality

Avg. Emotion Shift in Non-VR	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Avg.
Nervous	0	0	1	0	-4	-1	3	-2	-1	1	-1	1	0	1	2	0	0.00
Sad	0	-1	1	0	-2	0	1	-4	-1	0	-1	-1	-1	0	-2	0	-0.69
Anger	1	1	0	0	0	-1	3	-4	0	1	0	0	-1	0	0	-2	-0.13
Nausea	-1	0	-1	0	-1	0	1	0	0	0	-2	0	0	0	-1	0	-0.31
Liking	1	-1	-2	-1	-2	-1	-1	0	-1	-2	-4	2	-1	-1	0	-1	-0.94
Satisfaction	-2	0	0	0	1	1	0	0	0	0	-4	-2	0	-2	0	-1	-0.56
Mad	2	0	0	0	-1	-1	4	-2	1	0	0	0	0	0	0	-1	0.13
Lonely	0	2	0	0	-3	1	3	0	-1	0	0	-1	0	1	0	0	0.13
Rage	1	0	0	0	0	0	4	-2	1	1	0	0	0	0	-1	0	0.25
Happy	0	-4	-1	-1	2	0	-3	0	-1	-2	-2	-1	-1	-2	0	-1	-1.06
Easygoing	-2	-2	-2	-1	3	0	-3	-1	-2	-1	0	-1	0	-3	-2	-1	-1.13
Grossed Out	0	0	0	0	0	0	0	0	0	1	-1	1	0	0	0	0	0.06
Anxiety	0	0	1	0	-3	0	2	-1	1	-1	2	-1	-1	1	1	0	0.06
Grief	1	0	0	1	-1	-1	2	-1	0	1	0	0	0	0	0	0	0.13
Worry	0	0	-1	1	-4	-1	2	-2	-2	-2	-1	0	0	1	2	0	-0.44
Panic	1	-2	0	0	-4	0	3	-2	2	0	0	1	0	1	2	-1	0.06
Revulsion	0	0	0	0	0	0	3	-2	0	0	0	1	0	0	0	0	0.13
Wanting	-1	0	-1	0	0	0	2	-2	-2	-1	1	-1	-1	-1	-1	-2	-0.63
Desire	1	-1	-1	0	-3	1	-1	-2	-1	-3	-2	0	-1	-1	0	-1	-0.94
Relaxation	0	-1	0	-1	2	-1	-5	0	-1	-3	-3	-1	0	-3	-2	-1	-1.25
Craving	1	-1	0	2	-1	-2	0	-2	0	-2	0	0	0	-1	0	0	-0.38
Enjoyment	0	1	1	0	2	1	0	3	3	-1	-2	0	1	-1	1	-1	0.50
Dread	0	-3	2	0	-4	0	4	-1	-2	-2	0	1	1	1	2	-1	-0.13
Very Annoyed	1	0	0	0	-2	-1	5	-4	0	0	0	0	0	0	0	-1	-0.13
Longing	0	2	-1	0	-2	1	0	-1	0	-2	-1	2	0	0	0	0	-0.13
Calm	-1	0	0	-1	2	1	-2	1	-3	-3	-3	-1	0	-2	-1	-1	-0.88
Scared	1	0	2	0	-4	0	2	0	1	3	1	1	1	2	2	0	0.75
Chilled Out	-1	1	-1	-1	4	0	-6	1	-3	-1	-3	-1	0	-4	-1	0	-1.00
Fear	1	-2	3	0	-2	0	3	0	2	3	-1	1	1	2	2	0	0.81
Terror	0	0	3	0	0	0	4	2	1	3	0	1	1	2	3	0	1.25
Empty	1	2	0	0	-1	-1	-3	-5	0	-1	1	-1	0	0	-1	-1	-0.63
Sickened	-1	0	1	0	0	0	3	-5	0	-2	0	0	0	0	0	0	-0.25

Appendix E – Average Emotional Shift in 1st Playthrough when VR is used

Avg. Emotion Shift in VR when 1st	A	E	F	H	J	K	M	P	Avg.
Nervous	1	-4	0	0	2	2	1	1	0.38
Sad	0	-2	0	-4	1	0	0	-1	-0.75
Anger	1	-1	-1	-4	1	1	-1	-1	-0.63
Nausea	-1	1	1	0	1	-2	0	1	0.13
Liking	0	-2	1	0	-1	-4	-1	0	-0.88
Satisfaction	-1	1	3	4	-2	-5	-1	2	0.13
Mad	1	-2	-1	-2	1	0	0	-1	-0.50
Lonely	1	-2	0	1	1	0	1	0	0.25
Rage	1	-1	0	-2	1	0	0	0	-0.13
Happy	-1	1	0	0	-3	-1	-1	-1	-0.75
Easygoing	-4	3	-3	-1	-1	-2	-1	-2	-1.38
Grossed Out	0	0	0	0	1	-1	0	0	0.00
Anxiety	2	-2	1	1	1	3	1	1	1.00
Grief	1	-1	-1	-2	2	0	0	0	-0.13
Worry	1	-3	0	1	-1	3	1	2	0.50
Panic	1	-3	2	1	3	3	2	0	1.13
Revulsion	0	0	0	-2	1	0	0	0	-0.13
Wanting	-1	0	2	-2	-1	0	-1	-2	-0.63
Desire	-1	-3	2	-2	-3	-2	-1	-1	-1.38
Relaxation	-2	2	-2	0	-4	-5	-2	-3	-2.00
Craving	1	-1	0	-2	-2	0	1	-1	-0.50
Enjoyment	1	2	3	5	0	-2	2	2	1.63
Dread	2	-2	0	2	-1	3	2	0	0.75
Very Annoyed	0	-2	0	-4	0	1	0	-1	-0.75
Longing	0	-2	1	-2	-1	0	0	1	-0.38
Calm	-3	3	0	0	-3	-5	-2	-3	-1.63
Scared	2	-3	0	2	5	3	3	2	1.75
Chilled Out	-3	4	-2	0	-4	-4	-2	-1	-1.50
Fear	2	-1	1	2	5	3	3	2	2.13
Terror	1	1	1	4	4	2	2	2	2.13
Empty	1	-1	-1	-4	-1	2	0	-1	-0.63
Sickened	-1	0	0	-5	1	0	0	0	-0.63

