Violent Video Games in Virtual Reality: Re-Evaluating the Impact and Rating of Interactive Experiences

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ABSTRACT
Bespoke Virtual Reality (VR) laboratory experiences can be differently affecting than traditional display experiences. With the proliferation of at-home VR headsets, these effects need to be explored in consumer media, to ensure the public are adequately informed. As yet, the organizations responsible for content descriptions and age-based ratings of consumer content do not rate VR games differently to those played on TV. This could lead to experiences that are more intense or subconsciously affecting than desired. To test whether VR and non-VR games are differently affecting, and so whether game ratings are appropriate, our research examined how participant (n=16) experience differed when playing the violent horror video game "Resident Evil 7", viewed from a first-person perspective in PlayStation VR and on a 40" TV. The two formats led to meaningfully different experiences, suggesting that current game ratings may be unsuitable for capturing and conveying VR experiences.

Author Keywords
Virtual reality; video games; violence; age ratings.

CSS Concepts
• Human-centered computing~Virtual reality • Software and its engineering~Interactive games

INTRODUCTION
Decades of research has shown that experiences in virtual reality (VR) have meaningful effects on users, often more so than experiences on traditional flat screen monitors or TVs, providing psychological benefits (such as improved learning [6,58] or mental health [29]) but also psychological harm (escalating gambling [11], manipulation [2,33]). Inhabiting a virtual body that is physically or ethnically different can increase self-confidence [89] and improve perspective-taking [1,3,57], but acts, such as violence, carried out on one's virtual avatar can be processed as happening to oneself [79]. The key mechanisms that produce these differences are the illusory experiences of 'presence', or 'place & plausibility illusion' [74], and 'body ownership'. These lead to a more immersive and active engagement with the content experienced, a feeling of 'being there', in comparison to a more passive viewing of the content on flat screens. These lab-based studies have important ramifications for the creation and consumption of mainstream commercial video games in VR, because the user moves from being a *viewer* to a *participant*. Prior studies employed bespoke virtual environments, limited in functionality (to isolate specific factors) and detail (visual/narrative) and so research needs to be done on commercial products to determine how more richly detailed and potentially multifaceted game worlds influence experience.

The effectiveness of VR is particularly important because of the recent proliferation of consumer headsets, meaning the public is now able to experience high quality linear (e.g., film) and interactive (e.g., video games) VR content on par with productions currently viewed on flat screens. As game developers and researchers strive for greater realism and immersion in VR games, they may inadvertently create experiences with unexpected effects. This leads to questions of how this emerging and lucrative field might impact the consumer, and provides challenges to media ratings bodies (MRBs), organisations that provide age-based descriptions and limits for media, such as PEGI (Pan European Game Information), ESRB (Entertainment Software Rating Board) or the BBFC (British Board of Film Classification). Rating frameworks allow us to judge the level of protection and information provided to consumers, and extract factors that are relevant across both commercial and academic VR applications.

MRBs do not currently consider content experienced in VR as being differently affecting than the same content viewed on flat screens, as the same rating and content descriptors are given to versions of a game with and without VR modes. The primary factors that elicit illusions of presence and body ownership, those that cause the unique effects of VR, are *movement tracking* and *user input realism* [19]: the extent to which physical and virtual movements match. These are technical factors, leading to experiential factors, that MRB descriptors do not currently take into consideration. In other words, we argue that *the means by which VR is uniquely effective, and the impact of those effects, are outside the remit of media ratings*. This implies the public may not be fully informed about the content of VR media or the effect it may have, increasing the risk of unwanted or unexpectedly affecting experiences. If this is the case, ratings may need to adjust.

While others have shown that technological factors contribute to increased presence [19], the consequences of this increase are unexplored: *in what ways* do experiences change with presence, and can MRBs capture this?

Issues of sensitive or extreme content in video games, particularly violence, are a recurring social concern, however, there is no strong evidence that playing violent video games leads to long-term violent or anti-social behaviour/cognition [21,42,45,83]. VR introduces a new angle to this debate, because of the demonstrable effects VR experiences can have. When the virtual body is attacked (e.g., slapped [79]) or threatened (e.g., knife [63]), or harm is caused to a virtual character [67], the viewer subjectively and physiologically responds similarly to how they respond if the attacks were real. As VR increasingly tends toward realism in experience and interaction, it becomes necessary to understand how this might affect players, and so provide accurate and robust content ratings and descriptions.

This paper examines how experiences of a violent commercial game may be different in VR compared to TV through a comparative evaluation of a 15-minute sequence from "Resident Evil 7" [15], a commercial first-person horror game that supports both VR and flat screen presentations of the same content. Despite receiving the same rating and game descriptors as non-VR versions of the game, our results suggest that subjective experience was meaningfully different in VR: participants felt more personally involved in receiving and enacting the in-game violence. This suggests that VR games may need alternative or additional game descriptors to convey this effect. Based on our results, we identify four key challenges for understanding and safeguarding against potentially problematic VR content: *Consumer Awareness, Impermissible Content, Technological Advancement* and *Longitudinal Impact*.

RELATED RESEARCH AND CONTEXT

Violence in Video Games

The link between violent video games and violent or aggressive tendencies in real-life has repeatedly been explored over the last two decades, often to entirely contradictory conclusions, and with no clear support (for in-depth summaries of this on-going debate, see [27,34,43,50]). Leading proponents of causal links between violent video games and violent behaviour such as Bushman *et al.* [14] have been accused of manufacturing consensus [37] and sensationalism [49]. Markey and Ferguson called these efforts "The Grand Theft Fallacy" [39], and it has been noted that "scholarly opinions on video games may resemble moral panics" [26].

"Moral panic" describes the reaction to a belief that consuming a given type of content fundamentally threatens societal values [18,86]. These moral panics often occur to provide people with "a sense of understanding of the incomprehensible and control over the uncontrollable" [25]. However, of note is the fact that the labelling of "moral panic" does not state that there was no negative effect present, but that what effects might be present have been exaggerated.

