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Digital vs Virtual Reality

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Digital vs Virtual Reality

Abstract

This paper investigates how VR Impacts game user satisfaction. Four games were tested. Each game has a different genre to help better understand if it will affect player's preferences in platforms. This study uses a customized 'The Game User Experience Satisfaction Scale' (GUESS) which has seven key factors that are used to determine a satisfaction grade for each game on each platform. The results are then compared between each other to analyze the differences and similarities. The result of this thesis showed that the playtesters preferred playing on VR, and that both people with more gaming experience and those with less, preferred VR interactions over PC.

1. Introduction

1.1 Background

There are over 2.5 billion video game users in the world (*Padilla, 2018*) and 1% of Steam (*one of the largest digital distribution platforms for video games*) users own a VR-headset, which is around 1.3 million users (*Lang, 2020*). VR (*Virtual reality*) allows a gamer to feel present in a simulated computer-generated world that can be similar or completely different from the real world. Since our eyes and ears work the same in the real world and in a virtual world it creates a realistic feeling to the user. Under 2020 the VR industry will have an estimated value of 18.8 billion USD (*"Virtual Reality Market Size, Share, Growth - VR Industry Report 2026"*). The VR industry has especially grown in the last 2 years since the industry made the price for a VR headset more affordable for consumers.

The VR industry is expected to grow rapidly and reach a worth of 120.5 billion USD in 2026. (*"Virtual Reality Market Size, Share, Growth - VR Industry Report 2026"*). This shows an increasing interest in VR, and that VR games are becoming more and more popular and several PC games have adapted by making their games VR-supported. But is VR better, or just a new way of playing? Future game developers may find this useful to know if it is worth making their PC game VR compatible or not. It can also be useful to know if there are any advantages or disadvantages when it comes to VR and if this is specific to a genre.

The official ISO(International Organization Standardization) of usability includes three items: effectiveness, efficiency and satisfaction. Effectiveness is the chance for a user to succeed in achieving a set of goals, efficiency is the set of resources the user will have to use in order to complete the goals and the satisfaction is the user's attitude towards the game (*Federoff, 2002*). However, not all three items are equally valued in a game. The goal of a game is entertainment which makes the third item, satisfaction, the most important one to measure. Satisfaction is considered a multi-dimensional concept that involves fun, immersive environments, and compelling experiences.

There has yet to be a study on testing VR vs digital on more than one game where the genres were different and because of that, this area is relevant to discover user satisfaction in digital vs VR.

1.2 Related Research

1.21 GUESS

In September 2016 a game assessment tool named 'GUESS' was created to give a better understanding of what it is that makes a game good (Phan et al., 2016). It was created to evaluate *video game satisfaction based on key factors* and to be used for game developers and game designers to see if people were playing it in the way it was meant to be played (Chaparro and Keebler, 2016) The tool was developed using a mix of questionnaire pilot studies, expert reviews, exploratory factor analysis, and confirmatory factor analysis. The result. A new instrument measuring video game satisfaction (GUESS is described in section 2.2)

1.22 Gaming on the Rift

In 2017 a study was conducted '*Gaming on the Rift: How Virtual Reality Affects Game User Satisfaction* (Shelstad et al., 2017) where a first-person shooter game was tested to see if VR could provide a different unique experience vs from the computer screen. The study consisted of 40 participants that were chosen through their online University's research pool. The game that they tested was *Defense Grid 2* which is a tower-defense strategy game and took approximately one hour to complete. This study used GUESS as a method to calculate player satisfaction. The PC part was played on a 24-inch computer monitor and the VR part was played on an Oculus Rift Headset. The result showed a higher perception of the key factors Engrossment, Enjoyment, Audio aesthetic and Visual aesthetic). The remaining key factors which were Useability, Narrative, Personal gratification, and Social connectivity showed no difference.

1.23 Roettl and Terlutter 2018

In 2018 a study was conducted (Roettl and Terlutter, 2018) where 237 playtesters took part to play a platform game, which was designed and developed for 2D, 3D and VR to see how different factors such as attitude, presence and arousal made a difference when playing it. The playtesters played three levels each which lasted between 7-10 minutes and was randomly assigned to one of the three game conditions (2D, 3D and VR). In 2D and 3D the game was played on a large 46-inch, stereoscopic 3D-capable television. When participants played the 3D version they received special 3D glasses which allowed the experience of depth perception. When playing the game in VR the players wore an Oculus Rift headset. After a playtester had played the game a questionnaire was given to them to answer. The questionnaire consisted of 36 questions which were all related to the variable's presence, attitude and arousal. The results indicated that only presence differed and was higher in VR, the other two variables did not differ.

1.24 Exploring gameplay experiences on the Oculus Rift

In 2015 a study was conducted where 10 participants played a first-person shooter game using the Oculus Rift. (Chek Tien Tan et al.) Participants played the game *Half-Life 2* on both VR and on PC. During the game, the participants were recorded to capture gameplay and also facial and body captures. after which the participants completed questionnaires. After every gameplay, they made recordings of think-aloud sessions. Results showed that participants experienced a heightened experience and a richer engagement and a deeper immersion on the Oculus Rift than on the desktop setup.

2. Method

2.1 How to measure the quality of the game.

Every Game developer company tries to create a better game than the others. But what makes a game great? There have been many studies trying to answer that very question. Surely Originality, freshness and winning chances are important concepts when it comes to rating a game(Kramer, 2000). Gameplay recordings, think-aloud sessions, are great tools but may limit data collection. The Player's comments may not include every aspect of the game. In a study (Chris C, 1982) it was believed that the more a game could pull you away from your surroundings the more enjoyable it was. Many of these concepts are limited and only measure certain aspects of a game. The game user experience satisfaction scale (GUESS) is a newly developed psychometrically validated and comprehensive gaming scale that is appropriate for playtesting and game evaluation purposes. (Phan et al., 2016).