Appendix F – Average Emotional Shift in 1st Playthrough when VR isn't used

Avg. Emotion Shift in Non-VR when 1st	B	C	D	G	I	L	N	O	Avg.
Nervous	0	1	0	3	-1	1	1	2	0.88
Sad	-1	1	0	1	-1	-1	0	-2	-0.38
Anger	1	0	0	3	0	0	0	0	0.50
Nausea	0	-1	0	1	0	0	0	-1	-0.13
Liking	-1	-2	-1	-1	-1	2	-1	0	-0.63
Satisfaction	0	0	0	0	0	-2	-2	0	-0.50
Mad	0	0	0	4	1	0	0	0	0.63
Lonely	2	0	0	3	-1	-1	1	0	0.50
Rage	0	0	0	4	1	0	0	-1	0.50
Happy	-4	-1	-1	-3	-1	-1	-2	0	-1.63
Easygoing	-2	-2	-1	-3	-2	-1	-3	-2	-2.00
Grossed Out	0	0	0	0	0	1	0	0	0.13
Anxiety	0	1	0	2	1	-1	1	1	0.63
Grief	0	0	1	2	0	0	0	0	0.38
Worry	0	-1	1	2	-2	0	1	2	0.38
Panic	-2	0	0	3	2	1	1	2	0.88
Revulsion	0	0	0	3	0	1	0	0	0.50
Wanting	0	-1	0	2	-2	-1	-1	-1	-0.50
Desire	-1	-1	0	-1	-1	0	-1	0	-0.63
Relaxation	-1	0	-1	-5	-1	-1	-3	-2	-1.75
Craving	-1	0	2	0	0	0	-1	0	0.00
Enjoyment	1	1	0	0	3	0	-1	1	0.63
Dread	-3	2	0	4	-2	1	1	2	0.63
Very Annoyed	0	0	0	5	0	0	0	0	0.63
Longing	2	-1	0	0	0	2	0	0	0.38
Calm	0	0	-1	-2	-3	-1	-2	-1	-1.25
Scared	0	2	0	2	1	1	2	2	1.25
Chilled Out	1	-1	-1	-6	-3	-1	-4	-1	-2.00
Fear	-2	3	0	3	2	1	2	2	1.38
Terror	0	3	0	4	1	1	2	3	1.75
Empty	2	0	0	-3	0	-1	0	-1	-0.38
Sickened	0	1	0	3	0	0	0	0	0.50

Appendix G – Average Emotional Shift in 2nd Playthrough when VR is used

Avg. Emotion Shift in VR when 2nd	B	C	D	G	I	L	N	O	Avg.
Nervous	-4	-1	0	2	4	3	0	2	0.75
Sad	-1	0	0	0	0	-1	0	-2	-0.50
Anger	0	0	0	4	1	0	0	0	0.63
Nausea	0	-1	0	0	0	0	0	-1	-0.25
Liking	0	0	-2	-1	-2	2	-2	0	-0.63
Satisfaction	-1	0	-1	1	-1	1	-1	3	0.13
Mad	0	0	0	4	4	0	0	0	1.00
Lonely	0	0	0	5	1	-1	0	-1	0.50
Rage	0	0	0	4	3	0	0	-1	0.75
Happy	-1	0	-2	-3	-2	2	-2	2	-0.75
Easygoing	-1	-1	-2	-5	-3	-3	-2	-2	-2.38
Grossed Out	0	-1	0	2	0	2	0	0	0.38
Anxiety	-3	0	0	4	3	1	1	1	0.88
Grief	0	0	0	2	0	0	0	0	0.25
Worry	-3	-2	0	4	-1	2	0	1	0.13
Panic	-3	0	0	3	2	3	0	3	1.00
Revulsion	0	0	0	5	0	2	0	0	0.88
Wanting	-1	-1	-1	5	-2	-1	-1	-1	-0.38
Desire	0	-1	-1	-1	-2	-1	0	0	-0.75
Relaxation	0	0	-2	-5	-3	-1	-3	-2	-2.00
Craving	-4	0	0	1	0	0	-1	0	-0.50
Enjoyment	2	1	-1	0	4	1	0	5	1.50
Dread	-3	0	0	3	1	2	1	4	1.00
Very Annoyed	0	0	0	5	1	0	0	0	0.75
Longing	2	-1	-1	2	0	0	1	0	0.38
Calm	2	1	-2	-4	-6	-1	-1	-1	-1.50
Scared	-1	0	0	4	3	2	1	4	1.63
Chilled Out	2	0	-2	-6	-3	-2	-4	-1	-2.00
Fear	-1	1	0	5	3	3	0	2	1.63
Terror	0	2	0	5	3	2	0	4	2.00
Empty	0	0	0	-3	0	-1	0	-2	-0.75
Sickened	0	0	0	3	0	1	0	0	0.50