Re-Evaluating the Impact of Violent Content in VR

Some have suggested that VR content could be differently problematic to traditional media e.g., Madary *et al.* [48] referring to "risky" experiences such as violence. A recent sensationalist example of this view came from Bailenson [5] who, in an editorial, controversially [40,64,82] suggested that VR games represent a potential "over-the-counter digital boot camp" for mass shooters. As an experienced VR researcher, Bailenson will be familiar with how affecting bespoke, in-lab VR experiences can be. However, this specific claim is scientifically unfounded, and so research is needed if society is to have a reasoned debate on the content of games and understand whether violence in commercial VR products is problematic. It is incumbent on scientists to consistently re-evaluate the issues as and when tangible advances in gaming technology become available. VR appears to deliver such an advancement. Several studies have begun to point to significant differences between content consumed in VR versus TV or flat displays [19,51,59]. In considering the potential for psychological harm from virtual experiences, they suggested that "Virtual reality actually deserves the term reality, with all its prospects and risks". This is due to its capability to induce both an experience of "presence" in another reality, and "body ownership" of a virtual avatar.

The Unique Impact of Virtual Reality

Presence and Body Ownership

There is considerable debate on what constitutes presence [46,47,66]. Slater [74] discussed it in terms of *place illusion* (PI, the sensation of being in a real place) and *plausibility illusion* (PSI, the illusion that the scenario being depicted is actually occurring). Slater suggested that PI was constrained by the capability of the VR technology to *statically* portray virtuality with the same fidelity as reality. PSI was "the overall credibility of the scenario being depicted in comparison with expectations", for example the plot and narrative, the reactions of, and interactions with, virtual characters and the environment. Lombard and Jones [47] proposed other dimensions, such as spatial presence (akin to Slater's place illusion) as well as both delving more deeply into what constituted plausibility e.g. social presence, self-presence, and other experiential dimensions such as engagement, aspects arguably touched upon in consumer VR games.

Slater argued that "when both PI and PSI occur, participants will respond realistically to the virtual reality". This is evidenced in 'body ownership' or self-presence, which refers to the extent to which you believe that the virtual body of your VR avatar is your own. The illusion of body ownership requires both PI (e.g. at least partially correlating the virtual portrayal with the physical body position) and PSI (e.g. having the environment react to your touch). Experimentation has shown that our brains are particularly adaptive when it comes to body ownership, being able to "alter our sense of self and identity" [7]. See [19] for an overview of presence.

As Cummings & Bailenson [19] note, technology has continually advanced to increase our sense of presence in VR,

more recently adding room-scale head tracking, tracked input controllers, increased resolution, etc, all in at-home commercial devices. The key technological contributors to presence are *update rate*, *level of tracking* and *input realism*, with visual fidelity (a common aspiration in gaming) comparatively less important [19]. Fundamentally, it can be expected to tend toward the "reality horizon" [78] where VR approximates reality in sensorimotor contingencies and plausibility.

Psychological Effects of VR Experiences

The immersive and convincing nature of VR technology has been seen to have profound effects and provide meaningful benefits to an individual's cognition or behaviour [78]. There is an expanding body of research using VR for treating mental health issues including anxiety and paranoia [29]. VR can also influence memory: Schone *et al.* [69] linked VR experiences to more ingrained autobiographical memory than 2D video, and Segovia & Bailenson [71] found that VR can lead to false memory acquisition. Such ingrained or vivid recall could be both beneficial (e.g., learning) or detrimental (e.g., traumatic), depending on the nature of the experience. In a virtual teaching scenario, having a virtual lecturer regularly look directly at him/her improves the student's learning [6]; inhabiting taller or more attractive avatars can improve the user's self-esteem, even longer term outside of VR [89]; and seeing a digital representation of themselves doing physical activity increases a user's level of exercise, both inside and outside VR [28]. These effects occur because presence and body ownership in VR make the events feel more real.

The sense of 'realness' in VR also presents significant risks. Seeing one's virtual body being threatened with a weapon leads to a feeling of real physical threat and the corresponding physiological reaction [41,63] and causing harm to virtual characters can cause emotional distress [75]. The immersive worlds and avatars inhabited can have strong psychological effects on identity or personality: while attractive avatars foster positive self-identity, unattractive avatars can also lead to negative self-identity and more permissive attitudes [89]. Seeing a virtual representation of oneself consuming a product makes the user subconsciously favour that brand [2]. Users will gamble large amounts to match what they believe are real players, when they are in fact AI [11].

While there is little sound evidence showing negative cognitive or behavioural effects of violent, scary or sexual media (e.g., [23]), body ownership/embodiment leads the user to experience events first-hand. It is not known how this perspective might change the effects of violent or frightening media. As Madary *et al.* [48] note, embodiment may lead to "new risks generated by using VR by researchers and the general public...watching a film or playing a non-immersive video game cannot create the strong illusion of owning and controlling a [different] body". Fundamentally, VR can change how individuals view themselves and others, both positively and negatively (for a broader summary, see [73]).

VR and Realism in Game Experience

Research has investigated the effects that greater technological realism has on the enjoyment and experience of games. The way in which games are viewed influences game experience, as larger screens (e.g., [35]) or VR HMDs (e.g., [62]) lead to greater presence or immersion than small, flat screens, though this may be dependent on the fidelity and tracking level of the HMD (e.g., [24]). Motion controls also frequently lead to greater game enjoyment, perceived game realism and presence [52,72,87,88]. However, this outcome varies (e.g., [44]) and may be related to the type of game being played (e.g., sports vs. first-person shooters [12]). Immersion can amplify both positive and negative affect, depending on the nature of the task engaged in [38], and increased input realism further increases presence and immersion, which research outside of gaming has shown can increase self-avatar identity merging [41,89]. These patterns suggest that research is needed for us to understand if game experiences in VR may have stronger effects on players than traditional ways of playing games.

Video Game Ratings and Content Descriptors

As video games are a commercial endeavour, there are agencies that provide consumer-oriented guidance and information about the content of interactive media, primarily with the purpose of ensuring that children do not view content that is deemed unsuitable. Therefore, they represent the best lens through which to measure the level of protection/information provided to consumers. Two of the largest bodies are Pan European Game Information (PEGI) [60], that rates games for European territories; and the Electronic Software Rating Board (ESRB) [22], which covers North America and Mexico. Ratings boards tend to consult social, legal and scientific views to construct multi-tier rating scales based on age, judging what types of content are suitable for what age ranges. The age thresholds vary widely from body to body, though there is consensus at a 17/18-year-old top rating [91].

