Exploring mechanisms in VR games to change attitudes towards outgroups: contact, cooperation and embodiment.

Stuart Waters

Masters by Research

University of York

Computer Science

December 2020

Abstract

There are certain psychological mechanisms that are able to cause attitudinal change towards outgroups. The three key mechanisms in this report are contact, cooperation and embodiment. Within social science literature these mechanisms have been shown to create change in people's attitudes and behaviour. The use of VR has also emerged in Psychotherapy to create behavioural change within people. It is therefore possible that the melding of these mechanisms and VR gaming may create conditions that allow for attitudinal change within people.

A content analysis on 100 of the bestselling VR games on the Steam store was first carried out to understand how prevalent these mechanisms are within VR games. The results indicated that many VR games that are already available to consumers offer affordances for the mechanisms, meaning they may already be affecting attitudes towards outgroups. A second study was then conducted, this took the form of a between-group experiment with the aim of understanding whether VR games that featured embodiment had greater effects of attitudinal changes within participants compared to traditional screen-based games. The results seem to indicate that there was no difference between the two groups, however these results need to be interpreted carefully and may not tell the full picture. The report also realises that there is need for further research within this area to gain a full understanding of how games can be used to positively affect peoples' attitudes towards outgroups.

Table of Contents

Abstract	2
List of Contents	3
List of Tables	5
List of Figures	6
Acknowledgements	7
Declaration	8
Chapter 1 Introduction	9
1.2 This Report	10
Chapter 2 Literature Review	12
Introduction	12
2.1 Ingroups, Outgroups and Intergroup Relations	12
2.1.1. Cooperation and the reduction of intergroup conflict	12
2.1.2. The Contact Hypothesis and beyond: How positive intergroup contact is thought to	
positively affect attitudes towards outgroups	14
2.1.3 Prejudice and Roleplay.	1/
2.1.4. Summary	18
2.2 Virtual Reality	19
2.2.1. Presence	21
2.3 Virtual Reality Uses in Psychotherapy	21
2.4 Virtual Reality, Empathy and Embodiment	24
2.5 Summary: VR and outgroup blases	29
Chapter 3 Study 1: How many popular VR games afford key prejudice reduction mechanisms? A content analysis of the Steam Store	31
3.1 Aim	32
3.2 Method	32
3.2.1. Design	32
3.2.2. Measures	33
3.2.3. Procedure	35
3.2.4. Reliability Testing	36
3.2.5. Exclusion criteria for games	36
3.3 Results	37
3.4. Discussion	39
3.4.1. Affordances for attitudinal changes towards outgroups	39
3.4.2 Representation of BAME characters in VR games	42
3.4.3. Limitations	44
Chapter 4 Study 2: The impact of embodiment in a VR game on explicit racial bias	46

4.1	Aim
4.2	Hypothesis
4.3	Design
4.4	Procedure
4.5	The Game
4.6	Measures
4.7	Participants 52
4.8 R	esults
4.9 Di	iscussion
4.9	.1. Limitations
Chapter	5 Conclusions
5.1	Introduction
5.2	Summary of Research
5.2	.1. Content Analysis
5.2	.2. Experimental VR Study
5.3	Contributions
5.3	.1. Popular VR games may commonly provide affordances for key mechanisms
5.3 gar	.2. Cannot yet determine whether VR games are superior to traditional screen-based nes in causing attitudinal change
5.3	.3. Game Design 61
5.4	Future Work
5.5	Summary64
Referen	ce List
Append	ix

List of Tables

Table 1: Shows the proportion of games that featured the any of the three mechanisms of intere	st;
embodiment, cooperation or contact	38
Table 2: This table shows the percentage of games that feature BAME characters and white	
characters in specific roles	38
Table 3: Mean and standard deviation for each condition	53

List of Figures

Figure 1: Shows the mirror reflecting the avatar that was embodied by participants	48
Figure 2: Shows one of the abstract objects that players had to destroy	50
Figure 3: The pink laser that was emitted when players shot at the targets.	51
Figure 4: Boxplot of MRS Scores split by condition.	54

Acknowledgements

I would firstly like to thank both Dr David Zendle and Dr Harriet Over for their guidance, supervision and support throughout this project. I genuinely could not have finished this without them. It has not been an easy year for anyone, and they were always there to offer support and guidance at every turn. That will not be forgotten.

I would also like to thank my partner, Esther. She always encouraged me to do as best as I can throughout the project and who also sometimes forced me to get a piece of work done. Without both this encouragement and the welcome distraction from the project when necessary I may never have made it to the finish line.

Declaration

I declare that this thesis is a presentation of original work and I am the sole author. This work has not previously been presented for an award at this, or any other, University. All sources are acknowledged as References.

Chapter 1 Introduction

An ingroup is a group of people that an individual identifies themselves as being a part of [1]–[3]. An outgroup is a group that an individual does not identify as being a part of and usually the individual looks at these groups in a more negative way [2], [4], [5]. Group membership can be identified by an individual based on a number of reasons such as race, religion, culture or whether the individual shares similar interests to the group [1]–[3].

The negative attitudes that individuals may hold towards members of outgroups can have serious consequences. Potential consequences of this is the formation of prejudice which can lead to outgroup members being treated in negative ways and can, in some cases, lead to hate crime [6].

Prior research in the social sciences has suggested a variety of mechanisms that may be effective in eliciting attitudinal change towards outgroups and reducing negative biases towards them [3], [7]–[9]. These mechanisms include contact, where an individual has a positive contact experience with a member out an outgroup [10]; cooperation, where members of differing outgroups work together towards a common goal [7]; and embodiment, where an individual believes that they have control over another body or that another external body is part of their own [11].

Contact, cooperation and embodiment are not the only mechanisms that can be used to create attitudinal change. Other mechanisms that can cause a change are evaluative condition, whereby concepts and attributes that differ from a person's views are linked in order to change their attitudes [12]. Another mechanism that can be used are behavioural plans in which a person is given a set of instructions to avoid prejudice. For example, a person could be told that after they see a black person they need to think of something positive [13]. However, this study concentrates on the mechanisms of contact, cooperation and embodiment. These mechanisms appear to be relevant and common in VR games and can be found in major games such as *Half-Life: Alyx, Elder Scrolls V: Skyrim* among others.

One promising method for the delivery of the mechanisms of contact, cooperation and embodiment is Virtual Reality (VR). VR refers to an advanced human-computer interface which simulates a 3D environment that participants are able to move around and interact with. Researchers have hypothesised that the concept of presence, the feeling of "being there", makes it particularly effective as a platform to create behavioural and attitudinal changes within participants [14]. VR could therefore also be an effective platform for mechanisms such as contact, cooperation and embodiment to create such changes. One potentially impactful platform for the delivery of such mechanisms is VR gaming. The virtual reality market is becoming bigger than ever with VR games overall income increasing and the number of consumer headsets being shipped year on year also increasing [15]. Shuman [16] announced in March 2019 that the Sony PlayStation VR headset had reached 4.2 million units sold since it launched in October 2016. VR is becoming increasingly popular in both the console and PC gaming spaces. Shuman [16] announced in March 2019 that the Sony PlayStation VR headset had reached 4.2 million units sold since it launched in October 2016. VR is becoming increasingly popular in both the console and PC gaming spaces. Shuman [16] announced in March 2019 that the Sony PlayStation VR headset had reached 4.2 million units sold since it launched in October 2016. *Half-Life: Alyx,* a flagship VR title, was released for PC on the Steam Store in March 2020. This release of *Half-Life:Alyx* saw 43,000 concurrent users on launch day [17] and the best estimates suggest around 680,000 copies of the game sold within its first month [18]. These numbers show how popular VR gaming is becoming and show that there is a need to understand the effects VR gaming can have on players.

If VR gaming allows for any of the previously discussed mechanisms: contact, cooperation and embodiment with/of outgroup members then it is possible that it may cause attitudinal changes towards outgroups. For example, multiple studies have highlighted the importance of embodiment in creating empathy and leading to attitudinal change (see <u>section 2.4</u>), however it is unclear how prevalent embodiment is within VR games.

Furthermore, should these mechanisms be expressed in contemporary VR games, it is unclear whether they would affect gamers in this domain in a similar way to the ways they affect people in other domains. For example, in traditional experiments outside of VR positive contact with outgroup members has been found to reduce prejudice towards outgroups [19]. However, experiments within VR games differ to previous experiments as they take place in a virtual environment and may lack certain social cues that are evident when cooperating in the real world. It is therefore unclear whether generalisation should occur.

1.2 This Report

In order to address this gap in the literature, this report addresses two research questions:

RQ1: Which key mechanisms are featured within popular contemporary VR games?

RQ2: What is the effect of embodiment within VR games on attitudinal change towards outgroups?

In order to address these research questions two studies were undertaken. The first study addressed the first research question and consisted of a content analysis of the most popular VR games on the Steam Store. This was conducted to find how prevalent the key mechanisms of contact, cooperation and embodiment, with reference to positive attitudinal change towards outgroups, already are in VR games and to understand the roles which are given to black, Asian and minority ethnic (BAME) characters. The conclusion of this allowed for an understanding of whether there are VR games available to consumers that may potentially already be capable of causing positive attitudinal change.

The second study addressed research question 2 and consisted of an online VR gaming experiment. This study attempted to address whether the presence or absence of the embodiment mechanism in a VR game is capable of affecting people's attitudes towards outgroups, as highlighted in the literature. It is important to note, however, that due to COVID-19 related disruption, an adequate sample size was unable to be achieved for this study.

Chapter 2 Literature Review

Introduction

The topic of this thesis is the potential influence which VR games may have on reducing prejudice towards outgroups. In order to deal with this topic, it is first necessary to understand previous research that has been undertaken to understand both ingroups and outgroups, and also mechanisms that may have the effect of prejudice reduction between these groups. It is also necessary to understand the prevalence of contemporary VR technology, applications and research that has been carried out regarding this technology and its potential effects on behaviour and prejudice reduction, as well as understanding the popularity of VR gaming.

The literature review therefore begins with section 2.1 which introduces ingroups and outgroups and looks in depth at two key mechanisms related to this thesis; **contact** and **cooperation**, as well as the effects of these mechanisms on levels of prejudice. Section 2.2 gives context as to VRs place within gaming and details the phenomena of presence related to VR. Section 2.3 discusses the use of VR in psychotherapy and its effectiveness in its ability to change peoples' behaviour. Section 2.4 then introduces the importance of empathy, and the ways in which VR is able to elicit this emotion, before introducing another key mechanism, **embodiment** and the effects this can have on prejudice reduction. Finally, section 2.5 summarises the literature review and succinctly links the key pieces of information together.

2.1 Ingroups, Outgroups and Intergroup Relations

For this research project to be completed it is necessary to understand ingroups, outgroups and the relations that are forged between them. An ingroup can be defined as a group in which a person identifies as being a member maybe due to their culture, race, religion or by sharing similar interests [1]–[3]. An outgroup is therefore a group that an individual does not identify as being a member of which the individual usually sees in a negative way [2], [4], [5]. This categorisation of ingroups and outgroups can often lead to the formation of prejudice, bias and less than favourable attitudes towards members of outgroups [7], [20]–[22].

2.1.1. Cooperation and the reduction of intergroup conflict

In one of the first pieces of research which looked to understand intergroup relations Sherif conducted "*The Robbers Cave Experiment*" [7]. Sherif visited an American summer camp for boys to

carry out a longitudinal study. None of the boys knew each other when they arrived at the camp and they were randomly split into two different groups. Sherif noticed that as soon as this happened the boys started to suggest the groups should compete against each other and were beginning to verbally taunt members of the other group. This led to the boys creating their groups own social identity by coming up with a name for their group and then creating icons to represent their group names.

In the second stage of this study the groups were competing against one another in competitive games such as tug-of-war, baseball and American football. According to Sherif there was a rise in tension between the groups with this resulting in the groups attacking each other's icons, with one group burning the others' icons and raiding their cabin. When asked about friendship choices of regarding anyone in the camp around 93% of the boys chose ingroup members while only around 7% chose outgroup members.

The final stage of the study was to understand whether, when working towards a goal cooperatively, there would be a reduction in intergroup conflict. A truck that was used to go and collect food for the boys to cook with had 'broken down' which was in reality planned by Sherif. The boys in both groups witnessed this and decided to work together to get the truck working again, this was the first time the groups had worked cooperatively towards a goal. After successfully completing the goal of getting the truck started the groups went their separate ways and discussed whether the groups should work together to make a meal or one group make one meal and the other make theirs after. What was observed was that both groups made the meal together and there was a small amount of mixing between the groups while eating. Later both groups went swimming with each other and played together.

While Sherif conducted the experiment at a summer camp as a field experiment, it can be argued that it has high ecological validaty. However, there are also criticisms that can be made of the study. Firstly, it can be argued that the two groups do not reflect real world in-groups and out-groups as they were merely randomly assigned which group they were in, rather than being based on any interests they may have such as a sports team they support.

Another criticism is the demographics of the participants. The study was conducted at an all-boys camp and they were all of similar age. Due to this the results cannot really be generalised and instead the results may be fairly specific to boys around the age of 12. In order for the results to be generalised to the wider population then participants could have ranged in ages and also include females.

The findings and observations from [7] show how quickly and easily it can be for people to create ingroups and outgroups and how quickly bias and the potential for aggressive acts can form. However, it also shows how cooperation between groups can help reduce bias and changing attitudes towards outgroups. The creation of ingroups and outgroups has also been looked at in seminal studies from the mid-20th Century that still influence research in this area today.

Tajfel created the Minimal Group Paradigm (MGP) to understand how little social categorisation is needed for people to create intergroup bias [23]. In [24] Tajfel stated that just dividing participants into separate groups was enough to create intergroup bias. Participants aged between 14 and 15 years old were split randomly into groups, however the participants were told it was based on the rating of paintings, although participants were not aware who was in each group. Each participant was then tasked with choosing how to split money between two individuals, one member of their group and a member of the other, it was made clear that the participants were not choosing their own reward. The results in [24] concluded that even with this minimal categorisation participants chose to allocate more points to members of their ingroup and less to members of the outgroup in a way that meant the difference between the amounts going to each group was more important than simply awarding more to their ingroup.

The results in both [7], [24] show that just categorising participants into different groups is enough to form intergroup bias, prejudice and less than favourable attitudes towards outgroups. This effect has been replicated many times [25]–[29]. Being able to categorise participants in this way has allowed research to be carried out to understand how intergroup bias and attitudes towards outgroups can be affected in a positive way. As previously stated, in [7], working cooperatively between groups changed participants attitudes towards the outgroups and there are several studies that have also led to this conclusion [30]–[33]. The use of cooperation allows for people to recategorize differing groups into one larger group [34]. However, there are also other ways in which attitude towards outgroups can be affected.

2.1.2. The Contact Hypothesis and beyond: How positive intergroup contact is thought to positively affect attitudes towards outgroups

Allport's Contact Hypothesis is still highly regarded over 60 years after it was first published. In [3] Allport explains how ingroups and outgroups are formed and the relationship between these groups in great detail. This led him to suggest that, under the right circumstances, prejudice towards outgroups can be reduced using contact between groups. Allport states that prejudice could be reduced through allowing groups to interact. Allport also suggests that if the contact was put in

place by institutional supports, such as the law, the effect of reducing prejudice between the groups can be greatly exaggerated [3]. There are many studies that have concluded that The Contact Hypothesis does work [22]–[25].

This face-to-face intergroup contact can be used as a means to affect peoples' prejudice, both positively and negatively. In [39] it is explained that having positive contact with an outgroup member can reduce prejudice towards the outgroup as a whole. When testing the results of positive contact between Protestant and Catholic groups in Belfast there was a measured reduction in prejudice between the two groups.

Pettigrew & Tropp [19] undertook a meta-analysis consisting of 1,383 individual experiments from 526 papers. This meta-analysis analysed these experiments based on face-to-face contact with an outgroup and whether or not this contact reduced prejudice levels towards them. The results from this found that 94% of the studies showed contact with an outgroup led to a reduction in prejudice. This is important as it shows there is a definite correlation between contact and prejudice reduction in real life. There are also examples of contact having the same effect even without face-to-face contact due to an increase in empathy towards the outgroup.

Empathy can be defined as "...the ability to sense other people's emotion, coupled with the ability to imagine what someone else might be thinking or feeling." [40]. It is explained in [41] that positive contact with outgroups increased empathy and this change in empathy can lead to a positive change in attitudes towards members of that outgroup.

However, negative contact with an outgroup can lead to a negative change in attitudes. In [42] Meleady and Forder asked participants how often they had negative contact with an outgroup and found that more negative contact was associated with an increase in the levels of prejudice participants had towards the outgroup.

Barlow et al [43] also found that negative contact could lead to an increase in prejudice. In both experiments findings showed that negative contact is a related to prejudice. In fact, results show that there is potentially a stronger association between negative contact and increased prejudice than there is between positive contact and a reduction in prejudice. However, as the following studies show there is a link between positive contact, an increase in empathy and a positive change in attitudes.

