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Analyzing Genre-Specific Immersion in VR Gaming: Insights from Steam Reviews

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Short Paper

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Abstract

In the realm of virtual reality (VR) gaming, the role of game genres is pivotal in shaping player immersion which is still underdeveloped. This study investigates this interplay by analyzing user reviews of Steam's top 100 VR games, utilizing the BERT algorithm to pinpoint critical immersion factors and discern genre-specific influences. The findings indicate that from the most popular VR games, there are significant differences in player-perceived immersion among different game genres. Specifically, adventure and simulation games show the highest immersion, while music rhythm games show the lowest immersion. Despite its insights, the study acknowledges limitations like dataset scope and reliance on user-generated tags, setting a path for future research.

Keywords: Virtual Reality, Text Mining, Steam Review, Game Genre, Bert, Immersion

Introduction

Virtual reality (VR) enables users to engage in the virtual world with a realistic experience. It offers a lot of tasks to users, such as walking and exploring virtual surroundings talking and interacting with others, or even doing complex tasks that look like the real world or some fantasy (Bozgeyikli et al., 2016; Slater & Sanchez-Vives, 2016). These different kinds of tasks are not just about the novelty. They allow users to go beyond physical restrictions and dive into the virtual world.

While many scholars are trying to improve the immersive experience in VR, there is a noticeable gap in understanding how different tasks affect immersion. Studies have often concentrated on technological enhancements, such as improving visual fidelity or tracking accuracy, and psychological factors, like presence and engagement (Cummings & Bailenson, 2016). However, the specific nature of tasks within VR environments and their impact on immersion remains underdeveloped.

Our study proposes to explore how different game genres affect users' immersion experiences in VR. Recognizing that each genre incorporates distinct types of tasks, we hypothesize that different genres can significantly impact the level of immersion experienced by players. Our research question focuses on identifying **how the specific tasks inherent to various VR game genres correlate with users' perceptions of immersion**.

In this study, we examined immersive experiences in VR gaming through the proportion of positive user reviews about immersion from the top 100 VR games on Steam with the BERT (Bidirectional Encoder

Representations from Transformers) algorithm. The reliance on proportional data is supported by research that suggests the number of mentions in reviews can act as a surrogate for consumer attitudes and satisfaction levels (Nikolay et al., 2011). The significance of this method is further emphasized by recent studies (Vásquez, 2015);(Zhang et al., 2023) which demonstrate a strong correlation between the proportion of review mentions of certain attributes and the consumer ratings of products.

By analyzing the reviews, we gained insights into the factors that enhance immersion in VR gaming. Our findings not only deepen the theoretical understanding of immersion but also provide practical guidance for developers to improve the immersive quality of VR games.

Literature Review

Immersion in VR Gaming

Recent advancements in VR technology have significantly enhanced the realism and interactivity of gaming experiences, pushing the boundaries of player engagement and narrative depth (McMahan, 2013). As VR continues to evolve, understanding its impact on player experience such as immersion remains a key focus of contemporary research.

In the context of VR, immersion is defined as a psychological state where the user perceives themselves to be part of the virtual environment, often experiencing a suspension of disbelief that enhances their sense of presence within the virtual world (Slater, 2018). This sense of presence, which is a key component of immersion, is described as the feeling of being physically present in a non-physical world, facilitated by the VR system's ability to provide sensory feedback that mimics real-world interactions (Lombard & Ditton, 1997).

The degree of immersion can significantly influence a user's engagement and satisfaction, affecting both cognitive and emotional responses to the VR experience (Weidner et al., 2023). Understanding immersion in VR is therefore crucial for developers and researchers alike, as it impacts the design and effectiveness of VR applications, particularly in gaming, where the goal is often to create engaging and believable alternate realities (Sanchez-Vives & Slater, 2005).

Cognitive Load Theory

Different game genres in VR can provide a unique immersive experience. Cognitive Load Theory (CLT) (Sweller, 1988) provides a framework for understanding how human cognitive processing is impacted by the complexity of learning tasks. The theory divides cognitive load into three types: intrinsic, which is the complexity inherent to the task; extraneous, which is the load imposed by the way information or tasks are presented; and germane, which is the load devoted to processing, constructing, and automating schemas. Some game genres might enhance the immersive experience by minimizing cognitive overload and facilitating a state of flow (Csikszentmihalyi, 1990).

For instance, action games often require quick decision-making and rapid motor responses, which can heighten cognitive load but also intensify engagement and arousal when well-balanced (Green & Bavelier, 2012). In contrast, adventure games often emphasize narrative and exploration, potentially creating a different type of cognitive load by requiring players to engage in complex problem-solving and decision-making within a rich story context. These activities can enhance immersion through increased narrative involvement and emotional engagement (Jennett et al., 2008). Despite substantial research, there remains a crucial gap in empirical understanding of how specific cognitive loads imposed by different VR game genres affect immersion.