2.2 How GUESS Works

GUESS consists of nine key factors. Each factor consists of several questions which are referred to as items. Participants can rate each item in a questionnaire from one to seven. When calculating the GUESS score, the average is calculated from all the ratings per item. The highest grade an item can have is seven. The next step is to average the Item grades to get a factor average. The factor average is referred to as a factor grade. After which the sum of all the factor grades is calculated to give a final grade for a game (See Figure 1).

This method does not necessarily give the result of which game is better but rather showing the results if a game has higher usability or audio performance for example. This will determine if a game has different strengths and what these are for different platforms. (Chaparro and Keebler, n.d.).

2.21 Key Factors

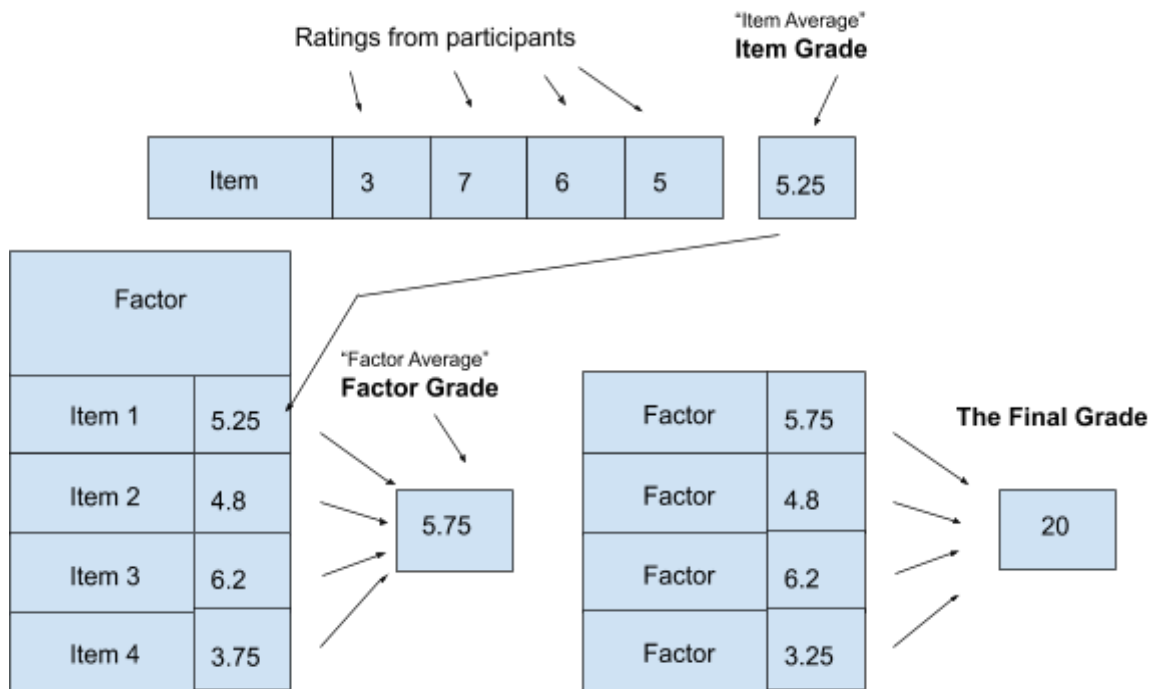
The Guess structure is built of 9 key factors, each referring to different aspects of the game.

A Short Description of Each Subscale

• Factor 1: Usability/playability	The ease in which the game can be played with clear goals/objectives in mind and with minimal cognitive interferences or obstructions from the user interfaces and controls
• Factor 2: Narratives	The story aspects of the game (e.g., events and characters) and their abilities to capture the player's interest and shape the player's emotions
• Factor 3: Play Engrossment	The degree to which the game can hold the player's attention and interest
• Factor 4: Enjoyment	The amount of pleasure and delight that was perceived by the player as a result of playing the game
• Factor 5: Creative Freedom	The extent to which the game is able to foster the player's creativity and curiosity and allows the player to freely express his or her individuality while playing the game

- Factor 6: Audio Aesthetics The different auditory aspects of the game (e.g., sound effects) and how much they enrich the gaming experience
- Factor 7: Personal Gratification The motivational aspects of the game (e.g., challenge) that promote the player's sense of accomplishment and the desire to succeed and continue playing the game
- Factor 8: Social Connectivity The degree to which the game facilitates a social connection between players through its tools and features
- Factor 9: Visual Aesthetics The graphics of the game and how attractive they appeared to the player

Note. A Short Description of Each Subscale. Reprinted from "The Development and Validation of the Game User Experience Satisfaction Scale (GUESS)," by M. H. Phan, J. R. Keebler, and B. S. Chaparro, 2016, Human Factors, 58, p. 1238



(Figure 1: Picture to illustrate how GUESS works)