The views within [44] reflect views of the time it was carried out and are in no way endorsed by researchers involved in this report. Batson et al [44] conducted three experiments to understand whether inducing empathy in participants for members of stigmatised groups led to attitude change

to the group as a whole and the groups used in this experiment were people who had contracted AIDS, the homeless community and convicted murderers. Each of these experiments consisted of using a $2 \times 2 \times 2$ factorial design by splitting participants based upon low vs high empathy towards the group, whether the member the group was responsible for being part of that group or not and broad vs narrow scope to the group which attitudes were assessed against.

The outgroups looked at within this series of studies were people living with AIDS, the homeless community and convicted murderers. The studies were all conducted in the same way with the only difference being a follow up phone call one to two weeks later in the study relevant to the convicted murderer outgroup. Participants were asked to listen to an interview with one member of those groups, however there was a change in one part of the interview depending whether participants were in the high or low empathy condition. In the high empathy condition participants hears a part in the interview which made clear that these individuals were part of their respective groups because they were victims of actions outside of their control. People in the low empathy group however heard that it was purely the individuals' fault and it was due to their actions that they found themselves part of their specific outgroup.

To fully understand the results of these experiments it has to be made clear that views at the time of these being conducted of these outgroups were not at all favourable and in some cases extremely negative. Results from the first two experiments found that participants that were in the high empathy condition were found to feel higher levels of empathy towards and had more positive attitudes towards the individual they heard interviewed and also the outgroup that individual was a member of. Results after the third experiment, which was related to convicted murderers, did not reflect the previous and there was no difference in empathy levels between the conditions, however in the follow up phone call there did appear to be a difference in empathy levels between the conditions and conditions with higher empathy led to more positive attitudes towards convicted murderers. Batson et al explain that this could be because in a face-to-face setting, participants wanted to answer the questions in a socially acceptable way, but this was not a barrier when answering over the phone.

The results in the first two experiments show that inducing levels of empathy towards members of an outgroup can lead to a positive change in attitudes towards both individuals and whole groups. While this is just one study showing how empathy can affect attitudes towards certain outgroups, other studies have looked at how it affects attitudes towards different outgroups and different bias towards them for example racial bias between white and black people. The results from the third study are questionable, however. The idea of the follow up phone call did not appear in either of the other experiments, bringing into question why it was included in the final one. It may be that something happened during the time after the experiment and before the phone call that may have affected participants answers. Also, participants were not aware that the follow up was part of the original experiment and instead believed it to be based around their attitudes towards prison reform, which may have naturally led to more empathetic answers.

Finlay and Stephan investigated empathies effect on the racial bias of white participants towards black people [45]. The study consisted of recruiting white participants and splitting them in to three conditions: two empathy conditions and a control condition. Participants were given several scenarios to read for depicting events that had occurred to members of the outgroup and members of the participants ingroup. Participants in the first empathy condition were asked to imagine themselves as the author of the scenarios and identify with the authors' feelings. The second empathy condition asked participants to imagine how they would feel as the author and to concentrate on how they would feel in that situation. Participants in the control condition were asked to observe what the author does and how they write, for example they were asked to note the language structures that were used to observe all the characteristics of their behaviours, this was to stop participants from feeling empathy while reading the scenarios.

Results from the experiments conducted in [45] showed that participants in both empathy conditions had a positive change in attitudes towards the outgroup of black people. However, rather than feeling empathy related to compassion and understanding it appeared that participants were feeling empathetic towards black people due to feelings of anger and disgust towards the perpetrators in the scenarios they were given. Finlay and Stephan explain that feeling these emotions of anger and disgust caused by reading the scenarios of black people being treated unfairly led the participants to be more receptive to empathising with the negative emotions the authors of the scenarios showed towards the white people in them.

As can be seen throughout these studies contact, whether face-to-face or not can lead to a reduction in prejudice towards outgroups. It may also then be possible that contact with a virtual avatar could also have this same effect.

2.1.3 Prejudice and Roleplay outside of VR

Another way in which prejudice can be reduced is through role play. Role playing exercises provide scenarios where prejudice can be experienced vicariously by participants. McGregor explains in [46]

that these role playing exercises can take the form of a dramatization and participants take on roles in the outgroups and take the perspective of another person is an important aspect.

In [47] Culbertson conducted an experiment to understand whether a roleplaying exercise had any effect on levels of prejudice towards the black community. It must be made clear that the views in [47] are not endorsed by researchers related to this study and instead reflect views at the time. Participants were either role players or observers and were given a role-playing exercise to complete. The story within the exercise was that a number of black people were moving to a white neighbourhood, and it may cause tensions. In the exercise the role players had to give a presentation and advocate for a specific theme. All the themes given were in favour of integration of the black community within the neighbourhood. Results showed that participants that were role players had a significant change in their attitudes towards the black community and also integration compared to the observer participants.

Again, in [46] McGregor conducted a meta-analysis looking at whether role playing was an effective form of prejudice reduction. McGregor's findings showed that, according to the studies included in his meta-analysis, that role playing exercises are able to reduce prejudice towards outgroups. This is important as it shows that role playing in the real world is able to reduce prejudice, just by imagining you are embodyingan outgroup member. This could translate to VR games.

There is the possibility that playing a VR game where you can see yourself playing as a member of an outgroup and role-playing in a VR game could also lead to the same outcome as face-to-face role playing. In the face-to-face role-playing exercises in the studies discussed participants had to imagine being the person in that role. VR games give players an opportunity to role-play and can facilitate embodiment without face-to-face activities with other people. VR games offer the opportunity to see the body of the character that the participant is role-playing.

2.1.4. Summary

It is clear that people form these ingroups and outgroups quickly and these divisions can be based on very little differences in some cases [7], [23], [24]. This categorisation of groups can lead to prejudice and to treatment of outgroups being less favourable than treatment of ingroup members [7], [20]– [22]. However, as noted above there are certain mechanisms that can lead to a reduction in prejudice towards outgroups. Contact is one of these mechanisms and has been discussed throughout <u>section 2.1.1.</u> It has been discussed how Allport's Contact Hypothesis explained, in great detail, how positive contact can affect attitudes towards outgroups [3]. As has been made clear from the literature positive contact has been repeatedly shown again to have a positive impact on attitudes towards outgroups. It may be that the use of contact within VR games has the same effect.

Cooperation is the second mechanism that is able to affect prejudice towards outgroups which has been discussed in <u>section 2.1.2.</u> If members of different groups are able to successfully cooperate with one another this can lead to a change in attitude towards the outgroup. As stated in [34] working cooperatively with other groups causes people to recategorize these smaller outgroups into one large group which in turn causes a positive attitudinal change.

The final mechanism is embodiment. Embodiment refers to the belief that a person has control over another body or that another external body is part of their own [11]. As previously mentioned, embodiment is linked to role-play where you imagine you are playing a character, VR is able to offer role-playing experiences where you are not only imagining the character you play as, you can see that character. As will be shown in this section, the feeling of embodiment that is able to manifest in participants can be a powerful mechanism that is able to lead to attitudinal change. There is evidence to suggest that there is a link between embodiment and VR. This will be discussed and looked at in-depth later on in the literature review (section 2.4.1) and also the link between embodiment and VR will be discussed.

Now that the literature has introduced and given some consideration to role-play and also given an in-depth discussion into contact and cooperation, it will now discuss VR, uses of VR with psychotherapy and the link between VR and embodiment. As will be made clear, it is possible that VR, more specifically VR games, may be able to facilitate these mechanisms and enable attitudinal changes towards outgroups.

2.2 Virtual Reality

In 2018 the global immersive headset (VR headsets, Augmented Reality headsets and Mobile Augmented Reality headsets) market reached \$10.3 billion and by 2024 is forecast to reach a value of \$40.2 billion [48]. Shuman [16] announced in March 2019 that the Sony PlayStation VR headset had reached 4.2 million units sold since it launched in October 2016. VR headset shipments rose from 3.7 million headsets in 2017 to 4.65 million shipments in 2018 and that number is expected to rise to 6 million headsets in 2019 [15]. The most popular VR headsets (PlayStation VR, Oculus Rift and HTC Vive), from their respective launches till the end of Q3 2019, have sold 7.5 million headsets between them [49].

SuperData [49] expect that by 2022 the VR headset market will more than double from \$3.2 billion in 2019 to \$6.8 billion in 2022. In 2019 consumer VR software is expected to reach \$1.1 billion dollars, the first time it will reach the \$1 billion milestone, and by 2022 consumer spending is expected to reach \$2.4 billion with games having an increased share in peoples' spending [49]. The headset sales figures along with the consumer software market for VR show that there is a growing market in this space and with an increase in VR games revenue expected over the next 3 years it is important area of research.

VR gaming offers a different experience to traditional gaming on a 2D screen. VR gaming offers users the opportunity to be transported into a virtual environment and become a part of it by transferring their physical presence in the real world into the virtual environment. Pallavicini et al explain in [50] that due to the high immersion found in VR games and experiences people are able to connect more to the characters and stories which in turn leads to more emotion felt within players and this could be due to the concept of presence.

Immersion and presence are two concepts that are closely related to one another but there are differences between them. Slater and Wilbur in [51] make the distinction between these two concepts clear. They state that immersion is an objective and quantifiable description of a system; '*...describes the extent to which the computer displays are capable of delivering an inclusive, extensive, surrounding and vivid illusion of reality to the senses of a human participant.*" For example, does the system match the movements that a participant makes, does the system use a 2D-screen or a head mounted display. Immersion is about the system and how it delivers information to the participant.

Presence is a psychological concept. It is the sense the player or participant has of being in that virtual environment, it is the sense of "being there" [51]. Participants who feel higher levels of presence exhibit behaviours and act in the virtual environment as they would in the real world. The virtual environment has become a more engaging place than the physical world around them.

The concept of presence in VR is important with regard to bias towards outgroups. As we will see, some have suggested that the increased sense of presence in VR may lead to players consciously and unconsciously feel as if the experience is real. In the following sections there are numerous studies that show that the concept of presence in VR is able to create emotional and behavioural change within people.

2.2.1. Presence

Putative differences between experiences in VR and experiences using traditional '2D' media are often rooted in the concept of presence. Sanchez-Vives and Slater [52] explains that the concept of presence is based around the feeling of "being there", where the player knows from a cognitive view that the virtual environment is not real and anything that is happening in that environment is also not real, however consciously and unconsciously they feel and behave as if it is real. This could mean, for example, that within the virtual environment a player could find themselves at the top of a mountain with a cliff edge with a drop of a few thousand feet in front of them but they have to reach the next checkpoint by crossing a creaky and rickety wooden bridge which the blustery wind is swinging side to side. The player knows that none of this is real and that it is all in the virtual environment, but they find themselves feeling nervous and their heart rate has increased as if they were really facing this obstacle.

Presence can be induced in a person by replacing senses that are experienced within the real world with feedback from the virtual environment such as tactile feedback, 3D visuals or spatialised sound [53]. Bowman and McMahan go on to state that "*presence refers to a user's subjective psychological response to a VR system*." This again relates to the feeling of "being there" where the player knows that the virtual environment is not real but unconsciously and consciously feels and acts as if it is real. There is also evidence that the sense of presence can be linked to emotional response within VR users.

Riva et al [14] analysed the link between presence and emotions. It is once again explained that the use of haptic feedback, visuals and sound affect the sensation of presence within players, and it is stated that this can lead to emotional responses within players. The use of VR in psychology also shows how VR can be used to create emotion and behavioural change.

2.3 Virtual Reality Uses in Psychotherapy

As mentioned in <u>chapter 2.2</u> the most mainstream and common use for VR is gaming. However, the ability of VR to create a sense of presence have led to several proposed applications of VR in the broad domain of psychology, and more specifically in psychotherapy. These are summarised briefly below.

When a patient is given some form of psychotherapy it involves procedures that help patients to develop healthier habits that help patients to overcome feelings of depression, anxiety and

problems such as chronic illnesses that is causing them emotional or physical distress [54]. The American Psychological Association (APA) [55] explain that there are different approaches to Psychotherapy and these consist of psychoanalysis and psychodynamic therapies, behaviour therapy, cognitive behaviour therapy, humanistic therapy and integrative therapy. VR is most commonly used in cognitive behaviour therapy (CBT) and more specifically in exposure therapy.

The APA [56] explain that exposure therapy was developed to help people confront their fears in a safe space therefore allowing people to break their behavioural patterns of avoidance which in turn helps lead to a reduction in fear. There are a variety of ways in which exposure therapy can be carried out, in vivo exposure (directly facing the fear in real life), imaginal exposure (imagining the feared object or situation), interoceptive exposure (causing a feared physical sensation that is harmless) and more recently virtual reality exposure (placing someone within a VR simulation and presenting them with their fear)[56]. Historically, in vivo exposure was seen as the gold standard of exposure treatment, however it does come with issues.

There are advantages to using in vivo exposure instead of imaginal exposure. Imaginal exposure would not be the best course of therapy for people that have aphantasia, while only a limited number of studies have looked at this phenomena it appears that people do have problems being able to imagine images [57]–[59]. Another weakness to imaginal treatment is participants are able to overwhelm themselves and find it hard to control what they are imagining [60] which can cause issues with the treatment. In vivo treatment means that people that suffer from this can still be treated. In vivo treatment also brings on stronger feelings of fear and anxiety caused by the fear stimuli for each patient.

On the other hand, in vivo treatment can also be troublesome and not be the most practical way to carry out treatment. In vivo can be an expensive form of therapy for example, Price et al. [61] explain that this type of treatment for fear of flying is not always possible due to the logistics, cost of repeat exposure in this way and the flight cannot be controlled for variables such as turbulence and delays. These issues may not be the same for all phobias, some will not cost as much as repeat flying or even a single flight, however control and logistics can be seen as issues for many types of phobias. Safir et al. [60] conducted a study to treat participants who had a fear of public-speaking in which they stated that while in vivo is better than imaginal exposure, it is also costly, time-consuming and control is limited which could mean the participant encounters people that they already know which could increase any anxiety or fear already felt. While cost, control, time and aphantasia are issues with in vivo and imaginal treatments they are not issues with virtual reality exposure (VRE)[62].

Riva [62], [63] states that the most common application of VR in CBT is in the treatment of phobias. VRE can be advantageous over both in vivo and imaginal exposure therapy as it can be far more controlled and cost effective than in vivo treatment because it can be administered in a therapeutic setting and the exposure to the feared stimuli is more controlled using VR [60]–[65]. VRE is also more advantageous to imaginal exposure as it allows for an experience that is more emotionally engaging and therefore more efficient in both habituation and extinction of the fear responses [62], [63]. There are many phobia studies that show how successful VRE can be and also suggest that it is as good as in vivo exposure treatment.

Hodges et al. [64], [65] first proposed and reported an experiment using VR and Virtual Reality Environments (VREs) in the use of phobia therapy to aid people suffering with acrophobia (fear of heights). Three environments were created; an elevator, balconies and bridges, to be used in therapy sessions with participants. The participants were split between a control group and treatment group with the treatment group being asked to attend 7 weekly meetings lasting between 35 to 45 minutes. At the end of treatment participants filled in the same questionnaire they did pre-treatment, these results were then analysed and found that, while there was no change in the pre-treatment group, the treatment groups measure of anxiety, avoidance and distress towards heights had decreased significantly. While it can be argued that this does show that VR has an effect and helped to treat phobia it is also stated that 7 out of the 10 participants in the treatment group also exposed themselves to heights in real life during the treatment which will have had some effect on these participants outcomes.[64].

Another study, which concentrated on acrophobia treatment, compared VRE to in vivo [66]. This study consisted on two groups, an in vivo exposure group and a VRE group. The key part of this study was the virtual environments created for it were of the same places in which the in vivo group visited. The findings suggested that VRE was just as effective as in vivo exposure and no significant differences were found either post-treatment or in a 6-month follow up between the groups [66]. These are not the only findings that suggest that VRE is as good as in vivo exposure, which is the current gold-standard in phobia therapy.

Wallach et al [67], in their study interested in public speaking anxiety, concluded that, while in vivo exposure and VRE significantly differed to a control group, there was not a significant difference between the two exposure groups. Then in the findings of a one year follow-up to this study, Safir et al [60] found that there were still no significant differences between the two treatment groups. This again gives strength to the argument that VRE is as good as in vivo exposure and shows that lasting effects between the two types of treatment are just as strong.

There have also been studies conducted that look into the effects of VRE in participants suffering from a fear of flying. In their review of recent research Price et al [61] found that several studies conducted therapy using VRE successfully found the results comparable to in vivo exposure. In studies interested in therapy for arachnophobia VRE was also found to be successful [68], [69] and it has also been found, once again, to be as successful as in vivo exposure [70]. These all help to strengthen the argument that VRE is as good as in vivo exposure and suggest that VR can be used to change both peoples' behaviours and their feelings towards something they may view in a negative light. Using other emotions VR could potentially be used to understand people from different outgroups and change their views on them.