Appendix H – Average Emotional Shift in 2nd Playthrough when VR isn't used

Avg. Emotion Shift in Non-VR when 2nd	A	E	F	H	J	K	M	P	Avg.
Nervous	0	-4	-1	-2	1	-1	0	0	-0.88
Sad	0	-2	0	-4	0	-1	-1	0	-1.00
Anger	1	0	-1	-4	1	0	-1	-2	-0.75
Nausea	-1	-1	0	0	0	-2	0	0	-0.50
Liking	1	-2	-1	0	-2	-4	-1	-1	-1.25
Satisfaction	-2	1	1	0	0	-4	0	-1	-0.63
Mad	2	-1	-1	-2	0	0	0	-1	-0.38
Lonely	0	-3	1	0	0	0	0	0	-0.25
Rage	1	0	0	-2	1	0	0	0	0.00
Happy	0	2	0	0	-2	-2	-1	-1	-0.50
Easygoing	-2	3	0	-1	-1	0	0	-1	-0.25
Grossed Out	0	0	0	0	1	-1	0	0	0.00
Anxiety	0	-3	0	-1	-1	2	-1	0	-0.50
Grief	1	-1	-1	-1	1	0	0	0	-0.13
Worry	0	-4	-1	-2	-2	-1	0	0	-1.25
Panic	1	-4	0	-2	0	0	0	-1	-0.75
Revulsion	0	0	0	-2	0	0	0	0	-0.25
Wanting	-1	0	0	-2	-1	1	-1	-2	-0.75
Desire	1	-3	1	-2	-3	-2	-1	-1	-1.25
Relaxation	0	2	-1	0	-3	-3	0	-1	-0.75
Craving	1	-1	-2	-2	-2	0	0	0	-0.75
Enjoyment	0	2	1	3	-1	-2	1	-1	0.38
Dread	0	-4	0	-1	-2	0	1	-1	-0.88
Very Annoyed	1	-2	-1	-4	0	0	0	-1	-0.88
Longing	0	-2	1	-1	-2	-1	0	0	-0.63
Calm	-1	2	1	1	-3	-3	0	-1	-0.50
Scared	1	-4	0	0	3	1	1	0	0.25
Chilled Out	-1	4	0	1	-1	-3	0	0	0.00
Fear	1	-2	0	0	3	-1	1	0	0.25
Terror	0	0	0	2	3	0	1	0	0.75
Empty	1	-1	-1	-5	-1	1	0	-1	-0.88
Sickened	-1	0	0	-5	-2	0	0	0	-1.00

Appendix I – Average Emotional Shift with Participants with Low Video Game Frequency

Low Game Frequency Avg.	B	C	K	L	M	N	O	P	Avg.
Nervous	-2	0	0.5	2	0.5	0.5	2	0.5	0.50
Sad	-1	0.5	-0.5	-1	-0.5	0	-2	-0.5	-0.63
Anger	0.5	0	0.5	0	-1	0	0	-1.5	-0.19
Nausea	0	-1	-2	0	0	0	-1	0.5	-0.44
Liking	-0.5	-1	-4	2	-1	-1.5	0	-0.5	-0.81
Satisfaction	-0.5	0	-4.5	-0.5	-0.5	-1.5	1.5	0.5	-0.69
Mad	0	0	0	0	0	0	0	-1	-0.13
Lonely	1	0	0	-1	0.5	0.5	-0.5	0	0.06
Rage	0	0	0	0	0	0	-1	0	-0.13
Happy	-2.5	-0.5	-1.5	0.5	-1	-2	1	-1	-0.88
Easygoing	-1.5	-1.5	-1	-2	-0.5	-2.5	-2	-1.5	-1.56
Grossed Out	0	-0.5	-1	1.5	0	0	0	0	0.00
Anxiety	-1.5	0.5	2.5	0	0	1	1	0.5	0.50
Grief	0	0	0	0	0	0	0	0	0.00
Worry	-1.5	-1.5	1	1	0.5	0.5	1.5	1	0.31
Panic	-2.5	0	1.5	2	1	0.5	2.5	-0.5	0.56
Revulsion	0	0	0	1.5	0	0	0	0	0.19
Wanting	-0.5	-1	0.5	-1	-1	-1	-1	-2	-0.88
Desire	-0.5	-1	-2	-0.5	-1	-0.5	0	-1	-0.81
Relaxation	-0.5	0	-4	-1	-1	-3	-2	-2	-1.69
Craving	-2.5	0	0	0	0.5	-1	0	-0.5	-0.44
Enjoyment	1.5	1	-2	0.5	1.5	-0.5	3	0.5	0.69
Dread	-3	1	1.5	1.5	1.5	1	3	-0.5	0.75
Very Annoyed	0	0	0.5	0	0	0	0	-1	-0.06
Longing	2	-1	-0.5	1	0	0.5	0	0.5	0.31
Calm	1	0.5	-4	-1	-1	-1.5	-1	-2	-1.13
Scared	-0.5	1	2	1.5	2	1.5	3	1	1.44
Chilled Out	1.5	-0.5	-3.5	-1.5	-1	-4	-1	-0.5	-1.31
Fear	-1.5	2	1	2	2	1	2	1	1.19
Terror	0	2.5	1	1.5	1.5	1	3.5	1	1.50
Empty	1	0	1.5	-1	0	0	-1.5	-1	-0.13
Sickened	0	0.5	0	0.5	0	0	0	0	0.13