2.22 Customized GUESS

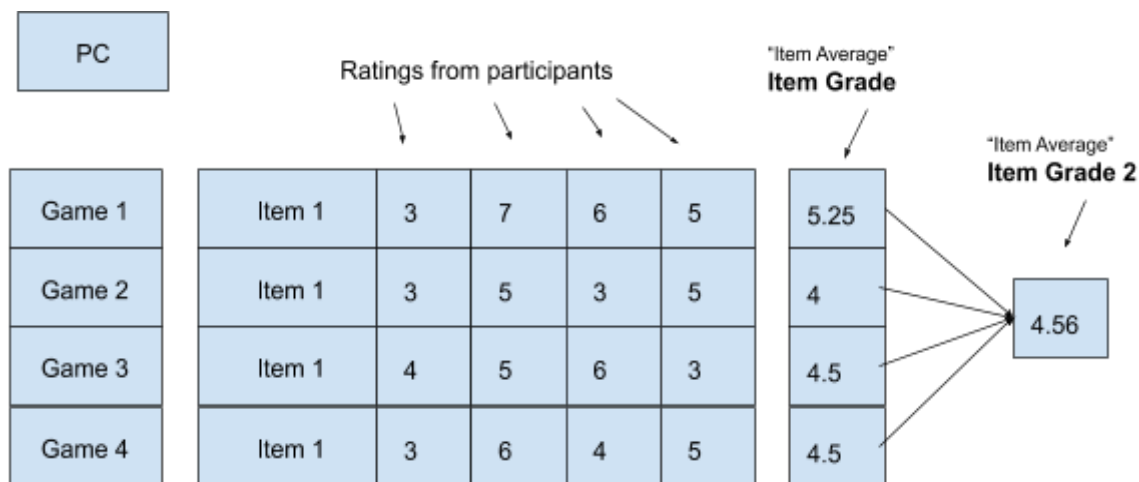
To compare VR with PC, it was required to tweak GUESS to suit this study's needs. Two key factors were taken out. Creative Freedom and Social Connectivity. These two factors would not

benefit a study comparing the same game on different platforms because it was expected, the result would be the same on both platforms and therefore give no usable data. Creative freedom refers to the extent to which the game is able to foster the player's creativity and curiosity. Social Connectivity refers to the degree to which the game facilitates a social connection between players through its tools and features. Both VR and PC versions of the game have the same game mechanics except for how you control the playable character. Since the VR version of the game has no difference in gameplay from the original PC version, it was expected to test the same on these key factors, Creative freedom and social connectivity.

Removing the two factors changes the overall score. Seven being the highest grade means that calculating the sum of all factors. The highest final grade a game could get is $7 \times 7 = 49$

Several items were also taken out from the factor Narratives. "I think the characters in the game are well developed" "I can identify with the characters in the game" are some examples. Asking the same questing on the same character twice, is believed to be useless since the comparison is between the same game.

As mentioned, GUESS can grade one game per test. It was required to change how calculations were made to find out the overall score for one console. To calculate Item Grade, the grade from all 4 games was averaged. This new Item grade was then used in the next steps (See picture 1.11]



(Figure 2: Item Grade calculation for all games)

2.3 Participants

10 individuals playtested all four games (See 2.4] on both platforms. There were two females and eight males. Nine playtesters were experienced gamers, meaning that they played more than 10 hours/week, and one playtester had beginner experience meaning that they have played some digital games before but it is not a part of their everyday life. None of the playtesters have tried VR before, and they have never played the games chosen before either. The average age was 26. The oldest playtester was 31 y/o and the youngest 23 y/o.

At the start of the testing, two participants were invited one at the time to play all four games and the games were played in order as listed(2.4). The first playtester started playing the first game on PC then VR, the second game was then reversed meaning that the playtester would now play the second game on VR first then on PC and this continued with the third and fourth game. The second playtester then started playing the first game on VR and then on PC. This was the pattern for all playtesters so that each game was played for the first time on each platform the same amount of times.

After the first two finished their tests, the rest of the participants were invited to test in pairs. One played on PC while the other played on VR. Games were played in order as listed (2.4). Each

gameplay ranged from 30 to 50 minutes, after which they were asked to fill out a questionnaire. A total of 8 questionnaires were filled out per participant.

2.4 Games Chosen for this Study

Four games will be tested ranging from different genres. The games chosen for this research are

1. Payday 2 - an action-packed, four-player cooperative shooter
2. Hellblade Senua's sacrifice - a dark fantasy action-adventure puzzle
3. No Man's sky - exploration survival game.
4. The Forest - an open-world survival horror game

There is no difference in gameplay between the PC and VR versions of the games. The only obvious difference is how you play, meaning through a screen with a mouse and keyboard or through your eyes with your hands.

2.41 Payday 2

This is an action-packed, up to a four-player cooperative shooter game (OVERKILL Software, *n.d.*). The player takes on the role of several actual and fictional characters and performs different kinds of robberies and heists. The game offers the choice to complete missions in various ways. Experience points vary, depending on the approach the player chooses. Payday 2 was originally made for PC and console.

In March 2018, *Overkill Studio* released a VR optimized copy of the game. Free to all the users of the original Payday 2. This game is primarily a First-person Shooter and serves this study well in finding out what players prefer in terms of weapons combat in games.



(Figure 3: picture of payday 2 gameplay)

2.42 Hellblade Senua's sacrifice

Set in the Viking age, a broken Celtic warrior embarks on a haunting vision quest into Viking Hell to fight for the soul of her dead lover (Hellblade.com, 2018).

This Award-winning game is a third-person puzzle game. Hellblade unfolds like a dark novel. Following the main character Senua journey through harsh and twisted environments. The game's story serves as a metaphor for the character's struggle with psychosis.

The player is given no hud, no tutorial and no help. With only the voices in your head, it's meant to give the player an untrusting attitude toward the environment.

This game is chosen to represent third-person and puzzle gameplay And serves this study in finding out what aspects of these genres players prefer.



(Figure 4: picture of Hellblade Senua's sacrifice gameplay)

2.43 No man's Sky

No man's Sky presents you with a galaxy to explore, filled with unique planets and life forms, and constant danger and action (No Man's Sky, n.d.). No man's Sky offers the player the possibility of exploring endless amounts of planets or galaxies. The infinite space is procedurally generated. Planets may support life if there are living conditions on that planet. This all depends on a number of factors: size, distance from the sun, etc.