2.4 Virtual Reality, Empathy and Embodiment

As outlined above, a variety of contemporary applications seek to leverage the unique ability of VR to create a sense of presence in the context of virtual facsimiles of real-world places, things and people for therapeutic ends. However, VR's potential for influencing psychological constructs such as empathy and outgroup bias have not gone unnoticed. Embodiment and perspective taking are techniques that can be used to elicit empathy within people, as will be discussed in this section. VR offers an opportunity to enhance embodiment and perspective taking and possibly therefore elicit empathy towards others, and there is the potential that VR games are also able to do this.

Perspective taking is "...the cognitive capacity to consider the world from another individual's viewpoint..." [71]. This allows people to understand other groups interests and needs, that they may not understand from their own viewpoint, which in turn elicits empathy [72]. VR may allow for a sense of perspective taking. This sense of perspective taking is often linked to empathy. There may be a link between levels of empathy and VR.

A key word in the definition of empathy, stated in <u>section 2.1.2</u> is '*imagine*'. As has been reasoned in <u>chapter 2.2</u>, <u>VR</u> is a better technique than imaginal exposure for phobia treatment and as good as in_vivo exposure [11]–[21]. It could therefore be argued that VR may be a superior approach for creating empathy within people than just imagining a situation in order for a person to sense someone else's emotions and feelings. There are a number of studies that have explored whether the use of VR can cause people to feel empathy.

In [73] Milk describes VR as "the ultimate empathy machine". Milk speaks about a documentary he made of a Syrian refugee camp titled '*Clouds over Sidra*'. The documentary was filmed with a 360 degree view and made to watch in VR. He goes on to explain that he was able to create this

documentary and then show it to people somewhere else in the world in order to try and create empathy within them and show them something they may not have otherwise seen or understood. The documentary made was much like the one used in [74].The results in [74] suggest that VR allows for a significantly greater level of empathy than a 2D format when watching a video. Participants were asked to watch a UN documentary in which a young Syrian refugee took people on a tour of a refugee camp. The control group watched this in a 2D format, and the other group watched it as a 360-degree VR experience. The findings showed that people in the VR condition experienced significantly greater empathy for the Syrian refugee and greater levels of empathic perspective taking.

Within [75] it is suggested that VR could be used to increase levels of empathy with differing outgroups such as the homeless, people who suffer from mental and physical impairments and also refugees. In the same vein as [74] participants were asked to watch a New York Times documentary about refugees called *"The Displaced"*. A 2 x 2 study was conducted which split participants into a VR condition and a non-VR condition. Within these Conditions participants were split depending on their results of a personality trait test depending on whether they had high empathy or low empathy traits.

In [76] Herrera et al carried out two studies with the aim of understanding whether this idea VR being the ultimate empathy machine was correct. In the first of the two studies two groups were compared. One of the groups took on a narrative based perspective taking task and the other were part of a VR perspective taking task. The task placed participants into the perspective of someone that has been made homeless. Results showed that participants in the VR condition reported higher levels of empathy and personal distress than participants in the narrative based condition, however after 8 weeks there was no significant difference between the two groups. However, fewer participants from the narrative based condition signed a petition supporting affordable housing, compared to the number of VR condition participants. In the second of the two studies participants were split into four groups. There was a narrative based and a VR group but also a desktop computer group and a fact driven information group. The fact driven group were asked to read statistics and information about the homeless population, the remaining three groups were taking part in perspective taking tasks. Again, the VR condition had the highest number of participants exhibiting helpful behaviour by signing the petition for more affordable housing than participants in the desktop or narrative based groups. This again shows the VR may be the "ultimate empathy machine".

Kors et al created a narrative VR game based around the 2011 nuclear disaster in Fukushima [77]. Within the game participants take on the partaker-perspective of a journalist who has to gain insights into characters that are distressed by interacting with the environment. Results found that participants that were engaged with the role-playing aspect did report more empathic states. It also appeared that participants used their own experiences to better understand the emotions of the characters within the game. The use of objects that participants interacted with were also a steppingstone for players to transfer their own experiences into the game world.

In [78] experiments were conducted to understand whether participants would be more helpful towards people who are colour blind if they experienced it themselves. Participants were split into two groups, a control group that were given a VR headset, shown images and asked to imagine being colour blind and another group that were given a VR headset with a colour-blind filter applied. Participants were then asked to volunteer as much time as they wished to help describe how example websites may not be accessible for people who are colour-blind. The results showed that the participants in the colour-blind filter applied group stayed longer and were twice as helpful as the other group which suggests the VR group of participants left with more favourable views to people who are colour-blind.

As stated in <u>section 2.1.4</u>, Embodiment refers to the belief that a person has control over another body or that another external body is part of their own [11]. Embodiment can be a powerful mechanism that is able to lead to emotional change within people. Therefore, if it is possible for people to feel that they are embodying a digital avatar, then it could be possible for this to change people's prejudice towards outgroups. This could also be true when embodying an avatar while participating in VR games. This is especially the case when perspective taking is considered as well.

In [8] Salmanowitz conducted an experiment to understand whether embodying a black person in a court setting in VR affected participants racial bias and answer to the Implicit Association Test, a response time test which examined the strength of positive and negative associations participants had towards black and white individuals. Participants were first split into two VR groups, one which embodied a virtual character and one which were placed inside the virtual world without a body.

The results in [8] concluded that participants who were in the VR scenario and embodied a black character scored lower on the IAT, which meant they had lower negative associations and racial bias than participants in other conditions. Although the difference in scores was not significant this could be attributed to the subtlety that the experiment was created with as there was no explicit means that told the participant they were playing as either a black or white character. Instead, it was only shown to them through a mirror behind a desk and if they looked at the virtual body which meant only roughly 50% of participants in the black character condition correctly remembered the race of the character. It could be argued that with stronger emphasis on perspective taking and embodiment then racial bias scores may have had a greater difference between the different conditions. Regardless of this the results do give strength to the argument that embodiment and perspective-taking in VR can affect attitudes towards out-groups.

Peck et al in [9] placed participants in a VR scenario in which they embodied a virtual character with a different skin colour. All participants in this study were white and were split into groups, one group embodied a "light-skinned" avatar, one group a "dark-skinned" avatar, another group an "alien-skinned" avatar (purple skin) and the final group did not embody an avatar but instead was placed within a virtual room with a "dark-skinned" avatar in it. Participants completed the IAT before being placed into VR and once again after completion of the VR scenario although participants were still in the VRE when asked this time.

The results in [9] concluded that participants in all three of the embodied scenarios scored significantly higher levels of embodiment than participants in the non-embodied scenario. Results from the second IAT, which participants completed after the VR scenario was completed, showed that participants within the embodied "dark-skinned" group scored lower than the other groups. Peck et al. do point out that participants levels of nervousness could have affected these scores as results indicated that some participants who felt higher levels of nervousness responded to the questions in the IAT quicker. These quicker response times are interpreted by the test as the participant having less implicit bias. However, it can be argued that these results again suggest that placing a person in VR and having them control the virtual body of a member of an out-group can affect attitudes towards the outgroup in a positive way.

However, while these studies use the IAT there are criticisms of it. One criticism is that the testretest reliability is rather poor and often a person's score will change each time they complete the test [79]. It is also possible that responses to the IAT reflect cultural stereotypes the participant has been exposed to rather than the participants own beliefs. In [80] it was found that exposing participants to new associations was enough to change their implicit attitudes but not their explicit attitudes.

Another way in which prejudice could potentially be measured is by measuring explicit attitudes. One such way of measuring this in regard to outgroups could be the use of the Modern Racism Scale (MRS) [81]. The MRS scale was developed to be less reactive and therefore have a greater validity and reliability than previous explicit measures [82]. In [83] McConahay compared results from the MRS to how willing participants would be to employ a black or white person. The results showed that the MRS has a good level of reliability, with a Cronbach's alpha score of .86. The reliability of the MRS is regularly shown to have satisfactory and good reliability and test-retest stability [84].

However, there have been criticisms of the MRS. One of the criticisms is whether the scale is actually measuring a form of modern racism or whether it was still measuring traditional racism [84]. Another criticism is whether it measures the full complexity of racism, the MRS consists of seven items and therefore it may not be enough data to understand the full picture [84]. A final criticism of the scale, and of explicit measure in general, is the social desirability of the answers that participants give [85]. This social desirability may mean that participants hide their true feelings when answering the questions and the measure is then not a true representation.

In [86] researchers conducted a series of experiments to understand whether embodiment and perspective taking of non-human entities was possible and would cause participants to change their behaviour and become involved in environmental issues. The first experiment was conducted to understand whether the feeling of embodiment would manifest when participants were put into a VR scenario in which they controlled a cow. The VR group perceived a significantly greater level of body transfer than the control group, who watched a video recording of the VR experience, and they also perceived a significantly higher level of inter-connectedness with nature. This suggests that body transfer and embodiment is possible and effective.

The second experiment which was conducted in [86] was designed to see whether participants were able to embody an even more obscure entity and understand whether they would still feel a greater sense of inter-connectedness with nature. Participants were again split into two groups, one VR group and one group that watched the VR experience on a 2D monitor. Within the experience participants were placed within a piece of coral under the ocean. To attempt to strengthen any amount of body transfer and embodiment researchers poked the participants when a fishing pole poked the piece of coral in the VR experience. Participants were also standing on a floor that had haptic feedback which as the coral body eroded vibrated. Levels of body transfer and interconnectedness with nature were again significantly greater within the VR group compared to the control group.

The third and final experiment in [86] was conducted to understand whether the coral experience would elicit the feelings of body transfer and inter-connectedness with nature without any haptic feedback or being poked by the researcher. Even without these pieces of feedback participants within the VR condition perceived significantly higher spatial presence and felt significantly greater levels of body transfer than participants within the video condition. These series of experiments show how powerful VR can be in allowing participants to feel as if they have embodied not only another person but a completely different living organism.

There are several more studies that show that VR can be used to increase empathy towards others through embodiment and perspective taking. In [87], a pilot study which aimed at caregivers for people who suffer from dementia, results showed that after the VR exposure participants reported a better ability to empathise with their patients.

2.5 Summary: VR and outgroup biases

The literature review that has been undertaken makes it clear that consumer VR is in increasing demand and that VR can be used to change peoples' behaviour, create a sense of empathy through embodiment and reduce prejudice in outgroups.

In <u>section 2.2</u> it is discussed that consumer VR is becoming increasingly common with an increase in spending on VR hardware and software happening year on year and forecast to rise within the coming years [15], [16], [48]. The sense of presence that can be created using VR can be a powerful tool that can be used to elicit emotion within users [14], [53]. With this increase in consumer VR and the power of presence it is clear that the effects of VR gaming need to be researched and the potential effects need to be understood.

However, while there is a lack of research within VR gaming, there is research that has looked into the effects VR experiences can have on peoples' behaviour and emotion[8], [9], [64]–[70], [74], [75], [86]. The APA [56] state that VR can be used in exposure therapy as a way to treat patients to any phobias they may have. Results from several studies show that VR is successful in treating different types of phobias and is able to change peoples' behaviour and emotions when confronted with one of their fears [64]–[70]. A number of these studies show that VR is as good as in vivo treatment.

VR is able to elicit empathy towards outgroups within people through perspective taking. It allows people to have a better understanding of outgroups, the ways in which they live and problems they may face and this understanding and perspective-taking can lead to increased empathy towards these outgroups [74], [75], [78]. There is one more mechanism that VR can enable which may lead to VR games being able to reduce prejudice, embodiment.

Embodiment is an mechanism that VR enables and can have powerful effects on participants. As discussed in <u>section 2.4.1</u> embodiment is the belief that a person has control over a different body or an external body. This belief has been shown to create empathy, create a feeling of inter-

connectedness and also reduce prejudice towards outgroups in a number of studies [8], [9], [86], [87]. It is possible then, that VR games may also have the same effect.

Therefore, firstly a study needs to be conducted in understanding whether there are already mechanisms within VR games that may have the effect of reducing prejudice towards outgroups. More specifically an understanding of whether or not VR games already facilitate contact, cooperation and embodiment is needed.

However, it is important to note that the literature on the impact of contemporary VR lack two key components with regards to prejudice reduction:

- 1. There is currently no knowledge of the prevalence of the three key mechanisms (contact, cooperation and embodiment) within popular VR games.
- 2. Whilst there is literature on VR and attitudes there is a lack of literature that has looked to see whether these mechanisms are able to reduce prejudice within VR games specifically.

Chapter 3 Study 1: How many popular VR games afford key prejudice reduction mechanisms? A content analysis of the Steam Store

The main aim of this study was to understand whether the most popular VR games on the Steam Store enable any of the following mechanics for prejudice reduction; embodiment, contact or cooperation. The reason why the study concentrated on positive uses of these mechanics was because it was carried out to understand if these games enabled prejudice reduction.

As outlined in the literature review, different forms of interaction with outgroups may affect the attitudes towards those outgroups. More specifically, situations that enable **embodiment** of a member of an outgroup may lead to an increased ability to empathise with the outgroup and also lead to a decrease in negative association and bias against the outgroup (see <u>section 2.4.1</u>); situations that enable **contact** with an outgroup may lead to an increase in empathy and therefore have a positive impact on attitudes towards the outgroups (see <u>section 2.1.2</u>); and situations that enable **cooperation** suggest that the act of working cooperatively with an outgroup member may lead to more favourable views upon the outgroup (see <u>section 2.1.1</u>).

Should VR games provide these affordances, they have the potential to have a non-trivial effect on attitudes towards outgroups amongst gamers. For example, the implementation of co-operative play with outgroups in a first-person shooter game may provide the ability for that game to lessen outgroup prejudice.

Furthermore, how outgroups in VR games are represented may have a variety of potential effects on players. More specifically 9 types of representation were assessed within this content analysis (see <u>section 3.3.2.)</u>. These representations were chosen because they allow for both negative and positive representations to be assessed, this will allow for a clear comparison to understand how BAME and white characters are represented and draw comparisons as to how negative or positive their representation appears to be. The character types assessed are also common throughout different genres of game and mean that it is possible to measure games regardless of their genre. For example, a multiplayer only game may not have a protagonist but will have multiplayer characters. Overall, the 9 types of representation that were chosen allow for flexibility across genres of video games, as several types of genres appear in the top VR games on the Steam store, and allow for comparisons to be made between positive and negative representations within those games.

However, whilst the VR gaming market is currently booming (see <u>section 2.2</u>), it is unclear how outgroups are represented in VR. Because of this, it is unclear whether these situations really do

commonly appear in VR games. It is therefore also unclear how VR games may potentially affect attitude formation with reference to outgroups.

3.1 Aim

A conceptual quantitative content analysis [88] was carried out to understand how many of the most popular VR games on the Steam Store enable any of the mechanisms of contact, cooperation or embodiment.

The main aim of this content analysis is therefore to understand how many of the most popular VR games on the Steam Store enable any of the mechanisms for prejudice reduction. More specifically, this was operationalised by investigating the representation of BAME characters and their roles within these games and how this compares to white characters within the same games.

As noted above, this aimed to not just chart the absolute amount of representation, but also whether that representation afforded the potential for either **embodiment**, **contact** or **cooperation** with these outgroups. There has not previously been a content analysis that looks at this, therefore the analysis here will give an initial understanding of these specific mechanisms within VR games.

White and BAME characters were the focus of the content analysis. These groups were chosen because racism and negative views towards BAME groups appear throughout society. These groups were also chosen due to racist behaviour the researcher has seen targeted towards people he has a close relationship with. The second reason these groups were chosen was because they appear within many popular video games, which can be seen in the games used in this content analysis. Due to these two reasons white and BAME groups were the focus, however due to the nature of the research, in future content analysis different groups could be analysed.

3.2 Method

3.2.1. Design

A list of the top 100 VR games on Steam that featured identifiable human characters was made. This list was generated by iterating through a list of all VR games on Steam, ranked by number of players. Overall, a list of 100 VR games with identifiable human characters was reached after iterating through the top 312 VR games on Steam. Formal criteria for inclusion within this list are given in <u>section 3.2.5</u>.

After the creation of this list, each game was analysed and coded to indicate whether it included any of the following mechanisms with reference to BAME characters:

- 1. Whether the game afforded the opportunity for **embodiment** with BAME characters
- 2. Whether the game afforded the opportunity for cooperation with BAME characters
- 3. Whether the game afforded the opportunity for **contact** of BAME characters

It is also unclear what types of roles BAME and white characters are given in VR games. For that reason the games were also analysed for the following forms of representation of BAME and white characters:

- 4. Whether the game contained BAME and/or white protagonists
- 5. Whether the game contained BAME and/or white antagonists
- 6. Whether the game contained BAME and/or white playable characters
- 7. Whether the game contained BAME and/or white story characters
- 8. Whether the game contained BAME and/or white side characters
- 9. Whether the game contained BAME and/or white multiplayer characters
- 10. Whether the game contained BAME and/or white non-interactive NPCs
- 11. Whether the game contained BAME and/or white friendly characters
- 12. Whether the game contained BAME and/or white enemy characters

3.2.2. Measures

In order to categorise the data that was analysed in these games a combination of resources was used, including Steam, YouTube and Twitch. More information on this can be found in <u>section 3.2.3.</u>

A specific overview of criteria for coding all variables for all games are given below.