Method

Data Collection

We used the Steam store to filter games based on language (English supported) and VR support (VR only) to ensure that our data is highly relevant to VR and to prevent issues with multi-language text during algorithm training. 2,938 games met the requirements. Because our sample is based on the number of user

reviews, we chose the top 100 games, which provided us with enough review data to train the language model. We gathered the reviews using the official Steam API, which offered information on every game review on Steam, such as the reviewer's time spent on the game, the text of the review, and the date of the reviews (Deng et al., 2023). Our data was collected on October 25, 2023, and in total, 282,847 reviews from 100 games were gathered.

While Meta store might be more focused on VR applications, we did not select it as our dataset because it did not provide an official API to collect user reviews.

Data Annotations for the Game Reviews

We randomly selected 2,500 reviews (25 for each game) from our dataset as the training data to train the BERT classification algorithm to identify reviews that reported a positive user experience of immersion. Using a codebook as a guide, we annotated the reviews about positive user experiences with immersion as 1 and the other reviews as 0. The codebook was referred to Deng et al.'s (2024) inclusion and exclusion criteria of immersion-related reviews, which were based on five aspects: terminology (immersion and its related terms), specificity (detailing specific experiences or emotions), game design (influence of game design elements on immersion), interactivity (enhancement of immersion through game's interactive features), and real-world Comparison (comparisons with real-world sensations). The details of the criteria are reported in Deng et al.'s work (2024).

Three separate coders participated in an initial annotation exercise that we conducted to verify the precision and uniformity of our manual coding procedure. Three coders were assigned to analyze a subset of 100 reviews for the review data to test the reliability of the coders. Cohen's k, which gauges the degree of agreement between coders above and beyond what would be predicted by chance, was used to assess inter-rater reliability (Cohen, 1988). For the review data, a score of .81 suggested strong agreement. Coders debated each disagreement until a consensus was reached in a series of consensus meetings to review coding discrepancies. Then, the coders started coding the 2,500 training reviews, and finally, 146 reviews (5.84%) of the 2,500 reviews about the favorable user experience of immersion were annotated with 1.

Topic Detection

We used the cutting-edge text classification algorithm BERT to categorize the sentiment of reviews (Devlin et al., 2019). BERT has a deep learning architecture that considers the context of a token from both its left and right sides, making it especially well-suited for tasks involving natural language processing.

We used the labeled dataset to train the model, in which every review was pre-classified as positive (1) or negative (0) according to the codebook's criteria.

We used several evaluation metrics to evaluate our final BERT model's performance. The model demonstrated an exceptional capacity to differentiate between the positive and negative classes, as evidenced by the Receiver Operating Characteristic Area Under the Curve (ROC AUC) of 0.9679. The overall accuracy of the model was 0.9766, demonstrating that it correctly classified 97.66% of the reviews. The macro average F1-score, which gives equal weight to both classes, was 0.9000, and the weighted average F1-score, which accounts for class imbalance, was 0.9772.

Tag Classification

All games on Steam have "Popular user-defined tags", such as "FPS" and "Music", which can be used to detect the game genres perceived by users. From the 100 games in our dataset, 1378 tag data are extracted. The proportions of positive reviews about the immersion of each game were equally assigned to all the tags of this game. However, the 1378 tags are not systematically categorized and not all of them are related to game genres. So, we referred to Lee et al.'s (2014) categorization of game genres about gameplay, which include Action, Adventure, Racing, Fighting, Puzzle, RPG, Shooter, Simulation, Sports, and Strategy, and added one more genre, Music (music rhythm games), to comprehensively categorize the VR games in our dataset. Finally, 388 tags related to game genres from the 1378 tags are extracted. Based on Lee et al.'s (2014) definition of game genres about gameplay, we coded the tags into the 10 genres (no tags are coded to the Racing genre from our dataset).

Results

An Independent-Samples Kruskal-Wallis Test was conducted to evaluate differences in the proportion of positive reviews about immersion on Steam across various video game genres (Figure 1). The test was applied to a total of 388 tags from the most popular 100 VR games on Steam, classified into distinct genres. The numbers of tags classified into each genre are shown in figure 2. The Kruskal-Wallis H test revealed a statistically significant difference in immersion scores across game genres, H (9) = 32.666, p < .001, with the test statistic adjusted for ties.

