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Analyzing VR Game User Experience by Genre: A Text-Mining Approach on Meta Quest Store Reviews

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Abstract: With the rapid expansion of the virtual reality (VR) market, user interest in VR games has increased significantly. However, empirical research on the user experience in VR games remains relatively underdeveloped. Despite the growing popularity and commercial success of VR gaming, there is a lack of comprehensive studies analyzing the impact of different aspects of VR games on user satisfaction and engagement. This gap includes insufficient research on the categorization of VR game genres, the identification of user challenges, and variations in user experiences across these genres. Our study aims to fill this gap by analyzing data from the Meta Quest store using K-means clustering and LDA (Latent Dirichlet Allocation) to categorize the representative genres of VR games. By employing text-mining techniques to conduct a detailed analysis of user experience, we effectively elucidate the primary issues and nuanced differences in user responses across various genres. Our findings serve as a valuable reference for researchers aiming to design games that align with VR user expectations. Furthermore, our study provides a foundational dataset for researchers aiming to enhance the user experience in VR games and suggests ways to increase the immersion and enjoyment of VR gameplay.

Keywords: VR games; game design; meta quest games; text mining; user experience; Latent Dirichlet Allocation (LDA)

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1. Introduction

In recent years, the virtual reality (VR) gaming market has grown rapidly and is expected to expand from $6.2 billion in 2019 to $54.2 billion in 2023 [1]. During the same period, the number of VR users has grown from 43.4 million to 68.9 million [1–3]. Particularly since the COVID-19 pandemic, people have become more immersed in VR and metaverses to engage in various activities at home [4,5].

VR games offer a user experience distinct from traditional PC games [6]. Firstly, VR extends the field of view, enabling a 360-degree perspective centered around the user's axis, rather than being limited to a fixed screen. Secondly, unlike conventional console or keyboard-and-mouse systems, the player's physical movements are directly translated into the game through sensor-based tracking, creating a deeper sense of presence and immersion. Thirdly, VR provides a multi-sensory experience, incorporating not only visual and auditory stimuli but also tactile and vestibular feedback, which enhances sensory stimulation. Together, these features contribute to a more immersive and intuitive user experience compared to traditional gaming channels. Studies have shown that the immersive experience of VR games enhances the user is emotional response, increases the realism of the game, and is effective in learning and training [7,8]. These immersive experiences create new research and development opportunities in various areas, including user interface design, immersive storytelling, and real-time interaction [9].

However, despite this growth, systematic analysis of the VR game user experience is still in its infancy [10].

Existing research has mainly focused on analyzing the characteristics and user experiences of a few popular games and genres [4,11,12]. For example, popular games like *Beat Saber* and adventure games like *Half-Life: Alyx* have been the subject of many studies [5,13,14]. These studies primarily analyzed user engagement, satisfaction, and the effectiveness of interface design in popular games. For example, Rack et al. collected and analyzed a behavioral biometric dataset for user identification in VR environments using *Half-Life: Alyx* [15]. Although these approaches are useful for deeply analyzing the user experience of individual games, they have limitations in terms of understanding the overall VR experience. Moreover, games outside these popular genres, such as *The Room VR: A Dark Matter* in the puzzle–horror category and *Brass Tactics* in the strategy genre, offer unique user experiences that differ significantly from mainstream titles like *Half-Life: Alyx* and *Beat Saber*. *The Room VR* emphasizes immersive puzzle-solving in a tense, horror atmosphere, while *Brass Tactics* focuses on strategic thinking and real-time tactical control, offering a completely different form of engagement. By focusing solely on widely studied genres, the research risks overlooking the distinct experiences provided by games in niche categories.

Genre categorization is not yet clear, particularly for VR content, which is a relatively new field [16]. This is because genre distinctions are often blurred because of the rapid release of various games. For instance, platforms like MetaQuest have struggled with providing clear genre categorizations, leading users to create their own solutions. On international community-driven sites, users have organized VR genre lists to fill the gap and share this information with others. Traditional PC games, on the other hand, have been extensively studied for genre categorization over a long period and have very specific genres. This plays an important role in user experience (UX) research. Each genre evokes a unique playing style and user response, and understanding these characteristics can lead to a better user experience [17]. Therefore, it is necessary to clearly categorize and analyze the genres of VR games. This will become increasingly important as VR content and metaverse games grow in popularity. This approach offers an opportunity to better understand and improve diverse user experiences.