Everything will also be the same for any players visiting the same planet because the math behind the game is the same. In NMS the player can fly different kinds of ships, gather resources, fight and much more.

This game is chosen to learn more about the exploration and survival genre in VR games and how it compares to Digital



(Figure 5: picture of No man's Sky gameplay)

2.44 The Forest

As the lone survivor of a passenger jet crash, you find yourself in a mysterious forest battling to stay alive against a society of cannibalistic mutants (*Endnightgames.com*, 2019). The Forest offers a range of survival gameplay for example, hunting, building and fighting. While this is also a survival game this game features a horror aspect which is expected to show interesting results when playing in VR



(Figure 6: picture of *The Forest* gameplay)

2.5 The Study

Different games take different amounts of time to complete. For the purpose of this test, we will test different aspects of the game for a set amount of time, or in some cases, the amount of time it takes to complete an objective/mission. The time spent on each session is based on the initial playthrough by the authors. Various save files are prepared to quickly be able to change to different testing areas. Some of the games have objectives spanning over the course of the game. In those instances, custom objectives will be given by the observer (See 2.51 *Scope of testing*). Custom objectives are designed to make sure a player experiences all of the game mechanics in limited time. For example, instead of waiting for a playtester to start building in *The forest*. They will simply be told to build a house but not how. This is to make sure the observer does not affect the results on enjoyment.

2.51 Scope of testing

Table A1: Scopes of playtesting

Game	Section	Time	Description
Payday 2 <ul style="list-style-type: none"> Action Shooter 	First world bank mission	~25 min	The first world bank mission is a well-suited mission to test the player. It will offer a stealth approach as well as loud. Controls will be explained to the player at the beginning of the mission. Easy, normal and High difficulty may be selected by the player. The player is free to do what they want. The player has 3 other AI teammates.
Hellblade Senua's sacrifice <ul style="list-style-type: none"> Adventure Third-person 	Prologue	~40 min	Hellblade Senua's sacrifice prologue is well suited to learn all the controls and experience the various mechanics the game has to offer.
No man's sky <ul style="list-style-type: none"> Adventure Exploration 	Flying Swimming Exploring Combat	~35 min	Players will start on a selected planet with some resources and a ship. Players will be instructed to explore the planet. 15 minutes will be allocated to exploring on foot <ul style="list-style-type: none"> -Players will then be instructed to jump into a nearby sea for 5 minutes. -Players will enter their ship and proceed to fly around exploring for 5 minutes before being told to leave the planet. -Players will spend 10 minutes in space fighting enemy ships.
The Forest <ul style="list-style-type: none"> Horror Survival 	Intro Scene Building Exploring Combat	~30 min	A save file will be loaded to jump into the game with some resources already gathered, and players will experience building in the game. Around 10 minutes will be devoted to this. <ul style="list-style-type: none"> - Players will then explore predetermined locations such as caves or scary scenes for about 10 minutes. - Lastly, 5 minutes will be spent on fighting the enemy.

3 Results & Analysis

A comprehensive report listing the M (average) from all answers that were submitted per item, are listed down below. The report shows the total on both VR and PC

3.1 Item Results

Items	M (Average)	M (Average)
<u>Usability/playability</u>		
The controls were easy to understand and memorize	4.85	4.43
The menu was easy to navigate through	5.18	5.25
I feel very confident while playing the game	4.35	4.55
The objectives were easy to complete	4.63	4.58
<u>Narratives</u>		
I am emotionally moved by the events in the game	4.1	4.98
<u>Play engrossment</u>		
I feel detached from the outside world while playing the game.	4.12	5.33
I cannot tell that I am getting tired while playing the game	4.53	5.1
Whenever I stopped playing the game I cannot wait to start playing it again	3.88	4.4
I do not care to check events that are happening in the real world during the game.	4.13	4.85
I temporarily forget about my everyday worries while playing the game.	3.8	4.6
I can block out most other distractions when playing the game.	4.08	4.98

<u>Enjoyment</u>	M (PC)	M (VR)
I think the game is fun.	4.63	4.85
I enjoy playing the game.	4.63	5.1
I do not feel bored while playing the game.	4.43	5.05
I am likely to recommend this game to others.	3.98	4.28
If given the chance, I want to play this game again.	3.85	4.25

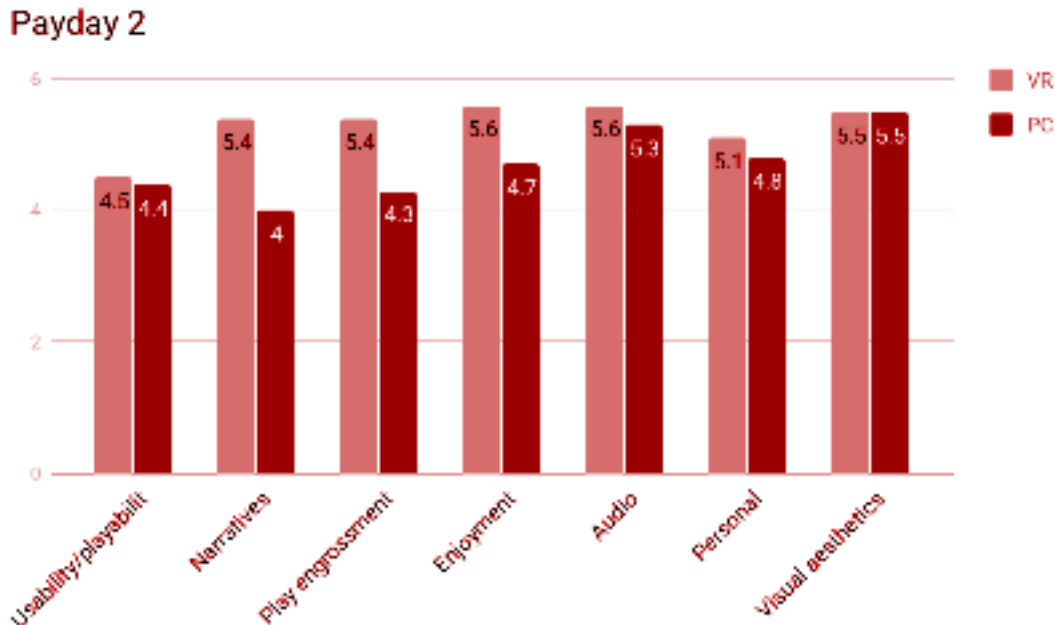
<u>Audio</u>	M (PC)	M (VR)
I enjoy the sound effects in the game.	5.2	5.53
I enjoy the music in the game.	4.73	4.93
I feel the game's audio (e.g., sound effects, music) enhances my gaming experience.	5.23	5.5
I think the game's audio fits the mood or style of the game.	5.63	5.95