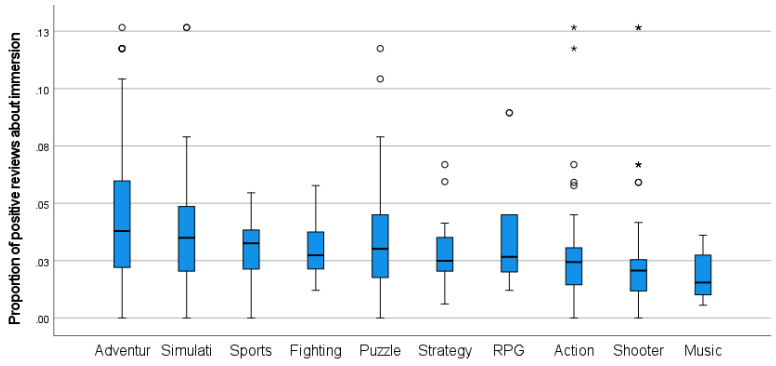

Figure 1. Independent-Samples Kruskal-Wallis Test

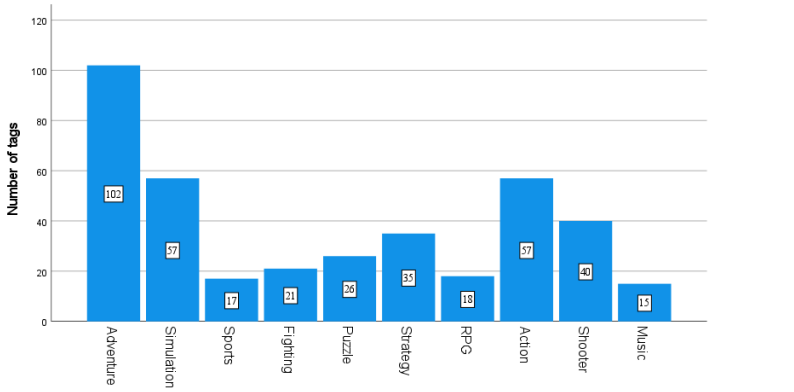

Figure 2. Number of tags classified into each genre

Discussion

Result of Each Genre

Adventure (3.79%) games in VR captivate players by enveloping them in richly detailed narratives and environments. This genre's strength lies in its ability to craft compelling stories that players can navigate and influence, a process that is significantly enhanced by VR's immersive nature. The sense of presence, a key factor in VR immersion, is profoundly felt in Adventure games as players physically navigate and interact with the game world, making narrative engagement a visceral experience (Cummings & Bailenson, 2016). As one review from ALTDEUS: Beyond Chronos mentioned: “Storytelling is really good, you can easily lose track of time or even ignore it altogether.” This direct interaction within a coherent narrative framework supports the concept of narrative presence, where players feel as though they are living out the story (Slater, 2018).

Simulated (3.50%) games, on the other hand, make immersion possible through their meticulous evocation of actual or fictitious environments, whose extraordinary accuracy gives players the illusion of operating in that reality. The immersion in these games is often derived from the player's ability to experiment and manipulate the virtual environment in ways that mirror real-world interactions, facilitated by VR's tracking and input systems (Boletsis & Cedergren, 2019). As one review of VTOL VR said: "You get to press each individual button move each control and operate every aspect of a real life modern aircraft but in a simple and easy way for anybody to understand." This mirrors the principle of experiential learning in VR, where learning and immersion are enhanced by doing and experiencing, leading to a more profound engagement with the game content (Freina & Ott, 2015).

The immersive appeal of Sports (3.26%) and Fighting (2.74%) games in VR may stem from their ability to replicate the physicality and excitement of real-world sports. This genre's success in capturing the kinetic energy and dynamic atmosphere of sporting events can significantly enhance the player's sense of presence, making the virtual experience feel lifelike (Teng et al., 2022). The direct physical engagement required in VR Sports and Fighting games can foster a deep sense of embodiment and agency, factors known to contribute to immersive experiences (Sanchez-Vives & Slater, 2005). For example, one review of the sports game Eleven Table Tennis mentioned: "Everything about it from the physics down to the haptic feedback creates the most stunningly accurate immersive experience." The immersive quality of both Sports and Fighting games in VR is further amplified by the technology's ability to create detailed, responsive game environments (Weidner et al., 2023). In these virtual arenas, every action and reaction is intensified, drawing players deeper into the competitive experience. The combination of physical engagement, skill mastery, and the visceral thrill of competition in VR contributes to the high immersion scores observed in these genres, as reflected in positive Steam reviews.

Puzzle (3.02%) and Strategy (2.50%) VR games captivate players with challenges that necessitate acute attention to detail, spatial reasoning, and pattern recognition (Berkman et al., 2020). This flow state is a cognitive alteration that mainly results from solving puzzles during which players' concentration deepens to the extent of being aware of their surroundings and the world around them (Mirvis & Csikszentmihalyi, 1991). Nevertheless, such a type of cognitive immersion, even though powerful, may not be able to take full advantage of VR in creating a sense of physical presence and emotional engagement, which are the key elements of VR technology's immersive quality (Slater, 2018). As one player mentioned when he played the strategy game Lazerbait: "I played it an was immersed not by fancy visuals or first-person gameplay, but rather by concentration when trying to play the game at max size with max AI on medium."