Appendix J – Average Emotional Shift with Participants with High Video Game Frequency

High Game Frequency Avg.	A	D	E	F	G	H	I	J	Avg.
Nervous	0.5	0	-4	-0.5	2.5	-1	1.5	1.5	0.06
Sad	0	0	-2	0	0.5	-4	-0.5	0.5	-0.69
Anger	1	0	-0.5	-1	3.5	-4	0.5	1	0.06
Nausea	-1	0	0	0.5	0.5	0	0	0.5	0.06
Liking	0.5	-1.5	-2	0	-1	0	-1.5	-1.5	-0.88
Satisfaction	-1.5	-0.5	1	2	0.5	2	-0.5	-1	0.25
Mad	1.5	0	-1.5	-1	4	-2	2.5	0.5	0.50
Lonely	0.5	0	-2.5	0.5	4	0.5	0	0.5	0.44
Rage	1	0	-0.5	0	4	-2	2	1	0.69
Happy	-0.5	-1.5	1.5	0	-3	0	-1.5	-2.5	-0.94
Easygoing	-3	-1.5	3	-1.5	-4	-1	-2.5	-1	-1.44
Grossed Out	0	0	0	0	1	0	0	1	0.25
Anxiety	1	0	-2.5	0.5	3	0	2	0	0.50
Grief	1	0.5	-1	-1	2	-1.5	0	1.5	0.19
Worry	0.5	0.5	-3.5	-0.5	3	-0.5	-1.5	-1.5	-0.44
Panic	1	0	-3.5	1	3	-0.5	2	1.5	0.56
Revulsion	0	0	0	0	4	-2	0	0.5	0.31
Wanting	-1	-0.5	0	1	3.5	-2	-2	-1	-0.25
Desire	0	-0.5	-3	1.5	-1	-2	-1.5	-3	-1.19
Relaxation	-1	-1.5	2	-1.5	-5	0	-2	-3.5	-1.56
Craving	1	1	-1	-1	0.5	-2	0	-2	-0.44
Enjoyment	0.5	-0.5	2	2	0	4	3.5	-0.5	1.38
Dread	1	0	-3	0	3.5	0.5	-0.5	-1.5	0.00
Very Annoyed	0.5	0	-2	-0.5	5	-4	0.5	0	-0.06
Longing	0	-0.5	-2	1	1	-1.5	0	-1.5	-0.44
Calm	-2	-1.5	2.5	0.5	-3	0.5	-4.5	-3	-1.31
Scared	1.5	0	-3.5	0	3	1	2	4	1.00
Chilled Out	-2	-1.5	4	-1	-6	0.5	-3	-2.5	-1.44
Fear	1.5	0	-1.5	0.5	4	1	2.5	4	1.50
Terror	0.5	0	0.5	0.5	4.5	3	2	3.5	1.81
Empty	1	0	-1	-1	-3	-4.5	0	-1	-1.19
Sickened	-1	0	0	0	3	-5	0	-0.5	-0.44

Appendix K – Average Emotional Shift with Participants with Low Video Game Experience

Low Game Experience Avg.	B	C	E	F	H	K	M	N	Avg.
Nervous	-2	0	-4	-0.5	-1	0.5	0.5	0.5	-0.75
Sad	-1	0.5	-2	0	-4	-0.5	-0.5	0	-0.94
Anger	0.5	0	-0.5	-1	-4	0.5	-1	0	-0.69
Nausea	0	-1	0	0.5	0	-2	0	0	-0.31
Liking	-0.5	-1	-2	0	0	-4	-1	-1.5	-1.25
Satisfaction	-0.5	0	1	2	2	-4.5	-0.5	-1.5	-0.25
Mad	0	0	-1.5	-1	-2	0	0	0	-0.56
Lonely	1	0	-2.5	0.5	0.5	0	0.5	0.5	0.06
Rage	0	0	-0.5	0	-2	0	0	0	-0.31
Happy	-2.5	-0.5	1.5	0	0	-1.5	-1	-2	-0.75
Easygoing	-1.5	-1.5	3	-1.5	-1	-1	-0.5	-2.5	-0.81
Grossed Out	0	-0.5	0	0	0	-1	0	0	-0.19
Anxiety	-1.5	0.5	-2.5	0.5	0	2.5	0	1	0.06
Grief	0	0	-1	-1	-1.5	0	0	0	-0.44
Worry	-1.5	-1.5	-3.5	-0.5	-0.5	1	0.5	0.5	-0.69
Panic	-2.5	0	-3.5	1	-0.5	1.5	1	0.5	-0.31
Revulsion	0	0	0	0	-2	0	0	0	-0.25
Wanting	-0.5	-1	0	1	-2	0.5	-1	-1	-0.50
Desire	-0.5	-1	-3	1.5	-2	-2	-1	-0.5	-1.06
Relaxation	-0.5	0	2	-1.5	0	-4	-1	-3	-1.00
Craving	-2.5	0	-1	-1	-2	0	0.5	-1	-0.88
Enjoyment	1.5	1	2	2	4	-2	1.5	-0.5	1.19
Dread	-3	1	-3	0	0.5	1.5	1.5	1	-0.06
Very Annoyed	0	0	-2	-0.5	-4	0.5	0	0	-0.75
Longing	2	-1	-2	1	-1.5	-0.5	0	0.5	-0.19
Calm	1	0.5	2.5	0.5	0.5	-4	-1	-1.5	-0.19
Scared	-0.5	1	-3.5	0	1	2	2	1.5	0.44
Chilled Out	1.5	-0.5	4	-1	0.5	-3.5	-1	-4	-0.50
Fear	-1.5	2	-1.5	0.5	1	1	2	1	0.56
Terror	0	2.5	0.5	0.5	3	1	1.5	1	1.25
Empty	1	0	-1	-1	-4.5	1.5	0	0	-0.50
Sickened	0	0.5	0	0	-5	0	0	0	-0.56