The legal mandate of game ratings varies by country, in some cases age ratings are legally enforced, while in others there is no enforcement. Major console manufacturers (e.g., Sony, Microsoft, Nintendo) and platform holders (e.g., Google Play) will not sell games without a PEGI or ESRB rating. A creator submits a description of the in-game content to the rating body, who then checks portions of it, before being able to receive a license to attach an age rating, and the implicit approval it brings, to their product. However, the Oculus VR store [56] does not require active vetting by the rating body before receiving a rating, and Valve's Steam store [85] has no requirements or restrictions on what is sold. This may leave PC VR users less protected/informed than on console.

For simplicity, the remainder of this section focuses on PEGI, as it is our local agency, and is responsible for informing hundreds of millions of people in Europe. However, as PEGI is part of IARC [36], an international effort to standardize ratings, they are representative of global game rating approaches. We also focus primarily on the aspects of PEGI related to violent content, though we believe VR may also have significant impact on the experience of sexual [30] or discriminatory content [31]. We will explain the current structure of the content descriptors and PEGI questionnaire,

including what content calls for a higher age rating, before discussing what we see as important limitations and issues with the process that need attention and research.

Age Ratings and Content Descriptors

PEGI uses five ratings of 3, 7, 12, 16 and 18, indicating the minimum age the player must be, and seven "content descriptors" upon which the age rating is judged: *Violence, Bad Language, Fear, Sex, Drugs, Discrimination* and *Gambling*. Manufacturers of VR headsets have advised that no child under the age of 12 (PlayStation VR) or 13 (HTC Vive, Oculus Rift) use their headsets, though the reasons why are unclear. It may be because young children are in a "critical period in visual development" [13] or simply that there is a danger of harm from unsupervised movement. Therefore, ratings 12 and above are most relevant for VR. Of the products given ratings of 12+ in 2017, 903 (83%) contained violence [60].

Of the 34 items with content descriptors in the PEGI questionnaire [61] (that content creators complete as part of submission), 18 (53%) relate to depictions of Violence. 4 relate to Sex, 3 each to Gambling, Drugs and Bad Language, and 1 to Discrimination, Fear and Horror. The creator must indicate if their game includes any of these depictions and accept the highest corresponding rating. The single entry for Fear requires a maximum rating of 7, when there are *"Pictures or sounds likely to be scary or frightening to young children"*. The one Horror entry requires a maximum rating of 12 when there are *"Pictures or sounds likely to be horrifying"*.

No fear-inducing content is considered in need of a rating higher than 12, despite the significant negative affect fear can induce. The heightened presence and body ownership in VR could increase the intensity of fear or horror responses, meaning that games that had a 7 rating for fear, or 12 for horror may need additional warnings, or even higher ratings, when in VR. While strong violence requires a high rating (16/18), and so requires greater safeguards, strong fear/horror content in VR can be available to much younger children. Examples of Violent content and the required age ratings are:

> *"Depictions of realistic looking violence towards fantasy characters"* (12)
>
> *"Depictions of realistic looking violence towards human-like or animal-like characters"* (16)
>
> *"Depictions of gross violence, which includes torture, dismemberment, sadism and horrific depictions of death or injury towards human-like or animal-like characters"* (18)

It is important to emphasise the word "depictions" ("pictures" in the fear/horror items) because many of the content descriptors focus on what is *seen*, rather than what is *done* by the player, or how the technology (how it is played) could have an effect. As these examples indicate, there are certain themes which influence the required rating, and a reading of the questionnaire indicates that they fall under the following general terms: *character design, setting, target/recipient, realism* and *gratuitousness*. Violence towards characters that are more animal-like or human-like (compared to e.g., alien designs) requires a higher rating. Minor violence in more fantastical settings is permissible at lower ratings (7/12). Violence against "innocent" or "vulnerable" human characters, especially if "motiveless" requires an 18 rating. Increasing the behavioural realism of *viewed* acts of violence, or the extent/gratuitousness of violence, leads to higher ratings, with only minor non-injurious harm permissible at a 12 rating.

Issues with Applying PEGI Ratings to Virtual Reality

Game ratings may focus on what is "seen" because they originated from agencies responsible for rating linear media (TV, film), where the only relevant factors were what was seen and heard. PEGI does not take technology into account, such as how the game is played. Problematically, the key ways in which VR has an influence on experience are technological: increasing the number of tracked degrees of freedom (head and body) increases presence and, thereby, increases the effects VR can have on a user (e.g., over stereoscopic displays [19]). Through presence, VR games may be more likely to induce behaviours or attitudes vs. 2D [8,10,17,58,90], by more personally identifying or interacting with virtual characters, or by feeling events are really occurring. "Realism" is a key factor in PEGI ratings, but only in terms of how realistic or detailed the viewed acts of violence are. VR induces a different sense of "realism". This means that the wording in the PEGI questionnaire may not be able to capture VR-induced effects on users. Comparatively, viewing violence being enacted on the player character in VR is likely to have a stronger effect than when on TV, as the violence is felt as if it is really happening [67,77,79]. Therefore, it is not just what is *seen* but how personally involved the user feels that has an effect, and this arises from technologically-mediated place and plausibility.

While PEGI does not annotate VR and non-VR games differently, games that make use of Sony's PlayStation VR [65] can include a statement on the back of the box saying "PlayStation VR creates a sense of presence and immersion". We argue that this is also insufficient notice for several reasons. Firstly, the text is very small compared to the rest of the material (see Figure 2), and it is in amongst the standard copyrighting labels at the bottom (what one participant in our study called "pollution"). Secondly, the word "presence" is rather uninformative by itself and more of a specialist term among people familiar with VR. Finally, "immersion" has long been used as a generic term for a state of being engrossed in an activity [16,38], so it does not adequately convey the sense of realism in VR. Therefore, we argue that better labelling and description of content may be needed.