3.2.2.1. Criteria of Mechanisms

Embodiment: A game was defined as featuring the embodiment of a BAME character if: (a) it was clear to the player that the character was BAME, (b) the player perspective was first person, and (c) the character was controlled by the player. A game was defined as featuring the embodiment of a white character if: (a) it was clear to the player that the character was white, (b) the player perspective was first person, and (c) the character was controlled by the player that the character was white, (b) the player

Cooperation: To be defined as featuring cooperation with BAME characters, the criteria a game must have met were: (a) the character(s) within the game helped the player to complete a task or

objective, and (b) it was clear to the player that the character(s) was BAME. For a game to be defined as featuring cooperation with white characters the criteria were: (a) the character(s) within the game helped the player to complete a task or objective, and (b) it was clear to the player that the character(s) was white.

Contact: A game was defined as featuring contact with BAME characters if: (a) the character was BAME, (b) the contact was positive and (c) the contact did not lead to any cooperation with a task or objective.

3.2.2.2. Measure of BAME/white character roles

Protagonist: A game was defined as containing a BAME protagonist if both of these things were true: (a) the leading character of the main story in the game was BAME, and (b) that character was controlled by the player. A game was defined as containing a white protagonist if both of these things were true: (a) the leading character of the main story in the game was white, and (b) that character was controlled by the player.

Antagonist: A game was defined as containing a BAME antagonist if: (a) the main antagonist character of the story in the game was BAME, and (b) the character was the main enemy of a player-controlled protagonist. A game was defined as containing a white antagonist if: (a) the main antagonist character of the story in the game was white, and (b) the character was the main enemy of a player-controlled antagonist.

Playable character: A game was defined as containing a BAME playable character if: (a) the character was BAME, (b) the character was controlled by the player, and (c) the events in the game did not take place within a story. A game was defined as containing a white playable character if: (a) the character was white, (b) the character was controlled by the player and (c) the events in the game did not take place within a story.

Story character: A game was defined as containing a BAME story character if the following criteria was met: (a) they were a BAME character, (b) it was a non-playable character (NPC), and (c) the player had to interact with this character to continue the games story. For a white story character, the criteria were: (a) the character was white, (b) it was a non-playable character, and (c) the player had to interact with this character to continue the games story.

Side character: The criteria for a game to have been defined as having a BAME side character was: (a) the side character is a member of the BAME community, (b) the character is an interactive NPC that the player does not have to interact with to complete the game, and (c) if the player did interact with this character, they would offer a mission or may give extra details about the story. To be defined as having a white side character the criteria to meet was: (a) the side character is white, (b) the character is an interactive NPC that the player does not have to interact with to complete the game, and (c) if the player did interact with this character, they would offer a mission or may give extra details about the story.

Multiplayer character: For a game to be defined as having BAME multiplayer characters the following criteria had to be met: (a) the character was BAME, and (b) the character was controlled by a different player. To be defined as having white multiplayer characters the criteria were: (a) the character was white, and (b) the character was controlled by a different player.

Non-interactive NPC: For a BAME non-interactive NPC to be marked as in a game the criteria were: (a) the character was BAME, and (b) the character was visible in the game, and (c) the player could not interact with them. The criteria for a white non-interactive NPC to be marked as in a game were: (a) the character was white, and (b) the character was visible in the game, and (c) the player could not interact with them.

Friendly character: A game was defined as having a BAME friendly character if: (a) the character was BAME, (b) the character helped the player with a task or objective, and (c) the character does not fit under any other definition. A game was defined as having a white friendly character if: (a) the character was white, (b) the character helped the player with a task or objective, and (c) the character did not fit under any other definition.

Enemy character: A game was defined as having a BAME enemy character if: (a) the character was BAME, (b) the character attempted to stop the player completing their task or objective, and (c) the character did not fit under any other definition. A game was defined as having a white enemy character if: (a) the character was white, (b) the character attempted to stop the player completing their task or objective, and (c) the character did not fit under any other definition.

3.2.3. Procedure

In order to analyse the games for the criteria set out above, data was collected for each game in our list regarding the representation of both white characters and BAME characters.

In order to determine whether each game contained the 12 kinds of content outlined in <u>section</u> <u>3.2.5</u>, <u>each</u> game was initially coded for the presence or absence of these features by the author of this manuscript. The reliability of this coding was then tested by having a second researcher independently code this data in the same manner. The degree of agreement between coders was formally tested through the computation of Cohen's kappa.

In order to code each of the 100 games for the presence of the 12 features under test, researchers did not follow a pre-specified process, but instead were free to look at a mixture of content from Steam, YouTube and Twitch. Steam hosts a limited number of videos and in-game screenshots on the store pages and allows for discussion of games. YouTube and Twitch are used throughout the gaming community to host walkthroughs and gameplay videos and a larger number of videos can be found on these services. Watching these videos and analysing the discussion meant that it was possible to collect data regarding the variables that were to be coded.

Indeed, in many cases both walkthrough and gameplay videos on YouTube can be found that allow viewers to watch a player play through the entirety of a game. This is frequently also the case on Twitch. This allowed accurate data collection as the videos show both the gameplay sections of a game and cutscene sections of a game. These videos showed the role and relationship characters had to the player character and helped to show any twists in the story during the game that may have involved certain characters.

3.2.4. Reliability Testing

A reliability test was undertaken on the whole data set with a second researcher, who independently coded this data using the same criteria and in the same manner. Cohen's kappa was used to test the agreement between both coders. In this case Cohen's kappa was scored at 0.83, indicating excellent agreement between coders. Any disagreements between coders were resolved through discussion.

3.2.5. Exclusion criteria for games

A final note must be made to make it clear why specific games were not included in our list of the 100 top VR games on Steam that contained identifiable human characters. An initial stage of analysis involved parsing all VR games on Steam to determine whether any were early access titles, beta versions, pre-orders, toolkits or utilities.

If any of the games listed fell into any of these categories, they were removed from the study. Early access, beta versions and pre-orders were not included because the full release version of the game is not available to play. The rationale for this exclusion was as follows: Early access and beta versions of games may have characters or mechanisms changed or added by the time the full release is
available and pre-order titles are not playable until they are released. Of the 312 games scanned, 62 were not included in the formal content analysis for this reason.

After these pieces of data were collected the next step was to determine whether there were human characters in a game or not and exclude games that featured no human characters at all. There were a number of games on the list that did not feature any human characters and instead either featured characters that were not human, these could have instead been alien characters or in some instances animals, or no characters at all. The games that did not feature human characters were then removed from the content analysis as they were of no interest to the research being carried out. Of the 312 games scanned, 124 were not included for this reason.

Finally, it is important to note that there are a number of games on Steam that included human characters, however it was impossible to know the ethnicity of these characters. This was due to never seeing the character themselves without them wearing full body clothing. An example of this can be found in racing games, in these games the player is playing as a human character and racing against other characters but they never see the ethnicity of these characters due to them wearing clothing that covers every part of their body and wearing helmets that cover their head. These games were then removed from further data collection with the rationale that the ethnicity of characters was needed and required to be determinable in order to meet the aims of this content analysis. Of the 312 games scanned, 26 were not included in the formal content analysis for this reason, leading us to our final set of 100 games. A list of these 100 games can be found in the appendix.

3.3 Results

Of the 100 games 68 were VR only games, meaning that they required some form of VR headset to be played. The further 32 games merely had support for VR, meaning that they are playable both with a VR headset and on a traditional screen such as a monitor.

Furthermore, 51 of the 100 (51%) games featured a black, Asian or minority ethnic character and 88 of the 100 (88%) games featured a white character. Table 1 (below) shows the percentage of games in which BAME and white characters are represented within specific roles.

Mechanisms

	BAME (proportion	BAME	White (proportion of	White
	of 51 games with	(proportion of	88 games with white	(proportion of
	BAME characters)	100 games in	characters)	100 games in
		total)		total)
Embodiment	20/51 (39.22%)	20/100 (20%)	58/88 (65.92%)	58/100 (58%)
Cooperation	20/51 (39.22%)	20/100 (20%)	32/88 (36.36%)	32/100 (32%)
Contact	35/51 (68.63%)	35/100 (35%)	50/88 (58.82%)	50/100(50%)

Table 1: Shows the proportion of games that featured the any of the three mechanisms of interest; embodiment, cooperation or contact.

Roles

	BAME (proportion	BAME	White (proportion	White
	of 51 games with	(proportion of	of 88 games with	(proportion
	BAME characters)	100 games in	white characters)	of 100 games
		total)		in total)
Protagonist	15/51 (29.41%)	15/100 (15%)	44/88 (50%)	44/100 (44%)
Antagonist	6/51 (11.76%)	6/100 (6%)	15/88 (17.05%)	15/100 (15%)
Playable Character	10/51 (19.61%)	10/100 (10%)	18/88 (20.45%)	18/100 (18%)
Story Character	25/51 (49.02%)	25/100 (25%)	29/88 (32.95%)	29/100 (29%)
Friendly	9/51 (17.65%)	9/100 (9%)	17/88 (19.32%)	17/100 (17%)
Enemy	16/51 (31.37%)	16/100 (16%)	23/88 (26.14%)	23/100 (23%)
Side Character	12/51 (23.53%)	12/100 (12%)	14/88 (15.91%)	14/100 (14%)
Non-Interactive	15/51 (29.41%)	15/100 (15%)	26/88 (29.55%)	26/100 (26%)
NPC				
Multiplayer	7/51 (13.73%)	7/100 (7%)	16/88 (18.18%)	16/100 (16%)
Characters				

Table 2: This table shows the percentage of games that feature BAME characters and white characters in specific roles.

Section 3.3.1 Examples of Roles

Within this section are examples of games in which the character types can be found.

Protagonist: Examples of games that feature protagonists are *The Elder Scrolls V: Skyrim, Half-Life: Alyx* and *Westworld Awakening*. In each of these games the player controls the leading character within the game that features a story which revolves around that character.

Antagonist: Examples of games that feature antagonists are *Half-Life: Alyx, The Forest* and *Borderlands 2 VR.* Each of these games include an antagonist who is the main enemy of the player-controlled protagonist.

Playable Character: Examples of games that feature playable characters are *Surgeon Simulator: Experience Reality, Vacation Simulator* and *First Person Tennis – The Real Tennis Simulator*. Within these games the player is not part of a story and instead they are experiences with no over-arching story. For example, playing in a tennis match in *First Person Tennis*.

Story Character: Examples of games that feature story characters are Half-Life: Alyx, The Elder Scrolls

V: Skyrim and *Borderlands 2: VR.* In these games the player must interact with these characters in order for the story to advance, for example, these could be characters giving the next story mission or bosses they have to defeat. Another important feature of story characters is that they are not playable, in other words, the player does not play as these characters.

Friendly: Friendly characters can be found in games such as *Elder Scrolls V: Skyrim, The Walking Dead: Saints & Sinners* and *Fallout 4: VR.* In this games characters appear only to aid the player in completion of a mission or objective. In *Elder Scrolls V: Skyrim,* for example, characters appear that will help the player to kill a dragon and can be seen aiding the player in doing so, however the playr cannot interact with them.

Enemy: Enemy characters can be found in games such as *Payday 2, GORN* and *Fallout 4: VR*. Characters that are classed as enemies are they to attempt to stop the character completing their objective. For example, in *Payday 2* a player's objective could be to rob a bank. Enemies will then spawn in order to actively stop the player from doing so. These characters do not interact with the player in any other way other than trying to stop them.

Side Character: Examples of side characters can be found in *The Forest, The Elder Scrolls V: Skyrim* and *Fallout 4: VR.* These games include multiple side characters which the player has the choice to interact with. If the player decides to interact with these characters, they may give optional side quests or offer some conversational dialogue to the player. Interacting with these characters is completely optional and down to the player as to whether they interact with them or not.

Non-Interactive NPC: Examples of non-interactive NPCs can be found in games such as, *The Elder Scrolls V: Skyrim, Gorn* and *L.A. Noire: The VR Case Files*. Within these games there are characters which the player can see but is unable to interact with, these could be spectators in a crowd or characters that are found in game and programmed to carry out a certain task which the player cannot interact with and can only observe.

Multiplayer Characters: Multiplayer characters can be found within games such as *Payday 2, Star Trek: Bridge Crew* and *The Forest VR*. These games facilitate the opportunity to play alongside other people, and these other people control characters within the game. For example, in *Payday 2,* players have the opportunity to play with a group of 3 other players each controlling a separate character. These characters would therefore be classed as multiplayer characters.

3.4. Discussion

3.4.1. Affordances for attitudinal changes towards outgroups

In this section the results for the mechanisms found within VR games will be discussed. These results can be found in Table 1. As can be seen from the results 39.22% of games which featured BAME

characters featured embodiment, compared to 65.92% of games featuring white characters. There are reasons certain reasons why there is such a difference. The first reason is that there are simply a larger percentage of games that feature white characters. More specifically, a larger number that feature white characters in a protagonist role (29.41% vs 50%). In VR games that feature protagonists it is often the case that players are embodying them; *The Forest, Rise of the Tomb Raider* and *Arizona Sunshine* are examples of games that feature white protagonists that the player embodies. On the other hand, there are a small number of games, such as *Half-Life: Alyx* that have the player embody a BAME protagonist.

However, there are also a number of games on this list that do allow you to pick or customise the character that you can embody, and these games were coded as featuring embodiment of BAME and white characters. Games such as *The Elder Scrolls V: Skyrim, Fallout 4 VR* and *Payday 2* allow players to either customise their character or pick between BAME and white characters. This combination of games that allow players to pick or customise a character and the number of games that feature white protagonists mean there is simply more opportunity for players to embody white characters.

While there is a number of games which feature BAME characters that also allow embodiment of these characters, it may be that players of these games do not take up that option. It is possible that, when playing games that allow customisation or options players may not choose the BAME character. Previous research has indicated that people pick avatars that match their own identity [89], [90]. However, the results show that 39.22% of these games already afford one of the key mechanisms.

The final possible reason that embodiment of BAME characters is lower than white characters, is that BAME characters appear to be used in different ways within games. BAME characters appear to feature as side and story characters, rather than being protagonists, playable characters or multiplayer characters.

When comparing games that feature BAME characters and games which feature white characters we can see that the percentage of games which afford cooperation is similar; 39.22% and 36.36% respectively. The percentages of both appear to be similar for cooperation due to the way in which BAME and white characters are used within games outside of the protagonist role. This also that if players play VR games that feature BAME characters they are just as likely to have to cooperate with these characters as they are in games which feature white characters.

It also means that 39.22% of games which feature BAME characters are potentially affording prejudice reduction through cooperation. This is a substantial percentage of games allowing this affordance and could potentially mean that 39.22% of games that feature BAME characters are able to affect attitudinal change towards outgroups.

The results also indicate that 68.63% of games involving BAME characters feature positive contact with BAME characters. A significantly larger percentage of games with BAME characters feature this key mechanism. The reason this percentage is larger for contact compared to cooperation and embodiment is due to the roles of these characters within the game. Simply, more games featured characters that afforded contact, than they had characters that afforded cooperation or embodiment.

For example, in *The Elder Scrolls V: Skyrim VR* there are BAME characters that the player may come into contact with outside of missions and have a brief chat with. These specific characters do not help the player complete a mission or objective.

However, as this study only coded for positive contact, there could potentially be a number of games that featured negative contact with BAME characters. There are other factors within specific games that may affect this. One of which may be the enemy that is being shot at. A player having to shoot or 'kill' an enemy who is a member of an outgroup may have the potential to lead to more negative attitudes. Allport states in [3] that contact should be positive and this idea of positive contact leading to a more positive attitude has been strengthened by more studies in the area [10], [39]. It could be argued that shooting members of an outgroup within a game is not a form of positive contact and would therefore not have the same effect on attitudes. This negative contact would need to be looked at in future work, as well as how this contact within VR games may affect attitudinal change towards outgroups. However, a large amount of VR games contains positive contact, which may lead a positive attitudinal change towards outgroup through this positive contact.

Embodiment, contact and cooperation are mechanisms that have been shown to increase empathy, as stated in <u>chapter 2.1.</u> This could potentially mean, if these mechanisms also have the same effect in VR games, then VR games already available may causing an attitudinal change towards outgroups within these games' players.

As stated in <u>section 3.1,</u> the main aim of this study was to understand whether the most popular VR games on the Steam Store enable any mechanics for prejudice reduction, more specifically embodiment, contact and cooperation. It is clear from the results in this study that popular VR from

this store front do afford the opportunity of these mechanisms to the players of these games. Therefore, it may be possible that current VR games are affecting attitudes towards outgroups.