Previous VR UX research primarily explored technical algorithms, content development, and performance metrics, providing important insights into user-friendly VR game interfaces [18]. However, much remains to be understood regarding the different genres of VR and metaverse experiences from a user-centered perspective. Efforts are being made to understand user perceptions of VR and metaverse experiences, including game pacing, interface design, and interaction evaluations in digital environments [16]. Existing research has primarily focused on developing techniques to understand the interactions between various factors or has studied specific genres of games. For example, Carroll et al. [17] compared the user experiences of different VR game genres to investigate how each genre affects user engagement and satisfaction. Roettl and Terlutter [6] studied how realism can be provided in VR sports games and concluded that each genre requires unique challenges and solutions.

This study aims to comprehensively compare and analyze metaverse games of different genres, focusing on the user experience and the characteristics of VR content by genre. It is important to understand real user feedback to promote a positive game user experience in a metaverse environment [19]. Since Meta Quest holds the majority market share, accounting for approximately 58% (Figure 1) of VR headset distribution, data for this study were collected from the Meta Quest store. This high distribution rate makes the Meta Quest store an ideal source for genre classification and user feedback analysis. In this study, we collected abstracted VR game genres from the Meta Quest store, used text-mining techniques to classify the genres, and performed topic modeling. The goal is to clearly identify the main complaints and differences in user reactions across genres. The Research Questions (RQs) are summarized as follows:

RQ1: How do user experiences differ across various VR game genre?

RQ1-1: What are the main user experience differences in VR game genres?

RQ1-2: What areas can improve the user experience by genre?
RQ2: What correlations do users show between genres?

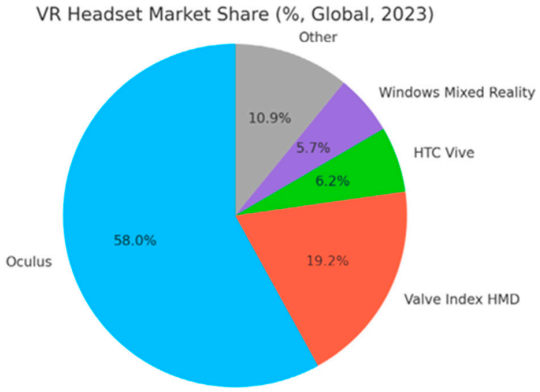

Figure 1. Steam users' share of VR headsets by device.

2. Research Method

VR games are available on various platforms, including Steam VR, PlayStation VR, and the Meta Quest Store. However, Steam VR and PlayStation VR support PC games or console games simultaneously; therefore, responses from users who enjoy various types of games are mixed. The Meta Quest store, on the other hand, provides only VR content, so we can obtain pure responses from VR users. Therefore, we collected data from all games in the Meta Quest store. The steps followed in this study (Figure 2) were as follows: (A) Data Processing, (B) Data Analysis, and (C) Results.