<u>Personal gratification</u>	M (PC)	M (VR)
I am in suspense about whether I will succeed in the game.	4	4.1
I feel successful when I overcome the obstacles in the game.	4.33	4.48
I want to do as well as possible during the game.	4.75	4.65
I am very focused on my own performance while playing the game.	4.68	4.78
I find my skills gradually improve through the course of overcoming the challenges in the game.	4.68	4.88

<u>Visual aesthetics</u>	M (PC)	M (VR)
I enjoy the game's graphics.	5.55	6.2
I think the graphics of the game fit the mood or style of the game.	5.96	6.18
I think the game is visually appealing.	5.55	6.08

3.2 Factor Analysis

For each game we looked at their individual score in each factor from all the 10 participants in both VR and PC. Statistical significance: Meaningful significance for factors requires a difference of at least 0.5 points. For total points at least 1.5 points. Adding up all the games tends to give a less random effect so we decided to use at least a difference on 0.3 points for factors and at least 1.0 points for a significant result.



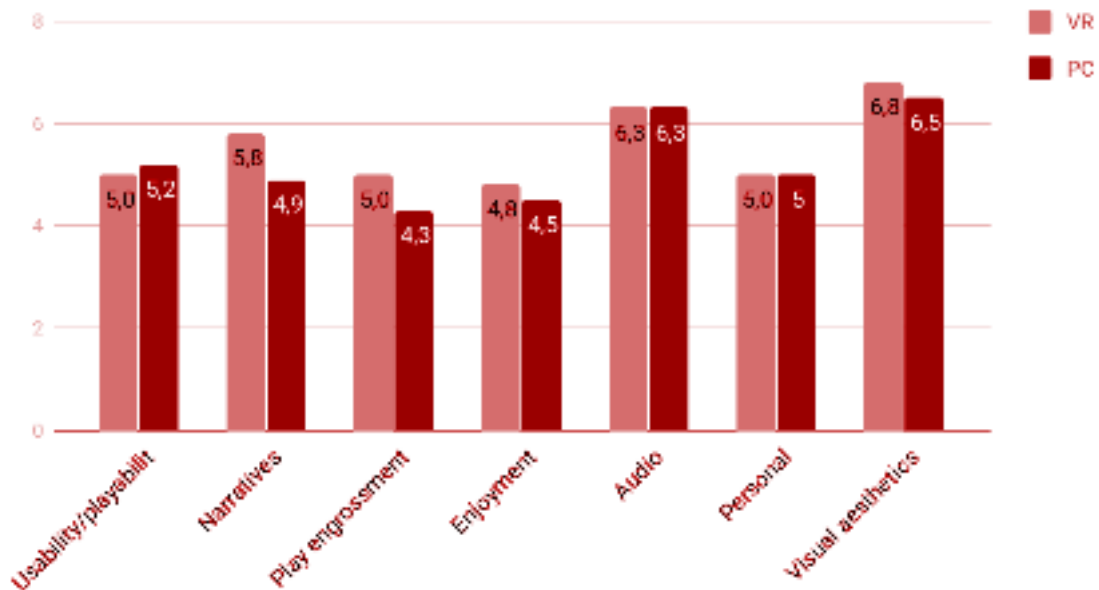
(Figure 7: statistics of payday2 gameplay)

Payday 2 tested much better on VR than PC(See Figure 7), we can see much higher results on factors Narratives, play engrossment and enjoyment. While visual aesthetics tested the same, players could better immerse themselves in the game on VR. Players also found the controls to be equal on both platforms as displayed in useability. However in the VR version, when it came to the item ‘The menu was easy to navigate through’, there was a huge spread between individual grades, where a playtester gave it a one and another playtester gave it a six.

Finally, Payday 2 tested **37,1** points on VR and **33** points on PC, out of a maximum of 49 points, showing it is more enjoyable on VR. The reason for this may be because this game has a high intensity and the VR entraps the user’s focus more thanks to the headset. It is also possible that because the user has to move around in real life while sneaking around and engaging enemies. This gives a more realistic feel thus leading to a higher grade on VR in Narratives, Play engrossment and Enjoyment.

The key factors Audio and Personal gratification did have a small difference as well. Personal gratification is believed to have a higher score on VR since the user is more engaged in the game and therefore is more eager to succeed. Audio is believed to have a higher score on VR because of the interactions in the game. When playing on PC and you hear a sound coming from behind, you simply turn the mouse but in VR you move your head around. This could lead to why the Audio played a better role.