3.4.2 Representation of BAME characters in VR games

The character roles that were analysed during this content analysis (definitions of all character types can be found in <u>section 3.2.2.2.</u>) were useful to help understand the types of representation of BAME and white characters in VR games. Firstly, the character roles allowed for an understanding of how the mechanisms of embodiment, contact and cooperation was implemented within the games. Secondly, the character types meant that we could measure whether there was any difference in the opportunity for players to come across white or BAME characters in more positive roles or more negative roles. However, any potential impacts of this representation must be contextualised with reference to both (a) how these characters are represented in-game and (b) what interventions these games afford (contact, cooperation, embodiment).

An interesting result of this content analysis is the number of games, which from the list of 100 analysed, feature BAME characters. Of the 100 top VR games on Steam that were analysed, just over half (51/100) contained BAME characters. While no conclusions for the reason of this can be made, it could be an area of further work to find out why this is the case. It may be that the developers of VR games range in ethnicities or it could be due to tokenism. Tokenism is the just a symbolic act [91], in this case a symbolic act of adding BAME characters to a game. It means that while these games may include BAME characters, it does not mean that these characters avoid negative stereotypes or have any positive impact into the players' experience and instead may be included just for adding some diversity to the characters within the game.

29.41% of games featured a BAME character used BAME characters in a protagonist role compared to 50% of games featuring a white character. This is significant because it means that there is opportunity for more BAME protagonists within games. If there were the same or closer number of games that featured BAME characters in this role there is potential and increased possibility that attitudes towards these outgroups could be positively changed. However, as the number of games that included BAME characters as protagonists is fairly low there is the possibility that players' simply are not playing those games and this potential is simply being bypassed, as players do not have the opportunity. On the other hand, this does mean that is 29.41% of the games analysed allow

players to have the opportunity to play through a story as a BAME protagonist. This could potentially mean that these games are facilitating a reduction in prejudice within the player base.

Similarly, almost half of games that contained BAME characters used these characters as story characters. This once again potentially means that if VR games are able to reduce prejudice there is a possibility that they may already be doing so by having this contact with story characters in VR games already available: For example as players of these games play through them and the story progresses the player is able to build a type of relationship with these story characters, as they begin to understand their personality and understand the backstory of these characters as they have contact with them. This contact may cause the player to feel empathy towards these characters and therefore reduce prejudice towards the outgroup the character belongs to.

While the results indicate that there is a large difference between protagonists and story characters featured within games being BAME or white characters there does appear to be smaller differences between other roles. Side characters are defined within our content analysis as interactive NPCs within a game that the player does not have to interact with to continue and could finish the game without ever interacting with them. For example, Skyrim is a large RPG game in which there are hundreds of characters to talk to, however, to complete the main story of the game you do not have to talk to all of the characters and instead may choose to talk to them or not even know the character exists.

The results from the content analysis showed that these side character roles were filled by BAME characters in 23.53% of games that featured BAME characters, whereas they were filled by white characters in 15.91% of the games that featured white characters. However, this is not a large difference and this could potentially be due to the diversity of developers involved in these games. Furthermore, given the optionality of interaction with side characters, the potential impact of this feature on gamers is unclear.

Overall, it appears from the results, that games feature BAME characters in a variety of character roles that are both positive and negative. However, what these character roles do not consider is other factors that could influence the potential effects any of the mechanisms may have on attitudinal change.

One of these factors could be the dialogue that occurs between characters within the game and the player. If the dialogue is positive, then it may be more likely to have a positive attitudinal change. In [3] it is stated that contact of a positive nature is needed to have a positive change in attitudes towards outgroups. Dialogue, in this study, was out of scope however this is an area that needs to be

better understood. In some cases, it may not be enough to just have differing ethnic groups in certain roles and instead dialogue needs to be taken into account as well.

Another factor that could have an effect is the amount of time spent with a character. It may be that the more time players spend with BAME characters in game, the more their attitudes change. The amount of exposure that people have to outgroups could lead to a bigger change in attitudes towards that outgroup. For example, if a BAME character within a game was a repeating character or a character that players spent a lot of time with then it is possible that the players attitudes towards the outgroup the character belongs to would change. While the content analysis has led to understanding of the roles of which BAME characters are found there are some questions left unanswered.

3.4.3. Limitations

In order to be as clear as possible, key limitations are explicitly listed here. Future work presented by both of the studies is discussed in <u>section 5.4.</u>

While the study is able to give some understanding as to whether VR games include mechanisms that could lead to positive attitudinal change, the main limitation is that it is unable to answer questions based on who is playing the games and how they affect attitudes, if at all. Understanding the people of play these games would help to develop a better understanding of whether it is members of differing outgroups playing games that involve these potentially attitude changing mechanisms. Also, if that is the case further studies need to be conducted to understand whether these mechanisms within VR games are able to positively change attitudes.

One of the limitations of the content analysis is the number of games analysed. While 100 games were analysed, searching the Steam store for games that have been tagged as including VR yields 2,165 results at the time of writing. Only 4.6% of these games were included in the content analysis. This could mean that had more games been included, the results may show something different. However, while it is a limited sample it focuses on the most popular games on the Steam Store that also fit the criteria of the content analysis. For example *Half-Life: Alyx,* one of the most popular VR games on Steam, averages around one thousand players every day [92]. However, on a game such as *Saber Fight VR* or *The Great C,* games that were outside of the games used in the content analysis average less than 5 daily players [93], [94].

Another limitation of the content analysis may be the decision not to include early access titles. These were excluded from the analysis because they are not feature complete and that could mean that while embodiment, contact or cooperation is not in those games at the moment, when the game is fully released it may feature one or more of these mechanisms within the game. However, this also means that there may be early access titles that do already feature these mechanisms. Some of these titles are popular as well and did appear in the 212 titles that were excluded from the content analysis. For example, *Blade & Sorcery* and *Hot Dogs, Horseshoes & Hand Grenades* are early access titles that appeared in the top 35 VR games on Steam at the time the content analysis was conducted. Including these early access titles may have led to a difference in results.

A final limitation of the content analysis was that it concentrated only on BAME groups. Other potential outgroups could be analysed within these same games, for example religious groups and LGBTQ+ groups. Currently, no comments can be made around whether VR games allows for any of the key mechanisms to take place regarding these outgroups.

Chapter 4 Study 2: The impact of embodiment in a VR game on explicit racial bias

As highlighted in Chapter 3, VR games commonly afford interactions with outgroups. One may speculate that this may potentially afford the opportunity for VR games to influence attitudes towards those outgroups.

More specifically, 39.22% of the top VR games on the Steam market with identifiable human BAME characters allow players to embody BAME characters. Embodiment has been shown to have important effects on prejudice formation in a variety of real-world contexts, which leads to greater levels of empathy within people and therefore a greater awareness of an issue or a change in prejudice (See <u>section 2.4.1</u>). The literature on virtual reality suggests that the sense of presence afforded by VR environments allows them to affect individuals in a similar way to the real-world, and in a qualitatively different way to traditional, screen-based media (see <u>section 2.3</u>).

However, at present it is unclear whether embodiment effects really do operate more strongly in VR games than in traditional screen-based games.

4.1 Aim

The main aim of this study is therefore to understand whether playing a five-minute VR game that allows players to embody a black avatar has more effect on participants attitudes to outgroups than playing the same amount of time in a non-VR version of the same game. The candidate attitudinal measure used in this study is explicit racial bias.

4.2 Hypothesis

H1: White participants who embody a black avatar in a short VR game will exhibit reduced explicit racial bias when compared to white participants who played a non-VR version of the same game.

4.3 Design

An experiment was conducted with a between-participants design. Two versions of a game were created, one version to be played in VR and the other to be played more traditionally on a screen in

front of the participant. In both of these games' participants embodied a black avatar. Participants were randomly assigned to play either the VR or the non-VR game for 5 minutes. After play, explicit racial bias was measured via administration of a variant of the Modern Racism Scale

4.4 Procedure

A priori power analysis indicated that 176 participants were needed in order to detect a medium effect with symmetric 5% false positive and negative error rates.

The original procedure for the experiment had to be changed due to Covid-19. Originally, university students would have been recruited as participants, primarily Computer Science and Psychology students, who would have been asked demographic questions and taking to a room in which they would be able to be placed into VR and play the game. Creating the experiment to be conducted in this way meant that participants themselves did not need VR headsets as they would have been placed inside a specific headset that would be used to play the game. However, due to Covid-19 the experiment had to be quickly adjusted to work online in some way. This presented some barriers to entry that otherwise would not have been there such as participants needing their own equipment, people trusting that the download was safe and people wanting to take part in a VR game as part of an experiment when they potentially have many other options available to them.

Participants were instead recruited online via advertisement links placed on both the "r/virtualreality" boards on Reddit. Advertisements for the experiment asked potential participants whether they would take part in a short experiment that started with playing a game followed by a questionnaire. Advertisements stated that the researcher was part of the University of York and undertaking this study as part of a Masters by Research course.

Participants then clicked through to the link in the Reddit post they were then taken to Qualtrics and presented with a consent form. After this section participants were asked a series of demographic questions, including a question asking which ethnic group they identified as being a part of. If participants identified as white, then they were then allowed to continue with the experiment. However, if participants identified as being part of an ethnic group other than white the experiment was then ended. This was due to the data only being required when participants identified as white as the experiment was designed around the potential for white people to embody a black avatar.

Participants were then instructed to click through to a webpage that contained the download file for the game. The download was automatic and simply gave the participants the executable file for the game and were asked to run this file when the download had finished. Participants were asked to run the file. When the game had loaded participants that were playing the game in VR were notified to put their headset on and were able to start the game once they had done so. Participants that were playing on a traditional screen did not get this notification and were able to start the game straight away.

Following gameplay, participants were automatically given the Modern Racism Scale to fill out via Qualtrics.

4.5 The Game

The game took the form of a wave shooter, these types of games are popular among the VR community. *Serious Sam VR: The Last Hope, GORN and Arizona Sunshine* are examples of wave shooter games that appeared in the top 100 list that was created for the content analysis conducted in the first study.

The game was played with a first-person view. This was decided because many games within the 100 games that were analysed in the content analysis used this view, adding ecological validity to the created game. Games such as *Half-Life: Alyx, The Elder Scrolls V: Skyrim VR, Payday 2, Vacation Simulator* all use a first-person perspective, as well as wave shooter games such as *Serious Sam VR: The Last Hope, Arizona Sunshine* and *GORN*. This first-person perspective adds a layer of ecological validity to the created game. Not only, do these examples use a first-person view but they were also found in the top 100 games used in the content analysis in Study 1.

Another reason for the first-person perspective is that experiments that have been previously conducted to understand a link between VR and empathy have also used a first-person perspective as can be seen in <u>section 2.3, section 2.4</u> and <u>section 2.4.1</u>.



Figure 1: Shows the mirror reflecting the avatar that was embodied by participants.

It took 5 - 7 minutes for the game to be completed. Previous VR studies lasted for a similar amount of time [74], [75]. A second reason for this time is that participants of the experiment may be susceptible to VR sickness. There are many reasons that people may suffer from VR sickness, such as age and experience with VR [95] and one way that VR sickness can be prohibited is by spending less than 10 minutes within it [96]. When designing the VR game the possibility that participants had not previously experienced VR or had little experience of it needed to be taken into account as participant well-being is important.

The game itself was created Unity and the SteamVR plugin. The SteamVR plugin is compatible with many different devices and meant that the game could be played using any of the most popular VR headsets. This was important when COVID-19 forced a change to run the experiment online, as it meant participants could play the game no matter the headset they were using.

When the game starts players are given time to look around the environment and to get used to being in the virtual world. This is especially important for participants that play in VR as it allows these participants to get comfortable wearing their headset and become used to the virtual environment, they were then part of. Also, following the original plan to conduct the experiment there could have been participants first use of VR, in which case some time for them to feel comfortable both, wearing a VR headset and being comfortable within a virtual environment was important, and giving them this time would help with that.

As participants looked around in the virtual environment, whether in VR or not, they were able to see a mirror directly in front of them (see figure 1). The mirror was the first thing that participants were presented with when the game started, this meant that participants could not miss the mirror. Participants also had to 'shoot' the mirror to start the game, again this meant that participants were forced to see the mirror. The mirror was a feature implemented in the game as it meant that participants would be aware of the avatar they were controlling and would be able to see their movements controlling the avatar. This was to try and make it clear to participants the ethnicity of their avatar and also to try to invoke some feeling of embodiment. This technique has been used in previous VR studies such as [9].

After participants were given sixty seconds to become comfortable, dialogue appeared on the screen explaining to participants that they were playing as the avatar, this again was used to help solidify the belief of embodiment. The dialogue was written as if the avatar was talking directly to the participant and through this dialogue participants were told what to expect when playing the game and how to play.



Figure 2: Shows one of the abstract objects that players had to destroy.

The gameplay and the dialogue remained the same in both versions of the game. The only differences between the two were based around the controls. In the traditional version of the game that was created to be played on a 2D screen the gun and camera were controlled by the participant's mouse. Mouse movement was used to control where the gun was pointing. This movement also affected where the camera was looking as the two were connected so that that the camera was always pointing in the same direction as the gun. The left mouse button was also used to 'shoot' the gun, when clicked the gun would 'shoot' a laser wherever it was aimed at. The game was created with these controls as it follows common control schemes in many games that are played using a mouse. However, these controls differed in the VR version of the game.

The objects that players had to target were abstract objects, such as the one if figure 2. The reason abstract objects were included was to avoid the potential for participants to feel that they were causing harm to another person.



Figure 3: The pink laser that was emitted when players shot at the targets.

The controls in the VR version, instead of following a common traditional control scheme, followed common control scheme in many first-person VR games. The camera was controlled by the movement of participants headsets, this means that the camera is moving along with participants head movement. The control of the gun also differed compared to the traditional version of the game. The gun was mapped to a VR kits controller which allowed participants to hold the controller in the real world and the movements of this controller were shown in-game by the movement of the gun. For example, if a participant moved the controller to the right and changed the angle of the controller.

After depletion of the time limit a notification popped up on the screen stating 'times up' and after three seconds this changed to a notification that explained to the participant that the game portion of the experiment was completed and they would be redirected to the survey. If a participant was playing in the VR group, it was also asked to remove their VR headset as it was not needed any further. After giving participants time to read this notification and remove their headsets the game opened up a browser window which took the user to a Qualtrics survey for the remainder of measurement.

4.6 Measures

Measurement of explicit racial bias was based on the Modern Racism Scale (MRS) [81]. The MRS asks participants to state on a Likert scale how strongly they agree or disagree with a series of statements. However, the MRS was slightly modified as the question "*Blacks have more influence upon school desegregation plans than they ought to have*" was removed. This decision was made as segregation was outlawed in America in 1954 [97] and participants may not have a great understanding of segregation and also due to this study potentially recruiting participants from around the world it was deemed too specific.

The modified MRS being used here therefore asks participants whether they agree or disagree with the following statements on a scale of 1-6. A score of 1 means that participants have more favourable attitudes towards the outgroup, and a score of 6 means that participants have less favourable views towards the outgroup. The total a participant can score is between 6 and 36. The overall measure of explicit racial bias is formed from the sum of their responses:

- 1. Discrimination against black people is no longer a problem.
- 2. It is easy to understand the anger of black people.
- 3. Black people are getting too demanding in their push for equal rights.
- 4. Black people should not push themselves where they are not wanted.
- 5. Over the past few years, black people have gotten more economically than they deserve.
- 6. Over the past few years, the government and the news media have shown more respect to black people than they deserve.

It is important to note that one question in the MRS is reverse scored: "*It is easy to understand the anger of black people.*"

The reason that the MRS was chosen as the measurement here was due to the potential issues that have been previously identified with the IAT. Also because the experiment was being run online and remotely it meant that participants were completely unknown and anonymous to the researcher and it was deemed that participant would feel free to express their beliefs due to this anonymity.

4.7 Participants

Participants that took part in this study were Reddit users, specifically users of the "*r/virtualreality*" subreddit and were all over the age of 18. This subreddit was chosen as there is the potential to gain a large number of participants and subscribers here are likely to have a keen interest in VR and therefore already own a VR kit. At the time of writing there are 160,716 subscribers to the "*r/virtualreality*" subreddit.

All 41 participants in this study identified as white. 17 participants were aged 18-29; 21 were aged 30-39; 1 was aged 40-49; and 2 were aged 50-59. 29 participants identified as male and 12 identified as female. 21 participants were randomly assigned to the VR condition, and 20 participants were randomly assigned to the non-VR condition. 7 additional participants applied to take part in the study but were not admitted because they did not identify as white. Of the participants that took part in this study 14 participants stated they played games daily; 25 played games more than once a week; and 2 played games less than once a week.

4.8 Results

Means and standard deviations for the measurement of explicit racial bias for all participants, split by condition, is given below as Table 3. It is also presented as Figure X.

Condition	Mean	Standard deviation	N
VR	22.952	2.673	21
Non-VR	23.050	3.410	20
All	23.000	3.016	41

Table 3: Mean and standard deviation for each condition.