Summary

VR can be a uniquely affecting medium, with cognitive and behavioural outcomes arising from bespoke, in-lab experiences. With commercial VR now proliferating, it is incumbent on researchers to determine if these effects carry over, and ensure the public is informed and protected. Currently, VR games are not rated as experientially different from traditional games by bodies such as PEGI, at least partially because the effects of VR may be outside the remit of the adju-

dication process. To investigate how the experience of violence in video games may differ between VR and TV presentations, we ran a study where participants played the game Resident Evil 7 on PlayStation VR and on a 40" TV.

RESIDENT EVIL 7

Resident Evil 7 (RE7) [15] is a 'survival horror' game played from the first-person perspective of protagonist Ethan. RE7 received the PEGI rating of 18 because of extreme violence and bad language. While this puts the game at the top of the rating scales, we are not arguing that VR games should necessarily have higher ratings: we are interested in whether the content descriptors, upon which *all* age ratings are based, are capable of taking the effects of VR into account. A game at any rating may need alternative or additional descriptors to explain the experience. However, as shown above, an increase in the realism, gratuitousness, or sexual nature of content calls for higher age ratings. If VR results in such effects, age ratings themselves may indeed need to be reconsidered. Further, an 18 rating does not fully preclude younger people from playing: it is unclear whether parents are aware of, and adhere to, game ratings when buying games for children [4,20], and these experiences could be particularly affecting.

Our reasons for using RE7 include that the in-game content is representative of what is frequently experienced in video games, such as violent attacks with weapons and scenes of blood, gore and death. This representativeness makes it a useful reflection of how mainstream violent/horror content could be differently affecting in VR. Also, at the time of writing, RE7 is only playable in VR on PlayStation 4 (PS4), and PEGI gave the same 18 rating and content descriptors to all three versions of the game (PS4, Xbox One and PC): the addition of VR content has not led to different descriptions.

The sequence played is an early part of the game in an abandoned house: it starts with exploration with no enemies or explicit threat, followed by a segment with frightening environmental noises, and ends with a segment where the character is directly attacked with a knife, and attacks the human assailant with an axe. Participants were informed of the graphic nature of the game by viewing a trailer and a gameplay excerpt before consenting to take part. They were also told that, if the experience became too uncomfortable at any time, that they should stop playing immediately. The same sequence was played in both Presentation methods.

EXPERIMENT: EFFECTS OF PRESENTATION METHOD

The game was played on a standard PS4 console with Dualshock 4 controller. The VR condition used the PlayStation VR headset (PS VR [65], Figure 1, left), whose 3D position and orientation is tracked by a PlayStation Camera. PS VR contains a 5.7-inch 1920 x 1080 OLED display and a ~100° field of view. It weighs ~610g with dimensions of 187 x 185 x 277mm. The flat screen was a 1920 x 1080 40" Sony Bravia TV. All participants played the game standing up, to reduce the mismatch with Ethan's posture in-game. The controls used in both conditions are standard first-person controls, except for rotation using the right thumbstick: this was continuous in the TV condition, but involved discrete 30° shifts in VR, as continuous rotation increased simulator sickness. The left thumbstick moved Ethan horizontally, X/O buttons picked up/placed down objects, and R2 (on top of the controller) defended or attacked, depending on the context.

Virtual Reality Presentation

The game world fills the 100° field of view and is viewed in stereoscopic 3D; it is rendered at 60fps but displayed at 120fps via reprojection. When participants move their head, through rotation or 3D translation, the in-game camera (from Ethan's point of view) changes in the same way. Character walking movement is controlled using the Dualshock 4.

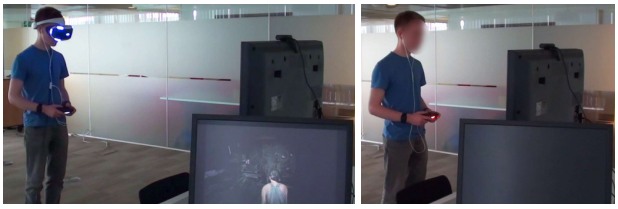

Figure 1: VR condition (left) and flat screen condition (right).

Flat Screen Presentation

Participants viewed the TV from 1m away (Fig. 1, right). The smaller the screen, or the further the viewer is from it, the smaller the field of view (FOV) occupied by the game. As VR encompasses the player's view, we wanted to have a flat screen setup that maintained a high FOV, to not confound the condition and reduce engagement [35]. The game is still viewed from Ethan's point of view, but the game world is in 2D (not stereoscopic 3D). The game was rendered at 60fps.

Participants

Twenty participants (10F, 10M), aged 18 or over, volunteered for the study, being paid £10 compensation. Participants were required to take part in both Presentation conditions, in a counterbalanced order. While they would be familiar with in-game events in the second condition, it allowed them to reflect on the differences between VR/TV experiences. One participant left the study part way through her first condition (VR) as the experience was too frightening, while two others left their VR condition due to simulator sickness. One participant had to leave after her first condition for personal reasons. This left 16 participants (6F) aged 18-30 (mean = 22.4) who completed both conditions (60 mins).

We chose to only recruit participants who stated they had some familiarity with games consoles and controls, for two reasons: 1) those who play games are likely to experience this kind of content, so we would not be taking measurements from unrepresentative users; 2) being unfamiliar with game controls would mean that the participant would need a longer practice session, or would spend more time in-game, to become familiar with how to play. This could lead to uneven exposure and game-time across participants, and so either more sustained emotion or frustration/boredom.

Measures

To get multiple perspectives on the participants' experiences, we employed self-report questionnaires and semi-structured interviews. They are organised here in relation to when they

were administered: after a condition or after completing the study. Upon arrival, participants first completed the 20-item state section of the State-Trait Anxiety Inventory (STAI) [80], to get a baseline measure of anxiety. The STAI is an established and validated means of measuring both trait and state levels of anxiety in clinical and non-clinical fields. Anxiety was measured because of the horror themes in RE7.