Hellblade Senua's Sacrifice

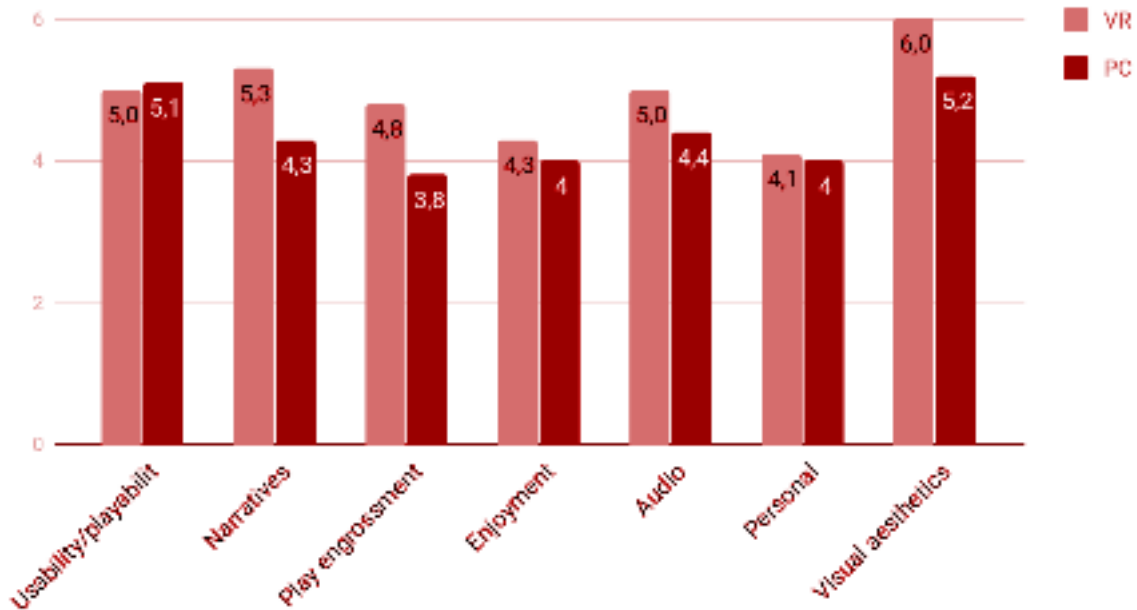


(Figure 8: statistics of Hellblade Senua's Sacrifice gameplay)

Hellblade Senua's Sacrifice had a significantly higher player satisfaction in VR than PC with a score of **38,7** points on VR and **36,7** points on PC where the maximum is 49 points. What especially participated in making VR the winner was the key factors Narratives and Play Engrossment (See Figure 8). These showed that the playtesters were more emotionally moved by playing in VR rather than PC and that immersive gameplay was higher, feeling that they lost track of time. All the individual grades given for each item by the playtesters did not show a huge spread, meaning that all playtesters mostly had the same experience when playing on both platforms.

The authors believe that the reason why Narratives had the highest difference between all the key factors, is because the game has a deep and psychological story that the user learns about at the start while the character is rowing into a dark and mysterious island. The VR blinds the users surrounding which can then lead to higher interest and focus. This is also believed to have helped with a higher grade on Play engrossment since the user is now more alert and intrigued by the game. Hellblade is a third-person game on both Vr and PC, which means players can not just turn their head but have to instead rotate the camera.

The Forest



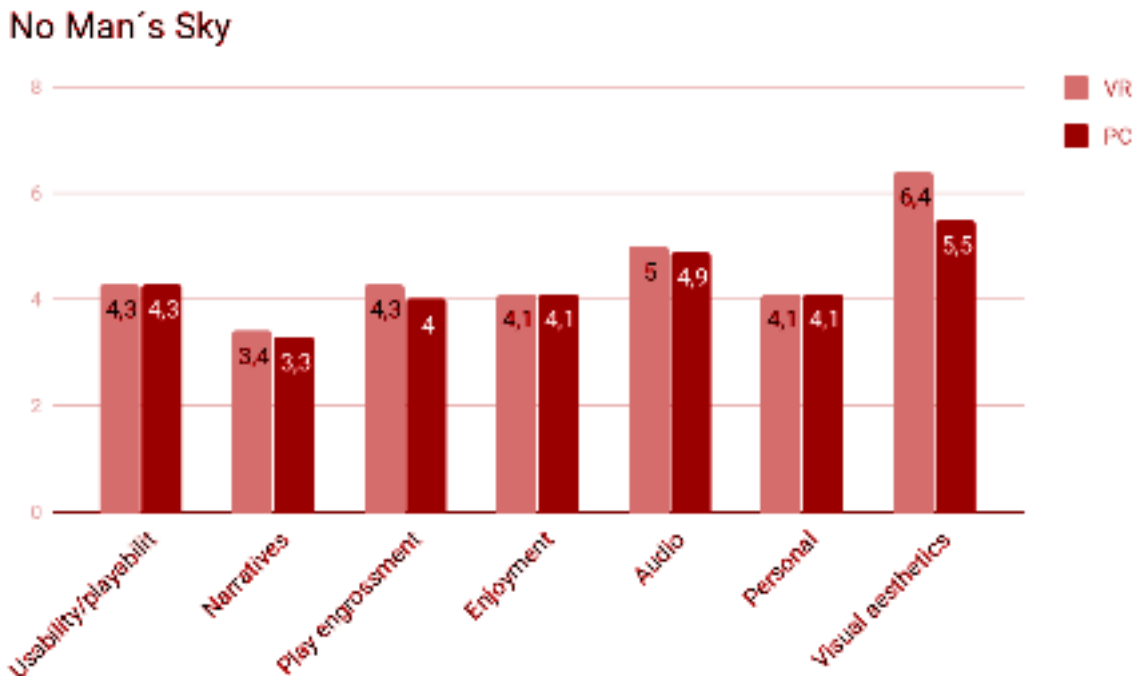
(Figure 9: statistics of The Forest gameplay)

The Forest: Had a much more noticeable difference in the factors Narratives, Play engrossment, Audio and Visual Aesthetics(See Figure 9). However, when looking at each item and each individual grade given by the playtesters for VR console there were several huge spreads. The items that contained these spreads were mainly in the 'Play engrossment' factor and 'Enjoyment' factor. Some felt that they got tired from playing the game while others enjoyed it. The item ' I think the game is fun' in the 'Enjoyment' factor showed that one playtester graded it a two while another graded it a max of seven points.