Appendix L – Average Emotional Shift with Participants with High Video Game Experience

High Game Experience Avg.	A	D	G	I	J	L	O	P	Avg.
Nervous	0.5	0	2.5	1.5	1.5	2	2	0.5	1.31
Sad	0	0	0.5	-0.5	0.5	-1	-2	-0.5	-0.38
Anger	1	0	3.5	0.5	1	0	0	-1.5	0.56
Nausea	-1	0	0.5	0	0.5	0	-1	0.5	-0.06
Liking	0.5	-1.5	-1	-1.5	-1.5	2	0	-0.5	-0.44
Satisfaction	-1.5	-0.5	0.5	-0.5	-1	-0.5	1.5	0.5	-0.19
Mad	1.5	0	4	2.5	0.5	0	0	-1	0.94
Lonely	0.5	0	4	0	0.5	-1	-0.5	0	0.44
Rage	1	0	4	2	1	0	-1	0	0.88
Happy	-0.5	-1.5	-3	-1.5	-2.5	0.5	1	-1	-1.06
Easygoing	-3	-1.5	-4	-2.5	-1	-2	-2	-1.5	-2.19
Grossed Out	0	0	1	0	1	1.5	0	0	0.44
Anxiety	1	0	3	2	0	0	1	0.5	0.94
Grief	1	0.5	2	0	1.5	0	0	0	0.63
Worry	0.5	0.5	3	-1.5	-1.5	1	1.5	1	0.56
Panic	1	0	3	2	1.5	2	2.5	-0.5	1.44
Revulsion	0	0	4	0	0.5	1.5	0	0	0.75
Wanting	-1	-0.5	3.5	-2	-1	-1	-1	-2	-0.63
Desire	0	-0.5	-1	-1.5	-3	-0.5	0	-1	-0.94
Relaxation	-1	-1.5	-5	-2	-3.5	-1	-2	-2	-2.25
Craving	1	1	0.5	0	-2	0	0	-0.5	0.00
Enjoyment	0.5	-0.5	0	3.5	-0.5	0.5	3	0.5	0.88
Dread	1	0	3.5	-0.5	-1.5	1.5	3	-0.5	0.81
Very Annoyed	0.5	0	5	0.5	0	0	0	-1	0.63
Longing	0	-0.5	1	0	-1.5	1	0	0.5	0.06
Calm	-2	-1.5	-3	-4.5	-3	-1	-1	-2	-2.25
Scared	1.5	0	3	2	4	1.5	3	1	2.00
Chilled Out	-2	-1.5	-6	-3	-2.5	-1.5	-1	-0.5	-2.25
Fear	1.5	0	4	2.5	4	2	2	1	2.13
Terror	0.5	0	4.5	2	3.5	1.5	3.5	1	2.06
Empty	1	0	-3	0	-1	-1	-1.5	-1	-0.81
Sickened	-1	0	3	0	-0.5	0.5	0	0	0.25

Appendix M – Average Emotional Shift with Participants with Low Virtual Reality Frequency

Low VR Freq. Avg.	D	J	K	L	M	N	Avg.
Nervous	0	1.5	0.5	2	0.5	0.5	0.83
Sad	0	0.5	-0.5	-1	-0.5	0	-0.25
Anger	0	1	0.5	0	-1	0	0.08
Nausea	0	0.5	-2	0	0	0	-0.25
Liking	-1.5	-1.5	-4	2	-1	-1.5	-1.25
Satisfaction	-0.5	-1	-4.5	-0.5	-0.5	-1.5	-1.42
Mad	0	0.5	0	0	0	0	0.08
Lonely	0	0.5	0	-1	0.5	0.5	0.08
Rage	0	1	0	0	0	0	0.17
Happy	-1.5	-2.5	-1.5	0.5	-1	-2	-1.33
Easygoing	-1.5	-1	-1	-2	-0.5	-2.5	-1.42
Grossed Out	0	1	-1	1.5	0	0	0.25
Anxiety	0	0	2.5	0	0	1	0.58
Grief	0.5	1.5	0	0	0	0	0.33
Worry	0.5	-1.5	1	1	0.5	0.5	0.33
Panic	0	1.5	1.5	2	1	0.5	1.08
Revulsion	0	0.5	0	1.5	0	0	0.33
Wanting	-0.5	-1	0.5	-1	-1	-1	-0.67
Desire	-0.5	-3	-2	-0.5	-1	-0.5	-1.25
Relaxation	-1.5	-3.5	-4	-1	-1	-3	-2.33
Craving	1	-2	0	0	0.5	-1	-0.25
Enjoyment	-0.5	-0.5	-2	0.5	1.5	-0.5	-0.25
Dread	0	-1.5	1.5	1.5	1.5	1	0.67
Very Annoyed	0	0	0.5	0	0	0	0.08
Longing	-0.5	-1.5	-0.5	1	0	0.5	-0.17
Calm	-1.5	-3	-4	-1	-1	-1.5	-2.00
Scared	0	4	2	1.5	2	1.5	1.83
Chilled Out	-1.5	-2.5	-3.5	-1.5	-1	-4	-2.33
Fear	0	4	1	2	2	1	1.67
Terror	0	3.5	1	1.5	1.5	1	1.42
Empty	0	-1	1.5	-1	0	0	-0.08
Sickened	0	-0.5	0	0.5	0	0	0.00