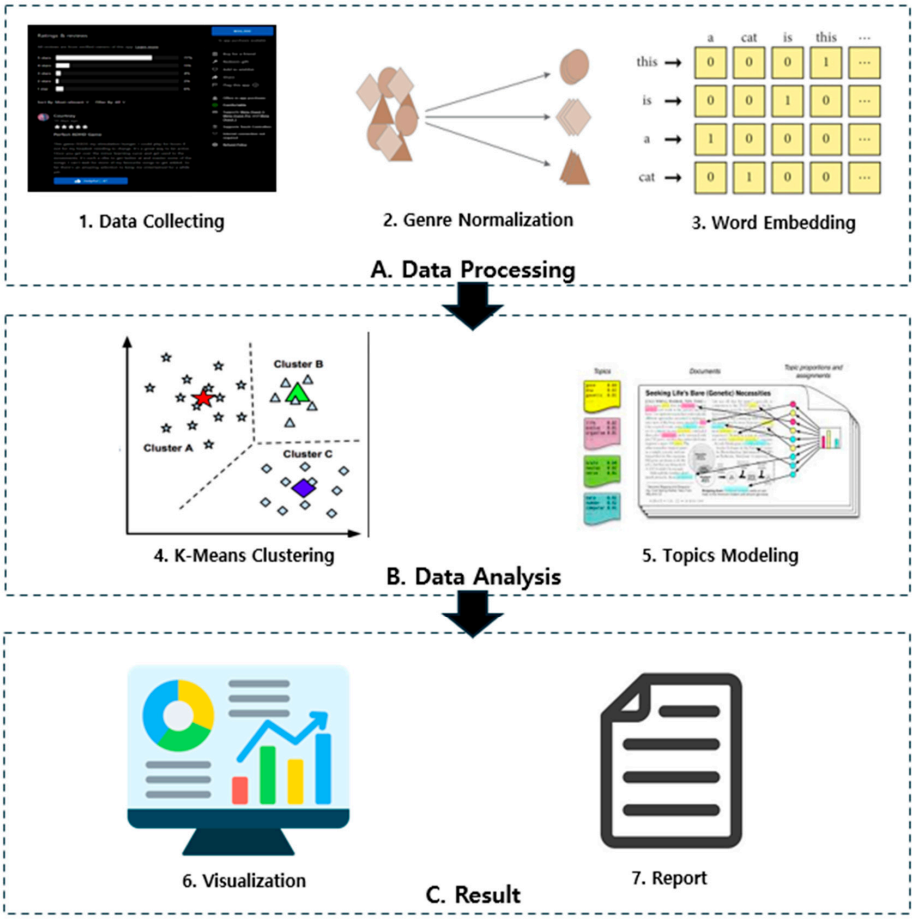

Figure 2. Data Flow.

2.1. Data Processing

2.1.1. Data Collection

To analyze the experiences of VR users, we used Python 3.10.11 is BeautifulSoup and Selenium libraries to analyze the latest comments in the Meta Quest store written in English from August 2023. We collected 115,531 records for each of the 157 games. The structure of the dataset used in this study uses the fields "Title", "Genre", "Rating", and "Review". The "Title" value contains the title of each game, the "Genre" value contains the genre of the content, the "Rating" value contains the rating provided by the user, and the "Review" value contains the text of each review (Table 1).

Table 1. Sample Data.

Title	Genre	Rating	Review
BONELAB	Shooting, Action, Adventure	3	buy the pc version instead so it . . .
BONELAB	Shooting, Action, Adventure	3	personally think that they are fine . . .
Alvo	Shooting	5	Updating my review I bought it . . .
Blaston	Shooting, Sports, Action, Mixed Reality	5	This game will get you moving It . . .
Gambit	Shooting, Action, Adventure	5	for 20 this game is economically priced . . .

2.1.2. Normalization

According to the data we collected (Tables 1 and 2), there is no 1:1 match between "Title" and "Genre". As our goal is to analyze genres, we normalized the data to ensure that the two fields satisfy atomicity. Additionally, we changed the data structure to "Genre", "Title", "Rating", and "Review" using the combination of "Genre" and "Title" as the primary key (Table 3). This increased the number of reviews to 327,320.

Table 2. Distribution of duplicate genres (This table shows the number and percentage of duplicate genres in your game).

Number of Title Duplicates	Title Number	Ratio
1	15	9.6
2	64	41.0
3	75	48.1
4	2	1.3

Table 3. Sample Normalization Data.

Genre	Title	Rating	Review
Shooting	BONELAB	3	buy the pc version instead so it . . .
Action	BONELAB	3	buy the pc version instead so it . . .
Adventure	BONELAB	5	buy the pc version instead so it . . .
Shooting	Blaston	5	This game will get you moving It . . .
Adventure	Gambit	5	for 20 this game is economically priced . . .

2.1.3. WordEmbedding

The review data were analyzed using the word embedding technique, with preprocessing performed using Python libraries, specifically the NLTK library. The following steps were taken during preprocessing:

(1) Text cleanup: Unnecessary elements such as punctuation, numbers, and emojis were removed to improve the accuracy of topic analysis.