Overall the game had a significant higher score when playing in VR than PC with a score of **34.5** on VR and **30.8** on PC. This horror game was able to captivate players more in VR.

This game had the most varying grades and the reason for that could be the genres associated with The Forest. Some may enjoy the horror and the building feature that the game provides while others simply do not. Overall the satisfaction was still higher on VR. The high grade on Narratives and Play engrossments on VR is believed to be due to the horror aspects of the game. A jumping enemy, or a crawling monster is scarier on a VR aspect than on PC, and therefore contributes to a more intense scare. Audio seems to again have an impact, even more than Payday 2. The more intense gameplay you have the bigger impact Audio seems to have. Audio ratings strengthen the theory that players enjoy it more when surround sounds are affected by head movements.

When it came to the significant difference in Visual Aesthetics the reason could be that the sunshine and the big green forest seemed to be more appealing in a VR environment and that the creatures looked more real when they were up-close rather than looking at them from a PC screen.



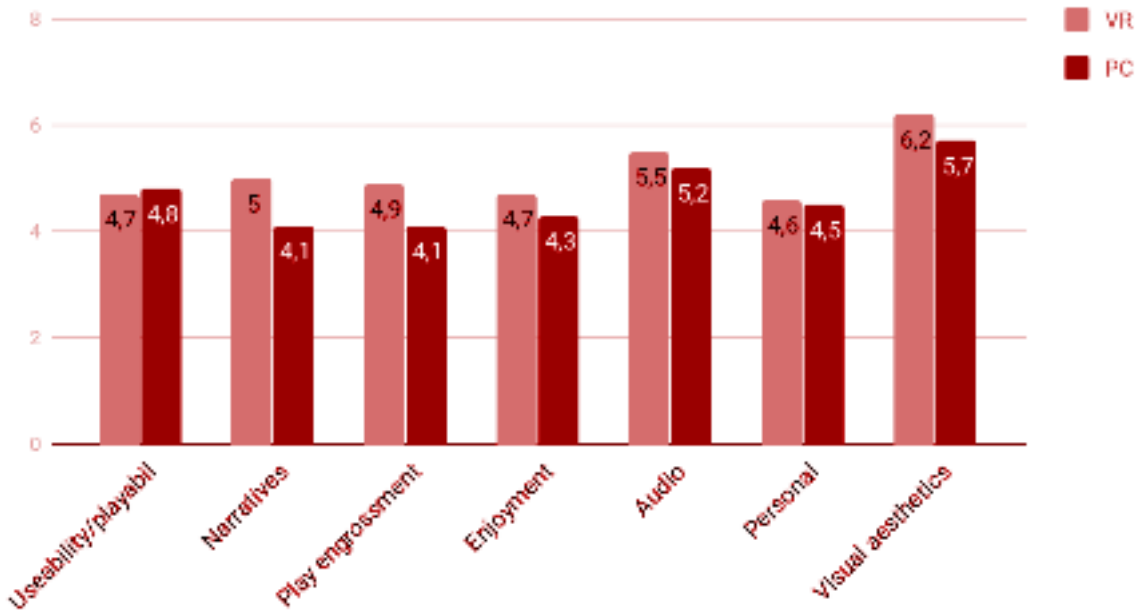
(Figure 10: statistics of No Man's Sky gameplay)

No Man's Sky had the least differences when playing between the platforms (See Figure 10). The only key factor that had a significant difference was visual aesthetics. Overall, No man's sky tested **31.6** points on VR and **30.2** points on PC. All playtesters had similar grades on each item.

No Man's Sky is a big open-world game where exploration is key. When playtesters started playing players were instructed to explore the planet. These types of objectives might have seemed boring to players due to the lack of reward since they were simply exploring a huge planet. It is arguable that players found it to be equal in Enjoyment, Narratives and definitely Personal Gratification, because of the repetitive gameplay. It requires a lot of play hours, from the author's experience to progress in the game. This was simply not possible in the time allocated for playtesting this game.

While the playtesting might have been dull, No Man's Sky is still a beautiful game. It is safe to assume that the realistic sizes of Landscapes, environments and animals affected Visual aesthetics. No Man's Sky features planets that are huge, and since they are procedurally generated, they do not include much infrastructure. They are instead vast landscapes of emptiness. Players can mostly hear footsteps, space engines and in-game music. It is strongly believed that this made the audio feel the same.