After each condition – Participants again completed the 20-item state STAI and a single question about their level of simulator sickness. Presence was measured using the 14-item Igroup Presence Questionnaire (IPQ) [70]. Body ownership was captured using 7-point Likert scales adapted from previous studies [41,76,79] to suit the nature of the RE7 sequence (from "Strongly Disagree" to "Strongly Agree"): 1) *"I felt as if the virtual body was my body"*; 2) "*When Mia was attacking, I felt this as if it was an attack on my own body"; 3) "When Mia was attacked with the axe, I felt as if I was physically attacking her"; 4) "When Mia was attacked with the axe, I felt personally responsible for this"*.

These questions were intended to measure if the participant felt they inhabited the virtual body (1) and if VR led to feelings of responsibility or participation (2-4). They are also important for identifying potential sources of experience that ratings/content descriptors are not sensitive to. PEGI ratings do not consider who in the game (player or other) is the victim or perpetrator of violence, and so we wanted to gain insight into whether VR experiences of player-directed, or player-enacted, violence led to different psychological states.

Post-study – Once both conditions, and their associated questionnaires, had been completed, participants were engaged in a semi-structured interview. They were first asked "*Did the two experiences, in VR and on a flat screen, feel the same?*" and, if not, how they differed. Because participants played the same section of the game, emphasis was placed on the "experience" of the two formats, rather than the game itself. Participants were then shown print-outs of the box cover art and information that RE7 is sold with (Figure 2).

Figure 2: PEGI 18 rating and Language/Violence content descriptors on the RE7 box (top right), and PS VR notice (zoom).

Participants were given a few minutes to look over the box before being asked "*Having experienced both formats, do you feel that the box materials, particularly the PEGI information, adequately informs you about what you experienced in both?*". If they felt the materials did not adequately inform them, they were asked what they felt was missing, or what they wished they had been informed about. They were next asked "*Was the VR experience similar to what you expected it to be?*", to get an idea of how different VR experiences are from what is imagined. Two final questions asked, "*How comfortable was the headset?*" and "*How easy was the game to control?*", examining if discomfort/awareness of the headset or difficulties with the controls impacted the experience.

Procedure

To prevent simulator sickness or a lack of playing proficiency from interfering with his/her experience [8], each participant completed an initial 5-minute acclimatisation session where they could experience movement in VR and learn the controls outside of the experimental sequence. For both presentation methods, a safe quiet room with no enemies was used. An acclimatization session preceded each condition and participants were excluded if they felt moderate or higher levels of simulator sickness.

To increase the likelihood that participants started the study in a similar emotional state, they watched 2 minutes of a relaxation video of a forest stream (on 15" laptop screen), similar to those used to induce contentment [32], before completing the baseline STAI state questionnaire. The controls and PS VR headset were then demonstrated, and the acclimatisation session started. If low levels of simulator sickness were reported, the participant sat away from the TV/PS VR while the experimental sequence was loaded. Once the first sequence had finished, participants were told to stop, hand over the controller, and take the headset off. They immediately completed the STAI, presence and body ownership questionnaires, and took an additional 5-minute break. Participants again watched another 2 minutes of the relaxation video, before completing the second condition. The experiment ended with the semi-structured interview. The Independent Variables were *Presentation Method* (VR vs flat screen) and *Condition Order* (VR first vs. TV first). The Dependent Variables were: *Duration*, state *Anxiety*, *Presence, Body Ownership* and *Subjective Interview Responses*.

Results

Effects of Presentation Method

For this analysis, only the data from each participant's first condition (8 x VR, 8 x TV) were compared using Mann-Whitney U pairwise comparisons. The average *Duration* for each participant's first condition was 10:18, ranging from 7:15 up to 13:32. Durations for VR conditions ranged from 8:58 to 13:10 (mean = 10:47, SD = 1:28) and TV conditions ranged from 7:15, to 13:48 (mean = 10:10, SD = 2:31), differences that were not significant ($U = 23.5$, $p = 0.37$).

Anxiety – There was no significant effect of Presentation Method on self-reported state Anxiety ($U = 24.5$, $p = 0.44$). Playing in Virtual Reality led to a mean anxiety score of 44.6 (SD = 9.59), while playing on TV led to a mean anxiety score of 39.4 (SD = 12.30). Each participant's first condition was also compared to their baseline anxiety, to examine if both

conditions influenced anxiety levels. Both VR ($p = 0.04$) and TV ($p = 0.006$) conditions led to significantly higher anxiety.

Presence – There was a significant effect of Presentation Method on overall IPQ score ($U = 2.00$, $p = 0.002$), as VR led to significantly higher presence (mean = 4.54, SD = 0.33) than playing on TV (mean = 3.43, SD = 0.56). VR also led to significantly higher values for the General, Spatial Presence and Realness sub-scales, but not for the Involvement subscale. Note that Involvement here describes the attention paid to the virtual world (awareness of the real world), not involvement in the virtual events.

Body Ownership – Presentation Method also had a significant effect on feelings of Body Ownership ($U = 9.5$, $p = 0.017$), with VR leading to greater body ownership (mean = 3.18) than TV (mean = 2.22).

Condition Order & Within-Subjects VR vs. TV

We next included the data from both of each participant's conditions, to analyse all within-subjects data and to determine any effects of Condition Order or interactions between the IVs. We used a mixed methods ANOVA, with Condition Order as between-subjects and Presentation Method as within-subjects factors. η_p^2 indicates effect size.

Anxiety – There was no significant effect of Condition Order on reports of Anxiety ($F_{(1,14)} = 0.68$, $p = 0.42$, $\eta_p^2 = 0.046$), and no significant interaction between Condition Order and Presentation Method ($F_{(1,14)} = 0.18$, $p = 0.68$, $\eta_p^2 = 0.013$). Averaged across both conditions, VR led to a mean anxiety of 43.69, and TV to 41.87.

Presence – Presentation Method had a significant effect on Presence ($F_{(1,14)} = 49.09$, $p < 0.001$, $\eta_p^2 = 0.78$), with VR leading to higher Presence (mean = 4.69) than TV (3.22). There was a marginal non-significant effect of Condition Order ($F_{(1,14)} = 4.16$, $p = 0.06$, $\eta_p^2 = 0.23$). There was no interaction effect ($p = 0.8$). For mean values see Table 1.