(2) Lowercase conversion: All text was converted to lowercase to avoid inconsistencies due to case differences.
(3) Stopword removal: Using the NLTK stopword list, common but contextually insignificant words (stopwords) were removed, ensuring that only meaningful information remained, which helps improve topic modeling performance.
(4) Lemmatization: NLTK's WordNetLemmatizer was applied to normalize different word forms (e.g., converting "running", "ran", and "runs" to "run") to maintain consistency and reduce redundancy in the dataset.
(5) Handling Out-of-Vocabulary (OOV) words: OOV words were either replaced with predefined special tokens or removed based on their frequency, ensuring these words did not negatively affect model performance.

After preprocessing, the text data were vectorized using the Word2Vec word embedding technology. During this process, words were converted into high-dimensional dense vectors, making them suitable for use as inputs to machine learning models. This preprocessing reduces the dimensionality of the data while preserving its core content, contributing to increased accuracy and efficiency when used as an input for topic-modeling algorithms [20].

2.2. Data Analysis

Genre normalization allowed us to determine the number of game titles in each genre (Figure 3). We defined genres with fewer titles than the median value (=7) as minor genres, and genres with more titles than the median value as major genres. We found that many of the major genres are used alone (Shooting, Action, Simulation, Health/Exercise, and Casual are the five genres used as a single genre). Minor genres, on the other hand, were not used alone but in combination with major genres, and most of them had too few "Title" values to be statistically significant (Figure 3).

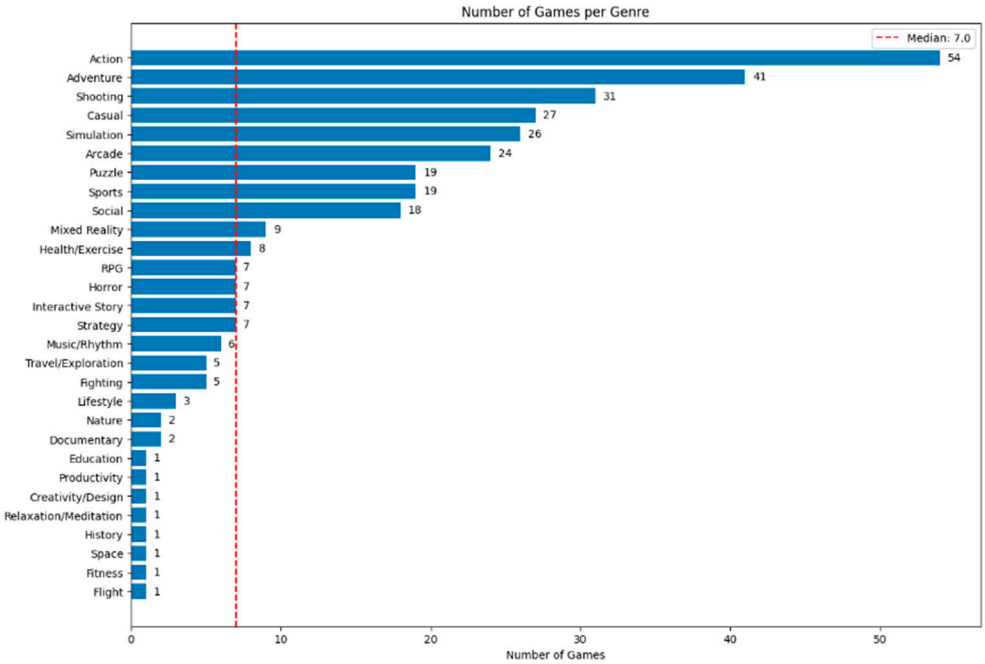

Figure 3. Games per Genre.

In conclusion, minor genres were deemed unsuitable for user experience analysis because of their small sample sizes and dependent features on the major genres. To address this, we clustered the genres using K-means clustering, which is the most popular clustering method [21].