The effects of VR embodiment on participants levels of prejudice were tested via an Independent Samples T-Test. Results (t(39)=-0.102, p = 0.459) indicated that VR embodiment (M = 22.952, SD = 2.673) did not have a significant effect on participants levels of prejudice when compared to participants who played the same game on a traditional screen (M = 23.050, SD = 3.410). The highest that could be scored was 36.





4.9 Discussion

The results from this experiment failed to support the hypothesis that embodiment of an outgroup in a VR game will lead to differences in explicit racist bias when compared to embodiment in a traditional non-VR game. There are various reasons that this may have been the outcome.

The first of these reasons is the number of participants. As noted in <u>section 4.4</u>, an a-priori power analysis indicated that 176 participants were needed in order to detect a medium effect with symmetric 5% false positive and negative error rates. Unfortunately, participation numbers are low (n=41) and did not meet the original requirement for the study. As mentioned previously, the original plans for this study did not involve running it online: rather the original plans were to run the study in person. However, this had to be changed due to COVID-19. When the study was run online, recruitment became much harder, and power became harder to achieve.

While the sample size is one reason that the results indicate that there was not a difference between the conditions, there were also societal events that may have had an impact on the results that participants gave. During the same period that the experiment was being carried out protests were happening around the world against police brutality, many of which were organised by the Black Lives Matter organisation. These protests were sparked by an event which saw police kneeling on a black man's neck which, sadly, resulted in his death [98]. A video of the incident was widely circulated across social media and news outlets were playing clips throughout the day. With this event being at the forefront of peoples' mind and the likelihood of the events being known by participants it may have affected the way in which they responded to our outcome measure [99].

On the other hand, some of these protests led to riots and looting taking place. Again, news outlets were reporting this, and videos were widely circulated on social media [100]. These events also may have potentially affected participant's answers. Participants may have answered questions in a way which made them appear more prejudicial than they otherwise would be [101], [102]. Both the events of rioting and looting and also the police brutality video that were all widely circulated may have affected different participants answers in different ways. If these events did not occur or occurred at a separate time to the experiment being carried out, then the results could have been different. However, events such as this could not be foreseen or planned for, and these results may therefore show participants attitudes towards outgroups at a set point in time rather than their levels of prejudice in more normal circumstances. If participants had viewed footage of any of the events discussed in the previous two paragraphs it may have affected their scores.

However, while it could be the case that these events and protests may have affected the responses from participants, it is possible participants in both groups were aware of these events and may have had a similar effect across both conditions.

Another factor that needs to be considered is the role that gender can have in empathy. There are many previous studies that show a link between gender and empathy, more specifically the link between females and higher levels of empathy [103]–[105]. This is important to keep in mind when it comes to this study because it may be that there would have been a different set of results if the gender make up of participants was different. 29 participants identified as male and it may be that, as studies have shown, males are less empathetic it may be harder to create an attitudinal change within them.

A final note must be made with reference to social desirability. It may also be, that due to these events participants were not willing to share their real beliefs. This could have been due to societal pressure making them feel like they have to appear to have more positive attitudes than they actually do.

However, it should be noted that another possibility is present: that the results obtained are accurate and that embodiment in a VR game really does not lead to greater changes to explicit racial bias than embodiment in a non-VR game. However, given the low statistical power, replication is needed with appropriate sample size it cannot be determined whether this is truly the case or not.

4.9.1. Limitations

There are limitations to the VR study that must be stated. The first, and main limitation was the lack of a pre-test. The addition of a pre-test would allow an understanding of participants score on the MRS before and after the manipulation. Including a pre-test and a post-test would mean that any level of change between the VR and non-VR groups could be measured or whether there was a difference in the measure before and after. Measuring both pre and post-test would potentially give a greater understanding of the changes in attitudes when comparing VR games and traditional screen-based games.

A second limitation to the study was the lack of a manipulation check during piloting. A manipulation check could be included in future studies to check the levels of embodiment felt by participants when playing the game. Due to not carrying out this manipulation check it is difficult to determine the effectiveness of the game in inducing a sense of embodiment. It may be the case that participants did not feel a sense of embodiment and therefore the game may not have had any effect on participants attitudes towards outgroups. Going forward this would be something that would be a meaningful addition to any experiments.

A third limitation of this study was the number of participants. As discussed in <u>section 4.9</u>, it was small sample size. Unfortunately, this may have been due to the required change of no longer being able to run the study in person and instead having to run the experiment online, which made recruitment difficult. This may simply not have been enough participants to see a difference in results between the two conditions. A larger sample size would allow for stronger results.

A fourth limitation of the VR study is the ecological validity of the game that was used. While it did resemble some popular wave shooter games such as *Space Pirate Trainer* and *Serious Sam VR: The Last Hope*, many VR games offer experiences that last longer and are more sophisticated. For example, they may have a large single-player story that takes several hours to complete such as *Half-Life: Alyx* or *The Elder Scrolls V: Skyrim VR*. It could be that these more sophisticated VR games may lead to an effect whereas a small game such as the one used in the experiment does not have an effect.

Future work based on these limitations is discussed in section 5.4.

Chapter 5 Conclusions

5.1 Introduction

As sales of VR hardware and software rise it is increasingly important that both the effects of VR games and the content that is found in them is understood. Certain mechanisms have been identified within the social sciences literature that may lead to attitudinal change towards outgroups. The mechanisms of interest to this report were contact, cooperation and embodiment. However, it was not clear whether these mechanisms are present in contemporary VR games or whether the inclusion of these mechanisms cause the same attitudinal change.

In order to address this gap in the literature two studies were undertaken: a content analysis and an online VR experiment. The content analysis aimed to understand whether popular contemporary VR games from the Steam Store provided affordances for the three mechanisms. The online VR experiment aimed to answer whether the use of one of these mechanisms, more specially, embodiment, caused a larger attitudinal change towards outgroups compared to traditional screenbased games. The results of these suggest the following contributions:

- The content analysis suggests that VR games commonly provide affordances for contact and cooperation with a BAME character, and embodiment of a BAME character. More specifically, 68.63% of games that included BAME characters afforded the mechanism of contact, 39.22% afforded the mechanism of cooperation and 39.22% afforded the mechanism of embodiment.
- 2. Results of the online VR experiment were unable to provide evidence that the mechanism of embodiment in VR games had a larger effect on attitudinal change within participants, compared to traditional screen-based games. However, these results contain a substantial possibility of false negatives and require replication before you interpret them usefully.

This chapter first summaries each of these studies and then moves on to discuss any limitations and future work that can be carried out.

5.2 Summary of Research

5.2.1. Content Analysis

A content analysis was first conducted which looked at the content that is in VR games that are readily available to consumers. The aim of this content analysis was to understand the extent to which the most popular VR games on the Steam Store afford the key mechanisms that could cause attitudinal change towards outgroups within players. The top 100 games which met the criteria of the content analysis were analysed for the mechanisms of contact with an outgroup, working cooperatively with an outgroup and the embodiment of a member of an outgroup.

The results indicate that, with regards to games featuring BAME characters, 39.22% featured embodiment, by allowing players to embody a BAME character while playing the game. Embodiment has been found to create attitudinal changes within participants (see <u>section 2.4.1</u>.). Cooperation with BAME characters, which can affect attitudes towards these outgroups (see <u>section 2.1.1</u>.), also features within 39.22% of these VR games. Finally, cooperation with BAME characters is featured in 68.64% of VR games that include BAME characters, and again cooperation has been found to affect attitudes towards outgroups (see <u>section 2.1.2</u>.).

However, it must be made clear that, while the content analysis results show the percentage of the 100 games that feature these mechanisms, the results do not show whether the VR games that include these mechanics do affect attitudes towards outgroups.

The results from the content analysis also show that BAME characters do appear in a variety of different character roles. While just under 30% of games that included BAME characters included a BAME protagonist, around 50% of them included BAME story characters. BAME characters appeared in all of the character roles that the games were analysed for and appear in both negative and positive roles.

While the results indicate that VR games that are available to consumers afford the mechanisms of interest and include BAME characters in different roles, there are other factors the study does not consider that could affect any potential attitude change. These factors include the length of time spent with a BAME character or the demographics of the players of these games, for example. These factors, as previously discussed in <u>section 3.4.2</u>, have the potential to affect any attitudinal change that may happen.

5.2.2. Experimental VR Study

The results from the content analysis show that VR games do afford the key mechanisms of contact, cooperation and embodiment and from prior research from social sciences we have seen that these mechanisms can reduce prejudice and cause attitudinal changed towards outgroups within people (see sections 2.1.1, 2.1.2 & 2.1.3). If this knowledge is coupled with the knowledge that VR experiences can cause behavioural and attitudinal changes (see sections 2.3 & 2.4), then it may be possible that VR games that feature these mechanisms may be causing attitudinal change towards

outgroups within players of these games. However, it is not yet clear whether this is the case. In order to address this an online VR experiment was conducted.

For this experiment, a short game was created featuring a black character. Participants were split into two groups with the first group using a VR headset and therefore embodying the black character avatar and the second group played on a traditional screen. The results from this study were unable to reject the idea that there was no difference in attitudes between participants who embodied an outgroup avatar in VR compared to those who took part using a traditional screen.

Previous work in the area has shown that VR experiences are able to change attitudes towards outgroups [8], [9], [74], [75], [78], [87]. This study aimed to build upon this work and understand whether VR games specifically, are able to affect attitudes in the same way. Much like the previous work the experiment used a first-person perspective, and it was made clear to them who they were embodying, through use of an in-game mirror. However, the results from the study did not replicate results from previous work. Results from previous work showed that VR embodiment was able to affect participants attitudes. Results in this study however, found no difference between playing a game in VR and playing a game in a more traditional manner. An important note to make here is that the results do need to be interpreted with caution, this is due to the limitations that have been previously discussed as well as the need of changing the study from in-person to online due to the Covid-19 pandemic.

5.3 Contributions

5.3.1. Popular VR games may commonly provide affordances for key mechanisms

The most important thing that was discovered when carrying out this research is that popular VR games, already available to consumers, provide affordances for the three key mechanisms that may cause attitudinal change towards outgroups. More specifically, the prevalence of contact, cooperation and embodiment within VR games that include BAME characters means that players are already being exposed to these mechanisms.

For example, 39.22% of the VR games that feature BAME characters also afforded one of the key mechanisms, embodiment. Interestingly, this could mean that these games are already causing attitudinal change towards outgroups within the player base. It is also possible that any change caused by VR games could be as powerful as change created by real world experiences. However, this study was unable to assess these things and future work will need to be conducted in order to understand if this is the case.

5.3.2. Cannot yet determine whether VR games are superior to traditional screen-based games in causing attitudinal change

Results from the content analysis indicated that VR games are affording key mechanisms for attitudinal change. It has also previously been discussed, within this report, the ways in which VR can be used to cause behavioural changes within participants, with the changes being just as powerful as changes caused by mechanisms in the real-world (see <u>section 2.3</u>). Therefore, the second study set out to understand whether VR games are superior at causing attitudinal changes towards outgroups than traditional screen-based games.

However, the results of the study appear to show that there was no difference between the VR or non-VR groups attitudes towards outgroups after they had played the game. There are some factors why this may be the case. The main limitation of the study was the lack of a pre-test. This would have meant that participants MRS scores could have been compared and analysed before and after playing the VR game and would have given a better understanding of whether any effect on attitudes did occur.

Also, due to COVID-19 unforeseen changes had to be made which led to a small sample size. The study therefore did not find a difference between VR and traditional screen-based games. However, there must be a large amount of caution in interpreting this outcome due to the small sample size. Also, while the results from the online VR study suggest that embodiment in VR games does not have an effect on attitudes towards outgroups, another factor to take into account was the BLM protests that were occurring at the time. These may have affected the results participants gave, as they may not have been comfortable giving answers they otherwise may have.

There are other factors based on the game design that may have led to the results gathered as well. It may be that the game was not long enough to create a change in attitudes. A game that lasts longer may be more likely to lead to a change in attitudes due to the participant spending more time with them.

A second game design factor may be that it was not clear to all participants that they were embodying a black character. While the game did include a mirror and the game started with participants looking in the mirror and including a need for the participants to interact with it, it may be that participants did not realise it was reflecting the avatar they were embodying. Another factor of game design that could affect results is how sophisticated the game is. Games that have sophisticated stories with world design that immerse the player could potentially lead to change in attitudes. However, the game created for this experiment was simpler in its design.

The main point that this study contributes is the idea that more research needs to be done in this field. As discussed in <u>section 2.2</u>, VR headsets are increasing in sales as the number of people playing VR games is increasing. This was also an exploratory study to begin to look at how VR games can affect people. However, there is a lack of understanding with regards to the effects these games are having on people. More specifically, whether they cause any attitudinal change towards outgroups. Therefore, more research needs to be conducted.

5.3.3. Game Design

Better understanding of these mechanics could, potentially, lead to a change in the way that games are designed. With more knowledge of how, for example, embodiment within VR games affects players with regards to attitudinal change towards outgroups it may lead to game designers having a better understanding of how their design decisions can affect players. If embodiment of a BAME character in a certain genre of game is able to affect attitudes positively then game designers can create games with the purpose of changing player attitudes.

This could mean that games that are available and have the potential of being played by a large number of people could be positively changing their attitudes just by designing the game slightly differently. Including more positive contact with outgroup members within games or changing the group that a character belongs to so that instead of having a white companion they are a BAME companion. Small changes such as that may allow these games to have an effect on large number of players.

This also means that players of these games may not know that these mechanics have been used within the game and that they are affecting them. If players were aware that these mechanics had been implemented to be used as an intervention it could steer them away from playing the game. However, creating a game that includes these interventions but does not highlight them could mean that more people are willing to play them. For example, *Half-Life: Alyx* has players embody a BAME character, which could potentially be having a positive effect on players attitudes and is one of the most popular VR games on the Steam Store. However, in order to fully understand how game design may be affecting players experience of embodiment and attitudes towards outgroups, further work must be carried out.

5.4 Future Work

Limitations of both of the studies in this report can be found in sections <u>3.5.3</u> and <u>4.9.1</u>. This section will discuss future work that has been identified based on the limitations and questions that arose when conducting the studies.

One piece of future work based on the content analysis would be to analyse a larger number of games which may strengthen the current results. It may also be that including games that did not match the set criteria could allow for a better understanding. There were a number of games that featured human characters but were rejected due to being in early access that could be included, this could be one of the first pieces of future work. It can be assumed that these early access titles do have a somewhat large player base, as these games appear in the top sellers lists on Steam. Therefore, there is the potential that these early access games could be feature the mechanisms laid out in this study and could therefore be changing attitudes towards outgroups. However, in the content analysis current form no conclusions can be made regarding this.

A content analysis on traditional games is another piece of future work that could be undertaken. Instead of looking at only VR games this could be expanded to look at all games. This would allow an analysis to be conducted to understand how many of these traditional games afford the key mechanisms. This would also allow for a comparison between VR games and traditional screenbased games and would make it clear whether there was any difference between the number of games affording these mechanisms.

Tracking results over time would be able to show whether the mechanisms within the games have changed over time as well. For example, it may be that the older the VR game is, the less cooperation it involves. It may be that as VR games became more complex and developers became more confident in how to make VR games these mechanisms may then be increasingly found in newer VR games.

Another piece of future work that was identified by conducting the content analysis is to understand whether the games currently available, that include these mechanisms, are having any impact on attitudes. It could be that games such as *Half-Life:Alyx* and *The Elder Scrolls V: Skyrim* are already affecting players attitudes. At the moment it is unknown whether that is the case or not. It would be valuable to create a better understanding of whether this is the case and potentially highlight whether games are already changing attitudes positively, or negatively.

Knowing whether games that are already available have any effect on attitudes could also lead to a better understanding of the types of games and game design elements that may aid any change. This

could mean that games could then be designed in the future to include specific design elements that do change attitudes in a positive way. It could also mean that some design choices may be avoided due to leading to a negative change in attitudes.

The final piece of future work that the content analysis helped to identify, is to analyse how the most popular VR games allow affordances for key mechanisms with member of outgroups other than BAME groups. This analysis would create an understanding of the number of VR games that allow for these mechanisms with different outgroups and it could potentially mean that these games are also causing attitudinal change towards these groups as well. Which would lead into more VR experiments that could be taking place to understand whether the effects are the same or differ depending on the outgroup featured within games.

Conducting the VR experiment also meant that future work was identified. One change that can be made to the VR experiment, in its current form, is the addition of a pre-test (as highlighted in <u>section</u> <u>4.9.1</u>). This would allow for a better understanding of how the game affects levels of attitudes, if at all. In the experiments current form, without the pre-test, it is difficult to understand whether the game affected participants attitudes, or whether attitudes did not change from before the game was played.