Appendix N – Average Emotional Shift with Participants with High Virtual Reality Frequency

High VR Freq. Avg.	A	B	C	E	F	G	H	I	O	P	Avg.
Nervous	0.5	-2	0	-4	-0.5	2.5	-1	1.5	2	0.5	-0.05
Sad	0	-1	0.5	-2	0	0.5	-4	-0.5	-2	-0.5	-0.90
Anger	1	0.5	0	-0.5	-1	3.5	-4	0.5	0	-1.5	-0.15
Nausea	-1	0	-1	0	0.5	0.5	0	0	-1	0.5	-0.15
Liking	0.5	-0.5	-1	-2	0	-1	0	-1.5	0	-0.5	-0.60
Satisfaction	-1.5	-0.5	0	1	2	0.5	2	-0.5	1.5	0.5	0.50
Mad	1.5	0	0	-1.5	-1	4	-2	2.5	0	-1	0.25
Lonely	0.5	1	0	-2.5	0.5	4	0.5	0	-0.5	0	0.35
Rage	1	0	0	-0.5	0	4	-2	2	-1	0	0.35
Happy	-0.5	-2.5	-0.5	1.5	0	-3	0	-1.5	1	-1	-0.65
Easygoing	-3	-1.5	-1.5	3	-1.5	-4	-1	-2.5	-2	-1.5	-1.55
Grossed Out	0	0	-0.5	0	0	1	0	0	0	0	0.05
Anxiety	1	-1.5	0.5	-2.5	0.5	3	0	2	1	0.5	0.45
Grief	1	0	0	-1	-1	2	-1.5	0	0	0	-0.05
Worry	0.5	-1.5	-1.5	-3.5	-0.5	3	-0.5	-1.5	1.5	1	-0.30
Panic	1	-2.5	0	-3.5	1	3	-0.5	2	2.5	-0.5	0.25
Revulsion	0	0	0	0	0	4	-2	0	0	0	0.20
Wanting	-1	-0.5	-1	0	1	3.5	-2	-2	-1	-2	-0.50
Desire	0	-0.5	-1	-3	1.5	-1	-2	-1.5	0	-1	-0.85
Relaxation	-1	-0.5	0	2	-1.5	-5	0	-2	-2	-2	-1.20
Craving	1	-2.5	0	-1	-1	0.5	-2	0	0	-0.5	-0.55
Enjoyment	0.5	1.5	1	2	2	0	4	3.5	3	0.5	1.80
Dread	1	-3	1	-3	0	3.5	0.5	-0.5	3	-0.5	0.20
Very Annoyed	0.5	0	0	-2	-0.5	5	-4	0.5	0	-1	-0.15
Longing	0	2	-1	-2	1	1	-1.5	0	0	0.5	0.00
Calm	-2	1	0.5	2.5	0.5	-3	0.5	-4.5	-1	-2	-0.75
Scared	1.5	-0.5	1	-3.5	0	3	1	2	3	1	0.85
Chilled Out	-2	1.5	-0.5	4	-1	-6	0.5	-3	-1	-0.5	-0.80
Fear	1.5	-1.5	2	-1.5	0.5	4	1	2.5	2	1	1.15
Terror	0.5	0	2.5	0.5	0.5	4.5	3	2	3.5	1	1.80
Empty	1	1	0	-1	-1	-3	-4.5	0	-1.5	-1	-1.00
Sickened	-1	0	0.5	0	0	3	-5	0	0	0	-0.25

Appendix O – Average Emotional Shift with Participants with Low Motion Control Frequency