Overall PC vs VR



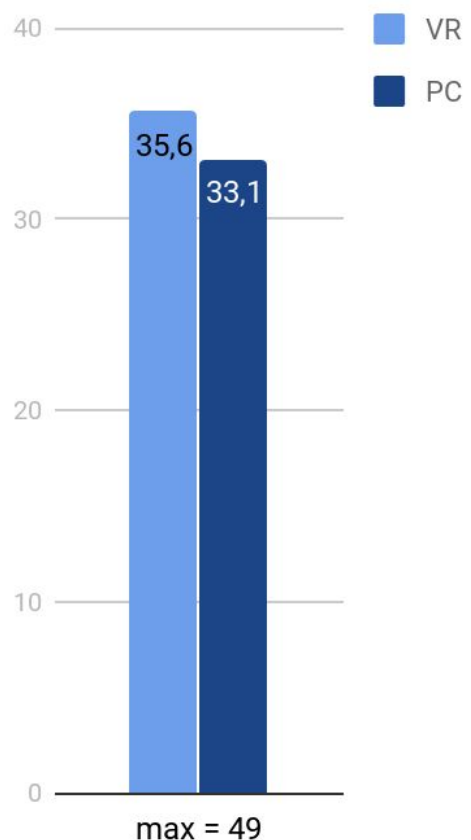
(Figure 11: statistics of overall gameplay)

After calculating every factor for every playtest and summing up the result, the overall score for PC was **33,1** points out of a total of **49,0** points and the VR scored a total of **35,5** points.

This shows that there is a significant difference when looking at all the games combined in each platform. As well as looking at some of the factors individually (Results 3.0). When it came to the genres: puzzle, adventure, FPS and survival, there was a significant higher score in Narratives as well as Play engrossment. Lastly, when it came to the genre: Exploration, there were no significant differences for most of the playtesters which resulted in similar scores on both platforms except for Visual Aesthetics.

This shows how important it can be to look at each game and its key factors individually. By looking at Narratives for example it had a huge impact on the genres FPS, survival, puzzle and adventure but when it came to exploration it had no impact. Even though No Man's Sky did not show a difference in Narratives and dragged the rating down, Narrative still had the highest difference of them all. We believe that VR brings out stronger emotions from the players because of the VR headset. Since the VR did get a higher score overall on all four games we believe that VR does possess some improved qualities for example, entrapping the player's focus better. VR option also seems to be better for games with high importance on audio.

Total Score



(Figure 12 Result)

3.3 Discussion

Since VR contains a headset that the player has to put on, making the real-world environment invisible to the user, it was expected that the key factor 'Play Engrossment' would have a higher score in VR, which proved accurate. Visual Aesthetics was also expected to test higher on VR. Due to the player's ability to immerse themselves and experience objects up close, it was expected participants would rate their experience higher on VR. This also proved accurate.

When looking into the play order of the games, and comparing their results, the initial two games showed a significant difference by switching platforms. The difference diminishes over the next two games. This could mean that the participants were more excited originally giving their new experience of VR. More testing on this area is however needed to see if initial experiences on VR boosts the player satisfaction.

The weakness of this study was the number of participants in the user study and the time spent on each game. Even though specific missions in each game were selected (See 2.4) for the playtesters it would have been more interesting to see the results if every game was played entirely from beginning to end. The reason why this study could not support this was a matter of time. It would also have been too much to ask a playtester to complete four entire games in VR and then again on PC. It could also have been beneficial if the study only used games from a certain year, for example, 2018, since the technology in the gaming industry can evolve quickly over the years.

When it comes to the factors we removed (see section 2.22) we strongly believe that it was key factors that would not have made an impact. GUESS was conducted to evaluate player satisfaction in a game, not to compare the same game on different platforms. Therefore it was necessary to look over the key factors and remove the ones we strongly believed to not have a meaningful difference in our study. Previous study also helped us on this matter (see section 1.22). They did not report a meaningful difference on these key factors as well. We believe that this only strengthens our study into finding out what and if the advantages and disadvantages there could be between switching platforms.

A former study (Shelstad et al., 2017) did not see a difference in the key factor Narratives, this was however, one of the biggest differences in our study when comparing a game on both platforms. The reason for this could be that several questions from Narratives were removed from our study (See 2.22) due to them being thought of as inefficient when comparing the same game on two platforms. They chose to include all of the questions, which may have weakened the score.

(Shelstad et al., 2017) did not have a difference in Play engrossment either which was also one of our biggest differences. We believe that the reason for that is the game they chose in their study. 'Defense Grid 2', which is a tower defense game means, the player views the game from a top-down perspective, and does not follow any character around. The game is about building defenses on different places on their map to stop enemies from evading their city. All of our four games involved the user to be or follow a character which could have been the reason for us having a higher grade on Play Engrossment.

There was also some studies (section 1.23 and section 1.24) that reported a result where the playtesters were more engaged when playing a game in VR. This also proved accurate in our study where Narratives and play engrossment had a significant difference.

3.4 Conclusion and Future research

Even though the overall score, for all games played on PC and VR did not differ by a lot. It was still clear that a game was more enjoyable in VR, especially genres like FPS, adventure, puzzle, or horror. The key factors that had the most significant difference just by switching from PC to VR (Item results 3.1) were Play engrossment and Narratives. These results showed that the player had a deeper connection to the game and that they had a more emotional experience with the game on VR. The Audio seems to have an effect when playing an FPS or a horror game but further research will have to be made in order to prove that.

In light of these results we would recommend games that include a character to follow, and have a story, to make their game VR compatible. This could contribute to a higher rating score on their game. When it comes to the exploration genre, games that are viewed from a top-down perspective, or games that do not include a character to follow should pass over and not make their game VR compatible, since these types of games seem to not have any difference in player satisfaction.

In terms of future research, we would suggest using an advanced data collector, for example, EEG (Electroencephalogram). This device could be used to help see the different emotions that a playtester goes through while playing a game and comparing this data with all other playtesters to see if it is specific to a certain group, and why, or if it is a common emotion that all the playtesters had. It would also be interesting to see how the results would be if three or more games with the same genre, from the same year, were to be tested on each platform.

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