	First Condition		**Second Condition**	
	VR	*TV*	*VR*	*TV*
Anxiety	44.63	39.38	44.38	42.75
Presence	4.54	3.42	4.84	3.0
Body Own	3.18	2.22	3.87	2.47

Table 1: Mean values for each measure under each condition.

Body Ownership – Presentation Method again had a significant effect on feelings of Body Ownership ($F_{(1,14)} = 27.36$, $p < 0.001$, $\eta_p^2 = 0.66$), with VR leading to greater body ownership (mean = 3.53) than TV (2.34). There was no effect of Condition Order ($p = 0.63$, $\eta_p^2 = 0.02$). There was a significant interaction effect between Presentation Method and Condition Order ($F_{(1,14)} = 4.26$, $p = 0.05$, $\eta_p^2 = 0.23$). Body Ownership for TV (2.47) was higher when played after VR (3.18) than when played first (2.22), yet Body Ownership in VR was highest (3.87) when played after TV (see Table 1).

Participant Interviews

Two researchers independently conducted Initial Coding through Descriptive (for main themes) and In Vivo codes (for detail and specific experiences). Coded phrases were discussed collaboratively, agreeing a common code set. Focused Coding categorized the most frequent and significant agreed codes based on the paper themes [68]. Representative excerpts are provided. When asked if the experience of playing RE7 on a TV and in VR was the same, every participant stated that it felt different, to greater or lesser extents. From the use of adverbs or qualifiers when talking of differences, nine expressed strong differences (e.g., "*very*", "*completely*" different); five saw moderate differences (e.g., "*they felt different*", "*quite different*"); and two saw minor differences (e.g., "*slightly different*", "*VR was a bit more immersive*").

The World and Events Felt Real

Twelve participants indicated that either or both of 1) the game world, and 2) the events taking place, felt more "real" in VR, that the world was "*encompassing*" (P1) or "*visceral*" (P11), which is supported by the significantly higher presence scores, including Spatial Presence and Realness scales:

P9: "It changed how real it felt, at some points I felt I could get closer to stuff and see more detail…in VR"

P12: "VR felt really like I was there…it felt more sort of palpable, like I could almost touch the [game world]"

Three participants (P13, 14, 16) who played in VR *after* playing on TV commented that VR still felt scarier, even though they knew what was going to happen. The statements also tie into another topic expressed by eight participants, that of feeling personally involved in the events:

P16: "it felt more like I was doing stuff in [VR]…it felt like stuff was actually coming at me, I wasn't just watching it happen"

P2: "especially at the…end, when she gets the axe to the neck, I felt really sorry [for her], I felt like really [empathetic] 'ugh'"

These comments correlate with the higher body ownership scores regarding physical or personal responsibility for in-game actions. Playing in VR made some participants feel more like they were actively involved in the violence, that it was happening to them, or that they were carrying out the violence themselves (further comments below).

Interactional Realism

Twelve participants commented on the impact of interactional realism, either how it influenced their experience, or would have, if it was better:

P3: "You could actually look around [as in reality] in VR"

P2: "If I had [motion controllers] then I would probably be flailing wildly and if I saw the knife coming at me I would probably do that [holds his hands up in a protective pose]"

P8: "if you do it [act out the attacks] yourself, that would probably make a bigger difference"

The comment from P8 points to how improving interactional realism might increase the user's engagement and investment in the content but combining this with greater feelings of responsibility could be affectively problematic. Our use of a traditional controller diminished the realism of the experience, as there was a disconnect between the player's action (pressing a button) and the characters action in-game (e.g., swinging an axe). Also, while participants knew they could

move their head in VR, and did so during the acclimatization process, several stopped doing so while playing the sequence. It appears to be because of the strong familiarity with playing traditional games, where the thumbstick moves the viewport, a disposition that may have been reinforced by playing on a gamepad and not motion controls (which are not currently supported in the PS4 version of the game):

P14: "Sometimes you forget you can tilt your head around [in VR] cos you have a joystick, so it's a bit funny"

Other aspects that impacted the sense of realism were the disembodied arms of Ethan, and the discrete turning method:

P9: "[realism] lacked a little bit when you see the hands floating"

P1: "The clunkiness [of movement] partly impacted presence, I felt like I was looking at the VR rather than the game"

P1 refers to the angular jumps used to turn in VR: this movement is unusual, but it was chosen to minimise simulator sickness. While a few participants explicitly stated that they noticed it, others did not, or did not indicate that it impeded their experience. Movement in the TV condition was also criticised for being "sluggish" (P10) or hard to control (P9).

The Adequacy of Game Information & Content Descriptors

The second question asked whether the information shown on the game box, including the PEGI rating information, sufficiently informed or conveyed the experience that participants had in VR and on TV. Six participants agreed that the words, pictures and labels sufficiently described, or warned potential players about, the content of the game:

P16: "It says it's an 18, it says there's going to be violence…which seems accurate"

P9: "'well, it's a game', it's not going to be that terrible"

Nine participants found the materials lacking in detail:

P15: "There's not so much gore in the pictures…I would have something like 'horror' or 'gore' rather than 'violence'"

P9: "when I saw the trailer…I had an idea of what it would be, from [the box] I know it would be horrifying but not as it actually is"

While these comments show that the box is mostly informative about what is seen, six participants explicitly commented on the comparative realism of the game in VR vs. TV and how this could be described (if they thought it need be):

P12: "I'm not sure if this would make people aware of the VR one… In terms of how it really did feel quite real…I'm not sure how you'd be able to put that into words"

P6: "when I see "violence" I don't really know what that means, because obviously that was violent towards you but also you were being violent. So…maybe that doesn't quite capture it…There was maybe a bit more of a horror aspect [of the violence] being a part of you, that wouldn't be captured in "Violence" and then you being violent, especially"

The comment from P6 ties back to the comments of increased personal involvement in the game, and they have potentially important ramifications for consumer games, whose interactive nature inherently require actions to be done *to* the player and *by* the player, be it negative acts like violence or intimidation, positive acts like helping or social bonding, or potentially problematic acts like sexual acts. As we suggested, the illusions of presence and body ownership present challenges to how interactive content should be described.