A second piece of work based around repeating the experiment was also identified. In the future it would be beneficial to recreate and run the experiment with a larger sample size. This could possibly mean that any effect that is seen may be greater and the results from this would be stronger than the results from this study which, unfortunately, only had a small sample size. It may also be possible to run the experiment in-person, as originally intended, which would allow for the sample size to be increased. While this is an important piece of future work to be carried out there are other experiment that can be conducted which will advance the knowledge in this area.

Thirdly, running the experiment with a more sophisticated game or allowing for a much longer period of game time, even over days or weeks, would be a useful experiment to run. This would help to lay foundation knowledge around the links between the levels of sophistication of a VR game or the time spent playing a VR game and any attitudinal changes towards outgroups they cause.

A final piece of future work and a particularly key area of research is to understand whether traditional video games have any effect on players attitudes towards outgroups. While this research has been centred around VR games there is the possibility that traditional screen-based video games, played on monitors and television screens may also have some affect. These traditional games reach a much greater number of people than VR games and so it is important to understand

how these can affect peoples' attitudes. It is possible that these traditional video games may not affect player' attitudes to the same degree that VR games potentially can, however the affect would be able to reach a far greater number of people and for this reason it is an important area of research.

Overall, there are a number of ways in which both of the studies could be improved upon in the future. While currently the studies do offer new knowledge that fills a current gap in the literature, there are multiple clear paths that can be explored and for these studies to be improved in the future. These improvements means that the knowledge around this can continue to expand and lead to a better understanding of how VR games can affect peoples' behaviour and attitudes.

5.5 Summary

This report was created, and the studies were undertaken due to a gap in the literature regarding VR games and the affordances made to contact, cooperation and embodiment of outgroups. On top of this there was a gap in the knowledge relating to the ways in which these VR games may be affecting attitudinal change which led to the online VR study being conducted to gain an initial understanding of this. The content analysis provides initial evidence that VR games do allow affordances for the three mechanisms, however the results from the online VR study are inconclusive due to the poor sample size. It is also evident that further work is necessary to gain a full understanding of these knowledge gaps.

Reference List

- [1] *Definition of IN-GROUP*. [Online]. Available: https://www.merriam-webster.com/dictionary/in-group. [Accessed: 28 Nov. 2019].
- [2] *What does ingroups and outgroups mean?* [Online]. Available: https://www.definitions.net/definition/ingroups+and+outgroups. [Accessed: 28 Nov. 2019].
- [3] G. W. Allport, *The nature of prejudice*, Unabridged, 25th anniversary ed. Reading, Mass.: Addison-Wesley PubCo, 1979.
- [4] *Definition of OUT-GROUP*. [Online]. Available: https://www.merriam-webster.com/dictionary/out-group. [Accessed: 28 Nov. 2019].
- [5] *Definition of out-group / Dictionary.com*, www.dictionary.com. [Online]. Available: https://www.dictionary.com/browse/out-group. [Accessed: 28 Nov. 2019].
- [6] *The Psychology of Hate Crimes*, https://www.apa.org. [Online]. Available: https://www.apa.org/advocacy/interpersonal-violence/hate-crimes. [Accessed: 01 Nov. 2020].
- [7] M. Sherif et al., 'Intergroup Conflict and Cooperation: The Robbers Cave Experiment', p. 133.
- [8] N. Salmanowitz, 'The impact of virtual reality on implicit racial bias and mock legal decisions', J. Law Biosci., vol. 5, no. 1, pp. 174–203, Apr. 2018 [Online]. Available: 10.1093/jlb/lsy005.
- [9] T. C. Peck et al., 'Putting yourself in the skin of a black avatar reduces implicit racial bias', *Conscious. Cogn.*, vol. 22, no. 3, pp. 779–787, Sep. 2013 [Online]. Available: 10.1016/j.concog.2013.04.016.
- [10] O. Christ et al., 'Contextual effect of positive intergroup contact on outgroup prejudice', *Proc. Natl. Acad. Sci. U. S. A.*, vol. 111, no. 11, pp. 3996–4000, 2014.
- [11] M. Gonzalez-Franco and T. C. Peck, 'Avatar Embodiment. Towards a Standardized Questionnaire', *Front. Robot. AI*, vol. 5, 2018[Online]. Availablehttps://www.frontiersin.org/articles/10.3389/frobt.2018.00074/full[Accessed: 19November2020].
- [12] M. A. Olson and R. H. Fazio, 'Reducing Automatically Activated Racial Prejudice Through Implicit Evaluative Conditioning', *Pers. Soc. Psychol. Bull.*, vol. 32, no. 4, pp. 421–433, Apr. 2006 [Online]. Available: 10.1177/0146167205284004.
- [13] B. D. Stewart and B. K. Payne, 'Bringing Automatic Stereotyping Under Control: Implementation Intentions as Efficient Means of Thought Control', *Pers. Soc. Psychol. Bull.*, vol. 34, no. 10, pp. 1332–1345, Oct. 2008 [Online]. Available: 10.1177/0146167208321269.
- [14] G. Riva et al., 'Affective Interactions Using Virtual Reality: The Link between Presence and Emotions', *Cyberpsychology Behav. Impact Internet Multimed. Virtual Real. Behav. Soc.*, vol. 10, no. 1, pp. 45–56, 2007 [Online]. Available: 10.1089/cpb.2006.9993.
- [15] VR device shipments by vendor worldwide 2017-2019, Statista. [Online]. Available: https://www.statista.com/statistics/671403/global-virtual-reality-device-shipments-byvendor/. [Accessed: 06 Aug. 2019].
- [16] (Mar. 25, 2019), 'PlayStation VR: The Next Wave of Games Coming in Spring and Summer 2019', PlayStation.Blog. [Online].
 Availablehttps://blog.us.playstation.com/2019/03/25/playstation-vr-the-next-wave-ofgames-coming-in-spring-and-summer-2019/[Accessed: 6August2019].

- [17] Half-Life: Alyx reaches 43,000 concurrent users on launch day, GamesIndustry.biz.
 [Online]. Available: https://www.gamesindustry.biz/articles/2020-03-24-half-life-alyx-reaches-43-000-concurrent-users-on-launch-day. [Accessed: 08 Dec. 2020].
- [18] Half-Life: Alyx So Far Sold About 680,000 Copies, Has Been Played By About 180,000 Valve Index Owners (Based on SuperData Numbers), New World Notes. [Online]. Available: https://nwn.blogs.com/nwn/2020/04/game-revenue-alyx-vr-steam-indexsales.html. [Accessed: 08 Dec. 2020].
- [19] Ovid: A Meta-Analytic Test of Intergroup Contact Theory. [Online]. Available: http://ovidsp.dc2.ovid.com/sp-4.02.1a/ovidweb.cgi?QS2=434f4e1a73d37e8c01e9bb09ab15b392fd634b897ae6ae4483 569b77bc7a0b0da1840288d03328a50df639ffa8f723e39a92c2cfc75da18f3b6773d239af 4cce75f011e6c0663e8f6f9a243b4bf59bc109da569188d70c6d94776ddb42ca777a6fe76b 36022e4f34f9228b0e3bd797f8902a792239ee89ef7a1562e8a462407ee743b7807ada9e3 2526267886a8c88c8103cf5c387385422f54e6c33053424e600173b13c7c43868cf761f20 da900a80dfa38ae072b95541fe5676f35bd8e4808b41939a7af11dee74af91a0cdeb0fc80b 4e5542fc8a04bf65c7393c0145fe13b87a10e2081f68aef4438ad53dc6a81c3bd9a17d8e48 2cc3e43105d022469396072d267b9907dde15fc70566de9b4190. [Accessed: 28 Nov. 2019].
- [20] S. T. Fiske, 'What We Know Now about Bias and Intergroup Conflict, the Problem of the Century', *Curr. Dir. Psychol. Sci.*, vol. 11, no. 4, pp. 123–128, 2002.
- [21] C. L. Aberson et al., 'Ingroup Bias and Self-Esteem: A Meta-Analysis', Personal. Soc. Psychol. Rev., vol. 4, no. 2, pp. 157–173, May 2000 [Online]. Available: 10.1207/S15327957PSPR0402_04.
- [22] R. Böhm et al., 'The psychology of intergroup conflict: A review of theories and measures', *J. Econ. Behav. Organ.*, Jan. 2018[Online]. Availablehttp://www.sciencedirect.com/science/article/pii/S0167268118300209[Access ed: 28November2019].
- [23] R. J. Crisp, *Social Psychology: A Very Short Introduction*. Oxford University Press, 2015.
- [24] H. Tajfel, 'Experiments in Intergroup Discrimination', *Sci. Am.*, vol. 223, no. 5, pp. 96–103, 1970.
- [25] H. Tajfel et al., 'Social categorization and intergroup behaviour', *Eur. J. Soc. Psychol.*, vol. 1, no. 2, pp. 149–178, 1971 [Online]. Available: 10.1002/ejsp.2420010202.
- [26] S. Otten and D. Wentura, 'About the impact of automaticity in the minimal group paradigm: evidence from affective priming tasks', *Eur. J. Soc. Psychol.*, vol. 29, no. 8, pp. 1049–1071, 1999 [Online]. Available: 10.1002/(SICI)1099-0992(199912)29:8<1049::AID-EJSP985>3.0.CO;2-Q.
- [27] Y. Dunham, 'Balanced Identity in the Minimal Groups Paradigm', *PLOS ONE*, vol. 8, no. 12, p. e84205, Dec. 2013 [Online]. Available: 10.1371/journal.pone.0084205.
- [28] S. Otten, 'The Minimal Group Paradigm and its maximal impact in research on social categorization', *Curr. Opin. Psychol.*, vol. 11, pp. 85–89, Oct. 2016 [Online]. Available: 10.1016/j.copsyc.2016.06.010.
- [29] M. B. Brewer, 'In-group bias in the minimal intergroup situation: A cognitivemotivational analysis', *Psychol. Bull.*, vol. 86, no. 2, pp. 307–324, Mar. 1979.
- [30] S. L. Gaertner et al., 'How does cooperation reduce intergroup bias?', J. Pers. Soc. Psychol., vol. 59, no. 4, pp. 692–704, 1990 [Online]. Available: 10.1037/0022-3514.59.4.692.
- [31] Ovid: Reducing Intergroup Bias: Elements of Intergroup Cooperation. [Online]. Available: http://ovidsp.dc2.ovid.com/sp-4.02.1a/ovidweb.cgi?QS2=434f4e1a73d37e8c1c06f752f8a56f11cad7628485e96a9d31f

354a4df43c559cfbe1e3356389282214c38b5339cfa2ab4f359b0d70c7c05e38c6b65d77c 4960250febfae34da3b28ef2e0df07309b6bd771b29904bf9d73fe07c13fe6f50837444f288 d196bd4613cc6e328c776f591eea69411213d28182f6277edfd66269abb7293bafcb264ed c26ce149d9a88e774e61e3ee93c092a233ee63815ee8892717241be0704ab36f8c689d1e3 caa6579cfa782bfd00d792aa74fedbb6ec74a61684e122d552d032e54d5cd6fb61e56abfa9 627c0d700258fe16823e69367790213f2d98fc6a3e7d40fc7c63889820b13d7ef02461200 948d00f0146d418cff02217fb4622a22004127b35cc0695504b9. [Accessed: 28 Nov. 2019].

- [32] B. A. Bettencourt et al., 'Cooperation and the reduction of intergroup bias: The role of reward structure and social orientation', *J. Exp. Soc. Psychol.*, vol. 28, no. 4, pp. 301–319, Jul. 1992 [Online]. Available: 10.1016/0022-1031(92)90048-O.
- [33] S. Worchel et al., 'Intergroup cooperation and intergroup attraction: The effect of previous interaction and outcome of combined effort', *J. Exp. Soc. Psychol.*, vol. 13, no. 2, pp. 131–140, Jan. 1977 [Online]. Available: 10.1016/S0022-1031(77)80006-1.
- [34] S. L. Gaertner and J. F. Dovidio, *Reducing Intergroup Bias: The Common Ingroup Identity Model*. Psychology Press, 2014.
- [35] L. Sigelman and S. Welch, 'The Contact Hypothesis Revisited: Black-White Interaction and Positive Racial Attitudes', *Soc. Forces*, vol. 71, no. 3, pp. 781–795, 1993 [Online]. Available: 10.2307/2579895.
- [36] C. C. Ellison and D. A. Powers, 'The Contact Hypothesis and Racial Attitudes among Black Americans', *Soc. Sci. Q. Univ. Tex. Press*, vol. 75, no. 2, pp. 385–400, Jun. 1994.
- [37] J. Binder et al., 'Does contact reduce prejudice or does prejudice reduce contact? A longitudinal test of the contact hypothesis among majority and minority groups in three european countries.', *J. Pers. Soc. Psychol.*, vol. 96, no. 4, pp. 843–856, 2009 [Online]. Available: 10.1037/a0013470.
- [38] G. Lemmer and U. Wagner, 'Can we really reduce ethnic prejudice outside the lab? A meta-analysis of direct and indirect contact interventions', *Eur. J. Soc. Psychol.*, vol. 45, no. 2, pp. 152–168, 2015 [Online]. Available: 10.1002/ejsp.2079.
- [39] N. Tausch et al., 'Individual-level and group-level mediators of contact effects in Northern Ireland: The moderating role of social identification', *Br. J. Soc. Psychol.*, vol. 46, no. 3, pp. 541–556, 2007 [Online]. Available: https://doi.org/10.1348/014466606X155150.
- [40] *Empathy Definition / What Is Empathy*, Greater Good. [Online]. Available: https://greatergood.berkeley.edu/topic/empathy/definition. [Accessed: 30 Oct. 2019].
- [41] J. F. Dovidio et al., 'Intergroup Contact: The Past, Present, and the Future', Group Process. Intergroup Relat., vol. 6, no. 1, pp. 5–21, Jan. 2003 [Online]. Available: 10.1177/1368430203006001009.
- [42] R. Meleady and L. Forder, 'When contact goes wrong: Negative intergroup contact promotes generalized outgroup avoidance', *Group Process. Intergroup Relat.*, vol. 22, no. 5, pp. 688–707, Aug. 2019 [Online]. Available: 10.1177/1368430218761568.
- [43] F. K. Barlow et al., 'The Contact Caveat: Negative Contact Predicts Increased Prejudice More Than Positive Contact Predicts Reduced Prejudice', *Pers. Soc. Psychol. Bull.*, vol. 38, no. 12, pp. 1629–1643, Dec. 2012 [Online]. Available: 10.1177/0146167212457953.
- [44] C. D. Batson et al., 'Empathy and attitudes: Can feeling for a member of a stigmatized group improve feelings toward the group?', J. Pers. Soc. Psychol., vol. 72, no. 1, pp. 105–118, Jan. 1997 [Online]. Available: 10.1037/0022-3514.72.1.105.
- [45] K. A. Finlay and W. G. Stephan, 'Improving Intergroup Relations: The Effects of Empathy on Racial Attitudes1', J. Appl. Soc. Psychol., vol. 30, no. 8, pp. 1720–1737, 2000 [Online]. Available: 10.1111/j.1559-1816.2000.tb02464.x.