The immersive draw of RPGs (2.67%) lies in their story-driven mechanics, where the intertwining of character arcs with the broader game world narrative creates a multifaceted engagement. Players invest in their characters through choices and actions that have tangible impacts on the game's story and environment, fostering a connection that transcends the screen (Murray, 2016). This engagement is deepened in VR, where the sense of presence amplifies the connection players feel with their characters and the virtual world (Slater & Wilbur, 1997). However, the complexity inherent in balancing narrative depth with gameplay mechanics such as combat and skill progression might occasionally decrease the immersive narrative experience, potentially explaining why RPGs' immersion scores, while substantial, do not surpass those of genres with a more singular narrative focus (Li et al., 2023). We also note that RPG games in VR always request powerful graphics cards. The immersive experience might be decreased by frame drop as mentioned by many reviews in RPG games (e.g. "Sometimes I get frame dropping when there are holograms around" - Blade and Sorcery).

The immersive rhythm of Action (2.44%) and Shooter (2.07%) games is driven by rapid gameplay that demands quick reflexes, creating a cycle of high-intensity engagement followed by periods of relative disengagement. This pattern, while exhilarating, may not consistently sustain the sense of presence that defines immersive VR experiences (Lombard & Ditton, 1997). Most reviews of these games were talking about the gameplay, movement, and shooting experience. The emphasis on physical action and immediate responsiveness often sidelines narrative depth and character development, limiting the emotional and cognitive connections that can deepen immersion (McMahan, 2013). Future developments in these genres could explore integrating more narrative elements and opportunities for emotional engagement within the fast-paced gameplay. Balancing the adrenaline-fueled action with story-driven sequences and character interaction could provide a more continuous immersive experience, leveraging VR's strengths to create a more cohesive and engaging virtual world (Quandt et al., 2015; Ryan & Thon, 2014).

The immersion in music rhythm (1.55%) games is intricately tied to a player's connection with the music and their ability to synchronize actions with rhythmic cues, a skill that varies widely among individuals (Karageorghis & Priest, 2012). The genre's reliance on musical affinity means that immersion can be highly subjective, with players more attuned to rhythm-based interactions likely to experience higher levels of engagement. However, for those without a strong inclination toward music games or who may not resonate with the game's specific musical choices, the immersive experience might be less pronounced (Brown & Cairns, 2004; Mandryk et al., 2006). For example, many reviews of Beat Saber complained that the developers prohibiting to play custom songs (e.g. "Since they removed the ability to play custom songs, I couldn't care less about the game"). Future music rhythm games could explore diversifying musical genres or customization of songs to accommodate a wider range of player skills and preferences.

Cognitive Load Management across VR Game Genres

Our findings indicate that regardless of genre, games that successfully optimize the balance between intrinsic, extraneous, and germane loads provide the most immersive experiences (Sweller, 1988).

First, optimal immersion requires a balance of **intrinsic load**, where the game's challenge matches the player's skill level. Adventure games often provide narratives and interactive environments that keep intrinsic loads at good levels, enhancing immersion (Adams, 2009). In contrast, puzzle games, which demand high levels of problem-solving, sometimes risk overloading players and fail to immerse players.

Extraneous load needs to be minimized to prevent cognitive fatigue and maintain focus on relevant tasks. Simulation games often integrate complex systems effectively, offering immersive learning opportunities by making these complexities relevant to gameplay (Rogers et al., 2004). However, strategy games can sometimes fail in this regard, as their complex logistical planning may not always contribute directly to the immersive experience, potentially increasing extraneous load (Truman et al., 2018).

Germane load optimization involves using cognitive resources to enhance immersion. RPG games integrate rich story elements and character development that contribute to deeper immersion through emotional engagement and learning (Alrehaili & Al Osman, 2022). On the other hand, sports, music and fighting games, which focus heavily on physical interactivity, may not utilize germane load as effectively, often relying more on immediate sensory engagement than on deep cognitive involvement (Szpak et al., 2020).

Limitations & Conclusion

This study advances our understanding of immersion in VR gaming by analyzing user reviews of the top 100 VR games on Steam. Through employing the BERT algorithm, we identified key immersion factors, emphasizing the influence of game genres. While insightful, the study's reliance on a limited dataset and user-generated tags for genre classification points to areas for future research. Expanding the dataset and employing manual genre categorization could enhance the precision of our findings. This paper also serves as a foundation for a larger paper in which the results of an additional experiment with participants will be evaluated.

These insights offer valuable guidelines for VR developers, aiming to craft more engaging and immersive gaming experiences, underscoring the importance of genre-specific considerations in the design process.

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