Given the ubiquity of comments about how "real" the world or the events felt, it was surprising that few participants offered comments on how to express that feeling on the game box. This could be because the box describes the overall tone (e.g., horror, violence) which is much the same in VR and on TV, and so they felt it was not necessary. It could also be because these experiences are new, and traditional materials, including age rating content descriptors, have not conveyed this aspect of games before, they only focus on what is shown. No participant noticed Sony's label regarding VR creating a sense of "presence and immersion", likely because it is small print and part of the copyright box. When it was pointed out, some agreed that it goes some way to expressing the experience, but that it fails to adequately do so, and that it is hard to suggest how this could be explained.

GENERAL DISCUSSION

The results from the study suggest that playing Resident Evil 7 in VR led to meaningful differences in experience, compared to playing it on a flat screen TV. As expected, it elicited higher levels of presence and body ownership. All participants reported that the experience in VR felt different to the experience in TV, though the perceived differences varied: some reported minor differences while others much greater differences. A common report was that VR made the virtual world and/or the events portrayed in the game feel more "real", as if the participant was more personally involved, or at least physically co-located with events, with stronger perceptions of both enacting and receiving violence. We argue that these are meaningful differences in experience and the results show that the immersive effects of VR observed in bespoke laboratory settings can be predicted to also occur in commercial products.

While VR consistently led to higher average anxiety ratings, these were not significantly different from those reported under the TV condition. This could be for several reasons. Firstly, anxiety may not be the best indicator for measuring the effect of a violent horror game. Secondly, the average duration of play was shorter than expected (10:18), so longer or repeated play sessions may more strongly influence emotional responses. Finally, we asked participants to stand close to the TV, so as not to play with a small FOV, potentially increasing the emotional impact over at-home distances [35].

Anxiety levels were comparable across the two Presentation Methods when VR was done first (VR = 44.6, TV = 44.4), but playing on TV first, the values were further apart (VR = 42.7, TV = 39.7). While the interaction was not significant for Anxiety, it was for Body Ownership and the values followed a similar pattern: the results suggest that the immersive effects of VR might carry over to the later TV condition, as effects of VR have been shown to continue after leaving

the virtual environment [17,29,89], while the comparative jump to VR from TV led to more intense responses.

The Impact of the Participants and Chosen Game

It is important to discuss the influence that the chosen platform (RE7 in PS VR) and the participants may have had on the results. For ethical and empirical reasons, we used participants who were familiar with games and were forewarned about the type of content they would experience. Therefore, it could be argued that the effects observed represent something of a 'best case scenario': participants were somewhat prepared for what they would experience and, to varying extents, familiar with typical game content. Gaming is now a larger entertainment medium [55] than film [81]. As more mainstream VR content is created, the more likely it is that people of all tastes and interests will be exposed to different experiences, some of which may be unwanted.

Also, RE7 represents an early example of a mainstream VR game, one still tied to a gamepad and running on limited computing resources. Five participants commented that the visual fidelity in VR was poorer than on TV, and for a few people, turning and attacking with the gamepad detracted from the immersion and sense of involvement in VR. Motion controls are available for PS VR (though not for RE7), the HTC Vive and Oculus Rift, which could increase interactional realism, forcing the player to physically swing their arm to attack with the axe. These headsets, and near future iterations, will also provide improved visual fidelity over the current PS VR. Improving visual and interactional realism leads to increases in presence [19], so the meaningful differences in this 'best case scenario' include not only 'conditioned' participants, but also a game of limited realism.

PEGI Ratings & Descriptions of Violent VR Content

We argue that the VR version of the game led to meaningful differences in experience, and so it suggests that VR games, or games that include the option of playing in VR, might need to include additional information or notices about the nature of the experience. While some participants were comfortable with how informative the game box and PEGI information were, several felt it lacked in detail concerning the level or nature of the violence, and others stated that the sense of realism made receiving or enacting violence more personal and potentially horrifying. All participants discussed how different the game felt to play in VR yet struggled to articulate how this could be explained to consumers.

PEGI and other ratings bodies do not consider the user being a target or enactor of violence as a relevant factor, only what violence is seen in the game. The frequency of comments about how participants felt they were actually involved in the violence suggests this is a meaningful distinction. Physiologically, we respond similarly to virtual and real physical assault [79], and causing virtual characters pain causes similar distress to real situations [75]. Games that have violence enacted upon, or by, a player in VR must consider that the person may feel physically attacked or responsible: inherently unpleasant experiences. A PEGI descriptor for 18-rated violence states "The emphasis is on the horrific nature of the violence" (Q1 [61]), and what our results suggest is that what makes violence "horrifying" may not just be what is *shown*, but how *involved* the player feels. In the same descriptor (Q1) it states that "*violence will not be treated as gross violence if the recipients die or are injured in an unrealistic manner*" but, in VR, users may feel more responsible for a death, and the "realism" of injuries is not limited to their portrayal.

It should be noted that this sense of realism is not in itself an inherently problematic effect, it is an agnostic mechanism by which content could have effects that need to be considered. In the case of RE7, realism led to violence that felt more real. However, in an adventure game, it could be the sense of accomplishment in climbing a mountain that feels more real. RE7 is already rated 18, the highest PEGI age designation, and so any additional labels or content descriptors would act to better inform adults of what they might experience.

Extrapolating our findings to other potential content, we can hypothesise that realism may be more of a concern in cases where games rated 12 or 16 contain milder violence, some mild sexual content or fear/horror, which are then intensified. The Q1 descriptor above could apply to less visually realistic violence in a 16-rated game, but which may feel more real when played in VR, potentially justifying an 18 rating. A game requires a 16 rating over a 12 when there are "*depictions of realistic looking violence towards human-like or animal-like characters*" (Q11). Again, the realism of violence is not just in the "depiction" but in the *involvement*. Similarly, a game will require a 16 rating over 12 when a "*depiction of nudity…could result in sexual arousal*" (Q15), and presence/body ownership in VR could make nude or semi-nude characters more arousing [30]. VR, particularly from a first-person perspective, increases realism in a manner PEGI does not currently take into consideration (that the events feel real). This judgement must be based on the nature of each game, but if realism is a factor in age rating, then VR-elicited realism may also be a factor. While we focus on PEGI, the factors governing ratings are similar across IARC [36] members, including North America's ESRB and others, and so our discussion here is relevant across ratings agencies.