- [46] J. McGregor, 'Effectiveness of Role Playing and Antiracist Teaching in Reducing Student Prejudice', J. Educ. Res., vol. 86, no. 4, pp. 215–226, 1993.
- [47] F. M. Culbertson, 'Modification of an emotionally held attitude through role playing.', *J. Abnorm. Soc. Psychol.*, vol. 54, no. 2, p. 230, 19590301 [Online]. Available: 10.1037/h0041942.
- [48] Virtual Reality (VR) Gaming Market Size, Trends and Forecast 2019-2024. [Online]. Available: https://www.imarcgroup.com/virtual-reality-gaming-market. [Accessed: 06 Aug. 2019].
- [49] SuperData Research | Games data and market research » SuperData XR Q3 2019 update. [Online]. Available: https://www.superdataresearch.com/superdata-xr-update/. [Accessed: 29 Oct. 2019].
- [50] F. Pallavicini et al., 'What Distinguishes a Traditional Gaming Experience from One in Virtual Reality? An Exploratory Study', 2017 [Online]. Available: 10.1007/978-3-319-60639-2_23.
- [51] M. Slater and S. Wilbur, 'A Framework for Immersive Virtual Environments (FIVE): Speculations on the Role of Presence in Virtual Environments', *Presence Teleoperators Virtual Environ.*, vol. 6, no. 6, pp. 603–616, Dec. 1997 [Online]. Available: 10.1162/pres.1997.6.6.603.
- [52] M. Sanchez-Vives and M. Slater, 'From presence to consciousness through virtual reality', *Nat. Rev. Neurosci.*, vol. 6, pp. 332–9, May 2005 [Online]. Available: 10.1038/nrn1651.
- [53] D. A. Bowman and R. P. McMahan, 'Virtual Reality: How Much Immersion Is Enough?', *Computer*, vol. 40, no. 7, pp. 36–43, Jul. 2007 [Online]. Available: 10.1109/MC.2007.257.
- [54] Understanding psychotherapy and how it works, https://www.apa.org. [Online]. Available: https://www.apa.org/helpcenter/understanding-psychotherapy. [Accessed: 29 Oct. 2019].
- [55] *Different approaches to psychotherapy*, https://www.apa.org. [Online]. Available: https://www.apa.org/topics/therapy/psychotherapy-approaches. [Accessed: 29 Oct. 2019].
- [56] What Is Exposure Therapy?, https://www.apa.org. [Online]. Available: https://www.apa.org/ptsd-guideline/patients-and-families/exposure-therapy. [Accessed: 29 Oct. 2019].
- [57] *Classics in the History of Psychology -- Galton (1880).* [Online]. Available: http://psychclassics.yorku.ca/Galton/imagery.htm. [Accessed: 29 Oct. 2019].
- [58] A. Zeman et al., 'Lives without imagery Congenital aphantasia', *Cortex*, vol. 73, pp. 378–380, Dec. 2015 [Online]. Available: 10.1016/j.cortex.2015.05.019.
- [59] R. Keogh and J. Pearson, 'The blind mind: No sensory visual imagery in aphantasia', *Cortex*, vol. 105, pp. 53–60, Aug. 2018 [Online]. Available: 10.1016/j.cortex.2017.10.012.
- [60] M. P. Safir et al., 'Virtual Reality Cognitive-Behavior Therapy for Public Speaking Anxiety: One-Year Follow-Up', *Behav. Modif.*, vol. 36, no. 2, pp. 235–246, Mar. 2012 [Online]. Available: 10.1177/0145445511429999.
- [61] M. Price et al., 'Virtual Reality as Treatment for Fear of Flying: A Review of Recent Research', *Int. J. Behav. Consult. Ther.*, vol. 4, no. 4, pp. 340–347, Jan. 2008.
- [62] G. Riva, 'Virtual environments in clinical psychology.', *Psychother. Theory Res. Pract. Train.*, vol. 40, no. 1–2, pp. 68–76, 2003 [Online]. Available: 10.1037/0033-3204.40.1-2.68.
- [63] G. Riva, 'Virtual Reality in Psychotherapy: Review', *Cyberpsychol. Behav.*, vol. 8, no. 3, pp. 220–230, Jun. 2005 [Online]. Available: 10.1089/cpb.2005.8.220.

- [64] L. Hodges et al., 'Virtual Environments for Treating the Fear of Heights.', *Computer*, vol. 28, pp. 27–34, Aug. 1995 [Online]. Available: 10.1109/2.391038.
- [65] L. Hodges et al., 'Virtual Environments Research at the Georgia Tech GVU Center', *Presence Teleoperators Virtual Environ.*, vol. 2, Jan. 1993 [Online]. Available: 10.1162/pres.1993.2.3.234.
- [66] P. M. G. Emmelkamp et al., 'Virtual reality treatment versus exposure in vivo: a comparative evaluation in acrophobia', *Behav. Res. Ther.*, vol. 40, no. 5, pp. 509–516, May 2002 [Online]. Available: 10.1016/S0005-7967(01)00023-7.
- [67] H. S. Wallach et al., 'Virtual Reality Cognitive Behavior Therapy for Public Speaking Anxiety: A Randomized Clinical Trial', *Behav. Modif.*, vol. 33, no. 3, pp. 314–338, May 2009 [Online]. Available: 10.1177/0145445509331926.
- [68] A. Garcia-Palacios et al., 'Virtual reality in the treatment of spider phobia: a controlled study', *Behav. Res. Ther.*, vol. 40, no. 9, pp. 983–993, Sep. 2002 [Online]. Available: 10.1016/S0005-7967(01)00068-7.
- [69] A. S. Carlin et al., 'Virtual reality and tactile augmentation in the treatment of spider phobia: a case report', *Behav. Res. Ther.*, vol. 35, no. 2, pp. 153–158, Feb. 1997 [Online]. Available: 10.1016/S0005-7967(96)00085-X.
- [70] A. Miloff et al., 'Single-session gamified virtual reality exposure therapy for spider phobia vs. traditional exposure therapy: study protocol for a randomized controlled noninferiority trial', *Trials*, vol. 17, no. 1, p. 60, Feb. 2016 [Online]. Available: 10.1186/s13063-016-1171-1.
- [71] A. D. Galinsky et al., 'Why It Pays to Get Inside the Head of Your Opponent: The Differential Effects of Perspective Taking and Empathy in Negotiations', *Psychol. Sci.*, vol. 19, no. 4, pp. 378–384, Apr. 2008 [Online]. Available: 10.1111/j.1467-9280.2008.02096.x.
- [72] C. D. Batson et al., 'Perspective Taking: Imagining How Another Feels Versus Imaging How You Would Feel', *Pers. Soc. Psychol. Bull.*, vol. 23, no. 7, pp. 751–758, Jul. 1997 [Online]. Available: 10.1177/0146167297237008.
- [73] C. Milk, *How virtual reality can create the ultimate empathy machine*. 1429714783[Online]. Availablehttps://www.ted.com/talks/chris_milk_how_virtual_reality_can_create_the_ult imate_empathy_machine[Accessed: 14July2021].
- [74] N. S. Schutte and E. J. Stilinović, 'Facilitating empathy through virtual reality', *Motiv. Emot.*, vol. 41, no. 6, pp. 708–712, Dec. 2017 [Online]. Available: 10.1007/s11031-017-9641-7.
- [75] D. Shin, 'Empathy and embodied experience in virtual environment: To what extent can virtual reality stimulate empathy and embodied experience?', *Comput. Hum. Behav.*, vol. 78, pp. 64–73, Jan. 2018 [Online]. Available: 10.1016/j.chb.2017.09.012.
- [76] F. Herrera et al., 'Building long-term empathy: A large-scale comparison of traditional and virtual reality perspective-taking', *PLOS ONE*, vol. 13, no. 10, p. e0204494, Oct. 2018 [Online]. Available: 10.1371/journal.pone.0204494.
- [77] M. Kors et al., The Curious Case of the Transdiegetic Cow, or a Mission to Foster Other-Oriented Empathy Through Virtual Reality. 2020 [Online]. Available: 10.1145/3313831.3376748.
- [78] S. J. (Grace) Ahn et al., 'The Effect of Embodied Experiences on Self-Other Merging, Attitude, and Helping Behavior', *Media Psychol.*, vol. 16, no. 1, pp. 7–38, Jan. 2013 [Online]. Available: 10.1080/15213269.2012.755877.
- [79] B. A. Nosek et al., 'Understanding and Using the Implicit Association Test: II. Method Variables and Construct Validity', *Pers. Soc. Psychol. Bull.*, vol. 31, no. 2, pp. 166–180, Feb. 2005 [Online]. Available: 10.1177/0146167204271418.

- [80] A. Karpinski and J. L. Hilton, 'Attitudes and the Implicit Association Test.', J. Pers. Soc. Psychol., vol. 81, no. 5, pp. 774–788, Nov. 2001 [Online]. Available: 10.1037/0022-3514.81.5.774.
- [81] J. B. McConahay, 'Modern racism, ambivalence, and the Modern Racism Scale', in *Prejudice, discrimination, and racism*, San Diego, CA, US: Academic Press, 1986, pp. 91–125.
- [82] D. Z. Migetz, 'Reassessing the Modern Racism Scale in Modern Times', p. 80.
- [83] J. B. McConahay, 'Modern Racism and Modern Discrimination: The Effects of Race, Racial Attitudes, and Context on Simulated Hiring Decisions', *Pers. Soc. Psychol. Bull.*, vol. 9, no. 4, pp. 551–558, Dec. 1983 [Online]. Available: 10.1177/0146167283094004.
- [84] T. Morrison and M. Kiss, 'Modern Racism Scale', 2017, pp. 1–3 [Online]. Available: 10.1007/978-3-319-28099-8_1251-1.
- [85] J. R. Axt, 'The Best Way to Measure Explicit Racial Attitudes Is to Ask About Them':, Soc. Psychol. Personal. Sci., Oct. 2017[Online]. Availablehttps://journals.sagepub.com/doi/10.1177/1948550617728995[Accessed: 20January2020].
- [86] S. J. (Grace) Ahn et al., 'Experiencing Nature: Embodying Animals in Immersive Virtual Environments Increases Inclusion of Nature in Self and Involvement With Nature', J. Comput.-Mediat. Commun., vol. 21, no. 6, pp. 399–419, 2016 [Online]. Available: 10.1111/jcc4.12173.
- [87] E. M. Wijma et al., 'A virtual reality intervention to improve the understanding and empathy for people with dementia in informal caregivers: results of a pilot study', *Aging Ment. Health*, vol. 22, no. 9, pp. 1121–1129, Sep. 2018 [Online]. Available: 10.1080/13607863.2017.1348470.
- [88] *Content Analysis Method and Examples / Columbia Public Health*. [Online]. Available: https://www.publichealth.columbia.edu/research/population-healthmethods/content-analysis. [Accessed: 01 Feb. 2022].
- [89] S. Canidate and M. Hart, 'The Use of Avatar Counseling for HIV/AIDS Health Education: The Examination of Self-Identity in Avatar Preferences', J. Med. Internet Res., vol. 19, no. 12, Dec. 2017[Online]. Availablehttps://www.ncbi.nlm.nih.gov/pmc/articles/PMC5732328/[Accessed: 10December2020].
- [90] L. Bullingham and A. C. Vasconcelos, "The presentation of self in the online world": Goffman and the study of online identities', J. Inf. Sci., vol. 39, no. 1, pp. 101–112, Feb. 2013 [Online]. Available: 10.1177/0165551512470051.
- [91] *Definition of TOKENISM*. [Online]. Available: https://www.merriam-webster.com/dictionary/tokenism. [Accessed: 29 Jan. 2022].
- [92] *Half-Life: Alyx · AppID: 546560*, SteamDB. [Online]. Available: https://steamdb.info/app/546560/graphs/. [Accessed: 10 Dec. 2020].
- [93] Saber Fight VR · AppID: 1208770, SteamDB. [Online]. Available: https://steamdb.info/app/1208770/. [Accessed: 10 Dec. 2020].
- [94] *The Great C · AppID: 841460*, SteamDB. [Online]. Available: https://steamdb.info/app/841460/graphs/. [Accessed: 10 Dec. 2020].
- [95] M. C. Howard and E. C. V. Zandt, 'A meta-analysis of the virtual reality problem: Unequal effects of virtual reality sickness across individual differences', *Virtual Real.*, pp. 1–26, May 2021 [Online]. Available: 10.1007/s10055-021-00524-3.
- [96] D. Saredakis et al., 'Factors Associated With Virtual Reality Sickness in Head-Mounted Displays: A Systematic Review and Meta-Analysis', *Front. Hum. Neurosci.*, vol. 14, p. 96, Mar. 2020 [Online]. Available: 10.3389/fnhum.2020.00096.

- [97] School Segregation and Integration / Articles and Essays / Civil Rights History Project / Digital Collections / Library of Congress, Library of Congress, Washington, D.C. 20540 USA. [Online]. Available: https://www.loc.gov/collections/civil-rights-historyproject/articles-and-essays/school-segregation-and-integration/. [Accessed: 17 Nov. 2020].
- [98] 'George Floyd death: Why US protests are so powerful this time', *BBC News*, Jun. 08, 2020[Online]. Availablehttps://www.bbc.co.uk/news/world-us-canada-52969905[Accessed: 18November2020].
- [99] M. Sternadori, 'Empathy May Curb Bias: Two Studies of the Effects of News Stories on Implicit Attitudes toward African Americans and Native Americans', *Contemp. Read. Law Soc. Justice*, vol. 9, no. 2, pp. 11–27, 2017.
- [100] 'George Floyd death: Why do some protests turn violent?', *BBC News*, May. 31, 2020[Online]. Availablehttps://www.bbc.co.uk/news/world-us-canada-52869563[Accessed: 20November2020].
- [101] M. Peffley et al., 'The intersection of race and crime in television news stories: An experimental study', *Polit. Commun.*, vol. 13, no. 3, pp. 309–327, Jul. 1996 [Online]. Available: 10.1080/10584609.1996.9963120.
- [102] L. Abraham and O. Appiah, 'Framing News Stories: The Role of Visual Imagery in Priming Racial Stereotypes', *Howard J. Commun.*, vol. 17, no. 3, pp. 183–203, Sep. 2006 [Online]. Available: 10.1080/10646170600829584.
- [103] C. D. Batson et al., "I've Been there, Too": Effect on Empathy of Prior Experience with a Need', *Pers. Soc. Psychol. Bull.*, vol. 22, no. 5, pp. 474–482, May 1996 [Online]. Available: 10.1177/0146167296225005.
- [104] B. A. Gault and J. Sabini, 'The roles of empathy, anger, and gender in predicting attitudes toward punitive, reparative, and preventative public policies', *Cogn. Emot.*, vol. 14, no. 4, pp. 495–520, Jul. 2000 [Online]. Available: 10.1080/026999300402772.
- [105] A. Macaskill et al., 'Forgiveness of Self and Others and Emotional Empathy', J. Soc. Psychol., vol. 142, no. 5, pp. 663–665, Oct. 2002 [Online]. Available: 10.1080/00224540209603925.
- [106] '2017-Hollywood-Diversity-Report-2-21-17.pdf'. [Online]. Availablehttps://bunchecenterdev.pre.ss.ucla.edu/wpcontent/uploads/sites/97/2017/04/2017-Hollywood-Diversity-Report-2-21-17.pdf[Accessed: 17November2020].

Appendix

No.	Game Title
	1 Half Life: Alyx
	2 The Forest
	3 PAYDAY 2
	4 Rise of the Tomb Raider
	5 Boneworks
	6 The Walking Dead: Saints and Sinners
	7 The Elder Scrolls V: Skyrim VR
	8 Elite Dangerous: Horizons Season Pass
	9 GORN
1	0 IL-2 Sturmovik: Battle of Stalingrad
1	1 Arizona Sunshine
1	2 Star Trek: Bridge Crew
1	3 City Car Driving
1	4 The Room VR: A Dark Matter
1	5 Contractors
1	6 Fallout 4 VR
1	7 Vertigo Remastered
1	8 Payday 2: Legacy Collection
1	9 VR Paradise
2	0 Hand Simulator
2	1 Creed: Rise to Glory
2	2 VR Kanojo
2	3 Rick and Morty: Virtual Rick-ality
2	4 Vacation Simulator
2	5 SinVR
2	6 Custom Order Maid 3D2 It's a Night Magic
2	7 Senran Kagura Peach Beach Splash
2	8 Summer Co-op Bundle
2	9 The Thrill of the Fight - VR Boxing
3	0 Deep Ocean Bundle
	1 Sairento VR
3	2 Borderlands 2 VR
3	3 Tales of Glory
	4 Hellsplit: Arena
3	5 Gal Gun 2
3	6 Fruit Ninja VR
3	7 LA Noire: The VR Case Files
3	8 Gun Club VR
3	9 Love Vibe: Aria
	0 Surgeon Simulator: Experience Reality
	1 Paranormal Activity: The Lost Soul
42	Tiny Town VR
----	--
43	Raw Data
44	Hatsune Miku VR
45	First Person Tennis - The Real Tennis Simulator
46	Shadow Legend VR
47	Arizona Sunshine - Dead Man DLC
48	Hotel R'n'R
49	Westworld Awakening
50	Serious Sam VR: The Last Hope
51	The Exorcist: Legion VR - Chapter 1: First Rites
52	Down the Rabbit Hole
53	Final Assault
54	A Fisherman's Tale
55	Accounting+
56	Out of Ammo
57	KOBOLD: Chapter 1
58	Suicide Guy VR
59	Titanic VR
60	The Curious Tale of the Stolen Pets
61	A-Tech Cybernetic VR
62	Serious Sam 3 VR: BFE
63	Apollo 11 VR HD
64	Nostos
65	Intruders: Hide and Seek
66	Monstrum
67	Espire 1: VR Operative
68	VR Super Sports
69	Premium Bowling
70	The Invisible Hours
71	Serious Sam VR: The First Encounter
72	Sprint Vector
73	Pinball FX2 VR
74	Itazura VR
75	Apollo 11 VR
76	Pixel Ripped 1989
77	Prison Boss VR
78	RollerCoaster VR Universe
79	Narcosis
80	A Chair in a Room: Greenwater
81	Crazy Fishing
82	Megadimension Neptunia VIIR
83	Stand Out: VR Battle Royale
84	Summer Funland
85	The Gallery - Episode 1: Call of the Starseed

86	Spice & Wolf VR
87	Knockout League - Arcade VR Boxing
88	The Assembly
89	Freediver: Triton Down
90	Mandy's Room 2: Naughty by Nature
91	Tokyo Chronos
92	Gal Gun VR
93	Pixel Ripped 1995
94	Groundhog Day: Like Father Like Son
95	Focus on You
96	DiRT Bundle
97	Mandy's Room
98	Baby Hands
99	Carly and the Reaperman - Escape from
	the Underworld
100	Cherry VX