Low Motion Control Freq. Avg.	B	C	D	F	H	I	J	K	L	M	N	O	P	Avg.
Nervous	-2	0	0	-0.5	-1	1.5	1.5	0.5	2	0.5	0.5	2	0.5	0.22
Sad	-1	0.5	0	0	-4	-0.5	0.5	-0.5	-1	-0.5	0	-2	-0.5	-0.67
Anger	0.5	0	0	-1	-4	0.5	1	0.5	0	-1	0	0	-1.5	-0.28
Nausea	0	-1	0	0.5	0	0	0.5	-2	0	0	0	-1	0.5	-0.22
Liking	-0.5	-1	-1.5	0	0	-1.5	-1.5	-4	2	-1	-1.5	0	-0.5	-0.89
Satisfaction	-0.5	0	-0.5	2	2	-0.5	-1	-4.5	-0.5	-0.5	-1.5	1.5	0.5	-0.39
Mad	0	0	0	-1	-2	2.5	0.5	0	0	0	0	0	-1	0.00
Lonely	1	0	0	0.5	0.5	0	0.5	0	-1	0.5	0.5	-0.5	0	0.17
Rage	0	0	0	0	-2	2	1	0	0	0	0	-1	0	0.11
Happy	-2.5	-0.5	-1.5	0	0	-1.5	-2.5	-1.5	0.5	-1	-2	1	-1	-1.06
Easygoing	-1.5	-1.5	-1.5	-1.5	-1	-2.5	-1	-1	-2	-0.5	-2.5	-2	-1.5	-1.50
Grossed Out	0	-0.5	0	0	0	0	1	-1	1.5	0	0	0	0	0.11
Anxiety	-1.5	0.5	0	0.5	0	2	0	2.5	0	0	1	1	0.5	0.44
Grief	0	0	0.5	-1	-1.5	0	1.5	0	0	0	0	0	0	-0.06
Worry	-1.5	-1.5	0.5	-0.5	-0.5	-1.5	-1.5	1	1	0.5	0.5	1.5	1	-0.50
Panic	-2.5	0	0	1	-0.5	2	1.5	1.5	2	1	0.5	2.5	-0.5	0.56
Revulsion	0	0	0	0	-2	0	0.5	0	1.5	0	0	0	0	0.00
Wanting	-0.5	-1	-0.5	1	-2	-2	-1	0.5	-1	-1	-1	-1	-2	-0.72
Desire	-0.5	-1	-0.5	1.5	-2	-1.5	-3	-2	-0.5	-1	-0.5	0	-1	-1.06
Relaxation	-0.5	0	-1.5	-1.5	0	-2	-3.5	-4	-1	-1	-3	-2	-2	-1.56
Craving	-2.5	0	1	-1	-2	0	-2	0	0	0.5	-1	0	-0.5	-0.72
Enjoyment	1.5	1	-0.5	2	4	3.5	-0.5	-2	0.5	1.5	-0.5	3	0.5	1.06
Dread	-3	1	0	0	0.5	-0.5	-1.5	1.5	1.5	1.5	1	3	-0.5	-0.06
Very Annoyed	0	0	0	-0.5	-4	0.5	0	0.5	0	0	0	0	-1	-0.39
Longing	2	-1	-0.5	1	-1.5	0	-1.5	-0.5	1	0	0.5	0	0.5	-0.11
Calm	1	0.5	-1.5	0.5	0.5	-4.5	-3	-4	-1	-1	-1.5	-1	-2	-1.28
Scared	-0.5	1	0	0	1	2	4	2	1.5	2	1.5	3	1	1.22
Chilled Out	1.5	-0.5	-1.5	-1	0.5	-3	-2.5	-3.5	-1.5	-1	-4	-1	-0.5	-1.28
Fear	-1.5	2	0	0.5	1	2.5	4	1	2	2	1	2	1	1.28
Terror	0	2.5	0	0.5	3	2	3.5	1	1.5	1.5	1	3.5	1	1.56
Empty	1	0	0	-1	-4.5	0	-1	1.5	-1	0	0	-1.5	-1	-0.56
Sickened	0	0.5	0	0	-5	0	-0.5	0	0.5	0	0	0	0	-0.50

Appendix P – Average Emotional Shift with Participants with High Motion Control Frequency

High Motion Control Freq. Avg.	A	E	G	Avg.
Nervous	0.5	-4	2.5	-0.33
Sad	0	-2	0.5	-0.50
Anger	1	-0.5	3.5	1.33
Nausea	-1	0	0.5	-0.17
Liking	0.5	-2	-1	-0.83
Satisfaction	-1.5	1	0.5	0.00
Mad	1.5	-1.5	4	1.33
Lonely	0.5	-2.5	4	0.67
Rage	1	-0.5	4	1.50
Happy	-0.5	1.5	-3	-0.67
Easygoing	-3	3	-4	-1.33
Grossed Out	0	0	1	0.33
Anxiety	1	-2.5	3	0.50
Grief	1	-1	2	0.67
Worry	0.5	-3.5	3	0.00
Panic	1	-3.5	3	0.17
Revulsion	0	0	4	1.33
Wanting	-1	0	3.5	0.83
Desire	0	-3	-1	-1.33
Relaxation	-1	2	-5	-1.33
Craving	1	-1	0.5	0.17
Enjoyment	0.5	2	0	0.83
Dread	1	-3	3.5	0.50
Very Annoyed	0.5	-2	5	1.17
Longing	0	-2	1	-0.33
Calm	-2	2.5	-3	-0.83
Scared	1.5	-3.5	3	0.33
Chilled Out	-2	4	-6	-1.33
Fear	1.5	-1.5	4	1.33
Terror	0.5	0.5	4.5	1.83
Empty	1	-1	-3	-1.00
Sickened	-1	0	3	0.67

Appendix Q – Average Emotional Shift with Participants with Low Horror-Based Content Frequency

Low Horror Freq. Avg.	C	E	I	M	N	Avg.
Nervous	0	-4	1.5	0.5	0.5	-0.30
Sad	0.5	-2	-0.5	-0.5	0	-0.50
Anger	0	-0.5	0.5	-1	0	-0.20
Nausea	-1	0	0	0	0	-0.20
Liking	-1	-2	-1.5	-1	-1.5	-1.40
Satisfaction	0	1	-0.5	-0.5	-1.5	-0.30
Mad	0	-1.5	2.5	0	0	0.20
Lonely	0	-2.5	0	0.5	0.5	-0.30
Rage	0	-0.5	2	0	0	0.30
Happy	-0.5	1.5	-1.5	-1	-2	-0.70
Easygoing	-1.5	3	-2.5	-0.5	-2.5	-0.80
Grossed Out	-0.5	0	0	0	0	-0.10
Anxiety	0.5	-2.5	2	0	1	0.20
Grief	0	-1	0	0	0	-0.20
Worry	-1.5	-3.5	-1.5	0.5	0.5	-1.10
Panic	0	-3.5	2	1	0.5	0.00
Revulsion	0	0	0	0	0	0.00
Wanting	-1	0	-2	-1	-1	-1.00
Desire	-1	-3	-1.5	-1	-0.5	-1.40
Relaxation	0	2	-2	-1	-3	-0.80
Craving	0	-1	0	0.5	-1	-0.30
Enjoyment	1	2	3.5	1.5	-0.5	1.50
Dread	1	-3	-0.5	1.5	1	0.00
Very Annoyed	0	-2	0.5	0	0	-0.30
Longing	-1	-2	0	0	0.5	-0.50
Calm	0.5	2.5	-4.5	-1	-1.5	-0.80
Scared	1	-3.5	2	2	1.5	0.60
Chilled Out	-0.5	4	-3	-1	-4	-0.90
Fear	2	-1.5	2.5	2	1	1.20
Terror	2.5	0.5	2	1.5	1	1.50
Empty	0	-1	0	0	0	-0.20
Sickened	0.5	0	0	0	0	0.10