Recommendations

When considering what recommendations to provide about how interactive content could be labelled or described differently, it is important to first consider the limited context from which our results arose, compared to the wide array of interactive content available. This study represents one insight into the differences between VR and TV experiences in a consumer product: it is from one game, of one genre (survival horror), with one control scheme and for only one experimental session. Different games with different content, or games played for longer, may reveal different effects and so call for different types of content descriptor. However, the effects we did observe appear to have arisen from the common immersive mechanisms of presence and body ownership, brought about by head-tracked interactional realism and a first-person perspective. These illusions led to most participants reporting that the experience felt more real and even

that they were personally involved, experiences that we argue need specific and clear notices. Realism is relevant across game ratings of violence, sex, gambling, crime and drugs [61], and so may impact a wide array of content.

As we argued earlier, Sony's own warning that VR "creates a sense of presence and immersion" is insufficient. We suggest that the term "*visceral realism*" may be a more explicit label or description. The effects of presence/body ownership are largely subconscious and/or inherent, so the word "visceral" (used by P11 to describe his VR experience) conveys the instinctive nature of the player's disposition and response. "Realism" clearly conveys that what is experienced feels similar to real events. "Realism" by itself, or "real experiences", may only suggest realistic portrayals of events, which does not fully capture the realism of VR. "Feels Real" perhaps moves closer to the nature of the experience, but marketing materials have often used "real" or "realistic" to simply refer to the look or behaviour of graphics, physics, vehicles or guns, *etc*. We believe that the two words "visceral realism" together imply that player experiences could feel instinctively, even irrepressibly, real.

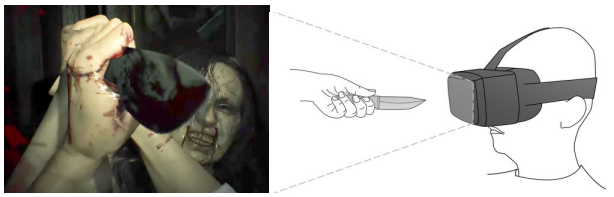

Figure 3: Example "visceral realism" experience from RE7 (left) and potential illustration for VR games (right), indicating the user may feel attacked in-game.

As participants stated, it can be difficult to define the effects of VR in words. But whatever words are used, we believe the fundamental concepts that should be conveyed are those of *realism*, *instinct* and *involvement in events*. The label could also be accompanied by an illustration, for clarity. PEGI and Sony both use icons or illustrations to convey different content or features, such as a spider for the PEGI "Fear" descriptor, or the waving lines next to a controller indicating vibration (see Figure 2). So, it may be that "visceral realism" (or its alternative) is also accompanied by an appropriate illustration. Figure 3 shows an example relevant to RE7, where a player is seen being virtually attacked in-game.

Given that VR experiences will become increasingly similar to real life, we outline four key challenges for understanding and safeguarding against sensitive VR content:

Consumer Awareness – The public need to be made more aware of how VR can influence them, and that meaningful psychological effects may be induced. Here, publishers and video game ratings agencies can play a major role in forewarning and educating the public. Public awareness is relevant across domains, however. For example, social manipulation can be strong in VR [11,33], so there is a need to protect the public from e.g., sexual assault in social experiences [9] in Facebook's future of a social VR [54].

Technological Advancement – Researchers advancing the state-of-the-art of VR experiences, interactions or feedback should consider and report how their designs might meaningfully impact the user's experience or state of mind. This will also help develop interface design guidelines that can safely increase or decrease immersion based on the preferences of the user by, e.g., altering the visual, behavioural or interactional realism, if this proves necessary. More research is needed into the comparative effects of consumer VR and TV across different types of content. We would suggest this need is a pressing one, given the rate of advancement of VR technology, and the fidelity and range of experiences already available to consumers. Of particular note is *interactional realism*: the extent to which controllers and input devices allow in-game actions to be realistically enacted. This area is being actively pursued by large companies and researchers [53,84] mimicking the tactile sensations and forces of real actions.

Impermissible Content – Ongoing research needs to be conducted into where "red lines" may exist for VR content: at what point, if any, does a portrayal, interaction or sensory fidelity reach a level of realism that is unacceptable, for social, psychological or legal reasons? Can VR serve as a "virtual boot camp" for shooters [5]? Research needs to determine if such a case is possible, and if so what guidelines or restrictions may need to be in place. Content creators should be able to push the artistic and aesthetic boundaries of their medium without potentially harming their consumers or being falsely accused of causing harm.

Longitudinal Impact – There is a lack of longitudinal research into the effects of VR experiences, as the headset devices have historically been large, cumbersome and expensive. Measuring at-home usage of VR simply has not been possible until the last few years, and research needs to be done to understand how long-term real-world experiences of VR content might be beneficial or harmful. Moral panics, and new waves of media coverage ascribing violent acts to violent VR video games may be inevitable until a concerted, and impartial, research effort can quantify both the immediate and long-term impact of sensitive VR content.

CONCLUSIONS

This paper presented an experiment that compared how participants responded to playing a commercial violent horror game in Virtual Reality (VR) and on TV. Game ratings bodies do not rate VR and traditional flat screen content differently, despite research showing that bespoke research experiences in VR can have strong and profound effects on emotion, cognition and behaviour. Our results show commercial VR products also produce meaningfully different experiences than on TV: participants reported significantly higher presence and body ownership, and that the violence received and enacted by them felt more real and personally involving in VR. Based on the results, we argue that VR games may need additional content descriptors, and discuss how to improve game ratings, to inform the public of the potentially unexpected realism of experiences, or to protect them from being exposed to unwanted or potentially harmful content.

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