Appendix R – Average Emotional Shift with Participants with High Horror-Based Content Frequency

High Horror Freq. Avg.	A	B	D	F	G	H	J	K	L	O	P	Avg.
Nervous	0.5	-2	0	-0.5	2.5	-1	1.5	0.5	2	2	0.5	0.55
Sad	0	-1	0	0	0.5	-4	0.5	-0.5	-1	-2	-0.5	-0.73
Anger	1	0.5	0	-1	3.5	-4	1	0.5	0	0	-1.5	0.00
Nausea	-1	0	0	0.5	0.5	0	0.5	-2	0	-1	0.5	-0.18
Liking	0.5	-0.5	-1.5	0	-1	0	-1.5	-4	2	0	-0.5	-0.59
Satisfaction	-1.5	-0.5	-0.5	2	0.5	2	-1	-4.5	-0.5	1.5	0.5	-0.18
Mad	1.5	0	0	-1	4	-2	0.5	0	0	0	-1	0.18
Lonely	0.5	1	0	0.5	4	0.5	0.5	0	-1	-0.5	0	0.50
Rage	1	0	0	0	4	-2	1	0	0	-1	0	0.27
Happy	-0.5	-2.5	-1.5	0	-3	0	-2.5	-1.5	0.5	1	-1	-1.00
Easygoing	-3	-1.5	-1.5	-1.5	-4	-1	-1	-1	-2	-2	-1.5	-1.82
Grossed Out	0	0	0	0	1	0	1	-1	1.5	0	0	0.23
Anxiety	1	-1.5	0	0.5	3	0	0	2.5	0	1	0.5	0.64
Grief	1	0	0.5	-1	2	-1.5	1.5	0	0	0	0	0.23
Worry	0.5	-1.5	0.5	-0.5	3	-0.5	-1.5	1	1	1.5	1	0.41
Panic	1	-2.5	0	1	3	-0.5	1.5	1.5	2	2.5	-0.5	0.82
Revulsion	0	0	0	0	4	-2	0.5	0	1.5	0	0	0.36
Wanting	-1	-0.5	-0.5	1	3.5	-2	-1	0.5	-1	-1	-2	-0.36
Desire	0	-0.5	-0.5	1.5	-1	-2	-3	-2	-0.5	0	-1	-0.82
Relaxation	-1	-0.5	-1.5	-1.5	-5	0	-3.5	-4	-1	-2	-2	-2.00
Craving	1	-2.5	1	-1	0.5	-2	-2	0	0	0	-0.5	-0.50
Enjoyment	0.5	1.5	-0.5	2	0	4	-0.5	-2	0.5	3	0.5	0.82
Dread	1	-3	0	0	3.5	0.5	-1.5	1.5	1.5	3	-0.5	0.55
Very Annoyed	0.5	0	0	-0.5	5	-4	0	0.5	0	0	-1	0.05
Longing	0	2	-0.5	1	1	-1.5	-1.5	-0.5	1	0	0.5	0.14
Calm	-2	1	-1.5	0.5	-3	0.5	-3	-4	-1	-1	-2	-1.41
Scared	1.5	-0.5	0	0	3	1	4	2	1.5	3	1	1.50
Chilled Out	-2	1.5	-1.5	-1	-6	0.5	-2.5	-3.5	-1.5	-1	-0.5	-1.59
Fear	1.5	-1.5	0	0.5	4	1	4	1	2	2	1	1.41
Terror	0.5	0	0	0.5	4.5	3	3.5	1	1.5	3.5	1	1.73
Empty	1	1	0	-1	-3	-4.5	-1	1.5	-1	-1.5	-1	-0.86
Sickened	-1	0	0	0	3	-5	-0.5	0	0.5	0	0	-0.27

Appendix S – Example Background Experience Sheet

UNIVERSITY OF HULL

Computer Science MSc by Thesis 2018 - 2019

Background Experience

Virtual Reality & Emotional Responses Study

Which best describes how often you play video games?

1	2	3	4	(5)
Never	Monthly	Fortnightly	Weekly	Daily

Which best describes how experienced you consider yourself at video games?

1	2	3	4	(5)
Not at all	Slightly	Moderately	Fairly Well	Very Well

How often do you use virtual reality technology?

1	(2)	3	4	5
Never	Rarely	Sometimes	Fairly Often	Regularly

How often do you use motion control technology?

1	2	(3)	4	5
Never	Rarely	Sometimes	Fairly Often	Regularly

How often do you consume horror / tension based media content, such as films or games?

1	2	(3)	4	5
Never	Rarely	Sometimes	Fairly Often	Regularly

Background Experience Form *Adam Kadow – MSc by Thesis*

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