2.2.1. K-Means Clustering

K-means clustering is an unsupervised learning technique that divides data points into K clusters by assigning them such that each cluster has a mean vector called the centroid, and the data points within the clusters are assigned in a manner that minimizes their distance from the centroid [22]. In this case, we need to find the optimal value of K—the number of clusters—to cluster the 28 genres. To achieve this, we found the optimal K using the silhouette coefficient [22], which measures the quality of data point clustering, to find the K that maximizes the average silhouette coefficient. The silhouette coefficient is calculated using the following formula:

$$s(i) = \frac{b(i) - a(i)}{\max(a(i), b(i))}$$

where $s(i)$ is the silhouette coefficient of data point i. It has a value between -1 and 1 and measures the quality of clustering. The closer it is to 1, the better clustered it is. The closer it is to 0, the closer it is to the cluster boundary, and the closer it is to -1, the worse clustered it is. $a(i)$ is the average distance of data point i from all other data points in the same cluster (inner cluster distance), and $b(i)$ is the average distance of data point i from all other data points in the closest cluster (outer cluster distance) [22]. In our study, the silhouette coefficient was employed to determine the optimal number of clusters for categorizing VR game genres, with a focus on user experience (UX). The silhouette coefficient is well suited for this purpose, as it evaluates how well each data point fits within its assigned cluster while also assessing the separation between clusters. Given that user experience is inherently subjective and varies greatly across different genres, ensuring that individual user preferences are clearly and distinctly grouped is essential. The silhouette coefficient, which ranges from -1 to 1, measures the quality of clustering by comparing intra-cluster cohesion and inter-cluster separation. A higher silhouette score indicates better-defined clusters, with the data points remaining closer to their respective cluster centroids while remaining distant from neighboring clusters. After calculating the silhouette scores for various numbers of clusters, we determined that using K = 7 provides the optimal balance for clustering VR game genres in a way that accurately reflects user experiences.

We performed K-means clustering using the optimal K with normalized "Title", "Genre", and "Review" using the following formula:

$$W(S, C) = \sum_{k=1}^{K} \sum_{i \in S_k} |y_i - c_k|^2$$

where W is the sum of the squares within a cluster, S is the set of all data points, C is the set of cluster centroids, K is the number of clusters, k is the kth cluster, and i is a data point. S_k is the set of data points belonging to the k-th cluster, y_i is Data point, and c_k is the center of the k-th cluster [22]. Through this objective function, each genre is organized similarly. As a result of K-means clustering, we obtained 7 categories (Figure 4), and the distribution of the categories is as shown in (Table 4). Representative games categorized by genre are shown in Figure 5. The titles for the seven categories were determined through a three-step analysis: first, by examining the 'Genre' data derived from the K-means clustering results (refer to Tables 2 and 5); second, by reviewing word cloud visualizations (Appendix B); and third, through the analysis of key user comments. By utilizing these three methods, we were able to name the categories based on a comparison of abstract genre groupings, the dominant themes identified in the word clouds, and the user feedback patterns. These three approaches were combined to derive data-driven titles for the final categories.

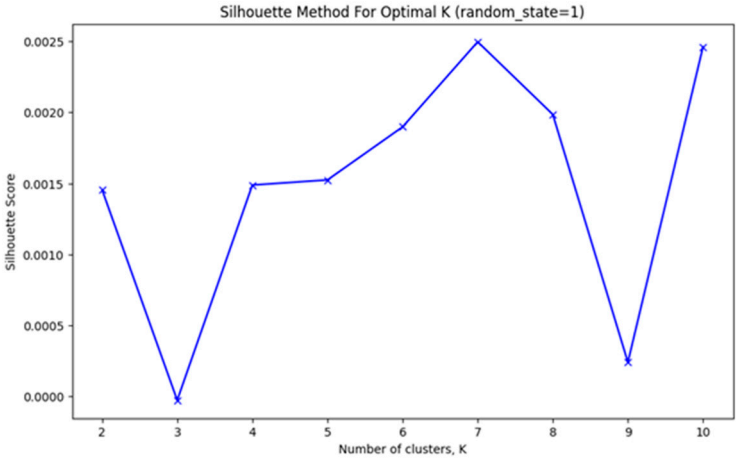

Figure 4. Optimal K via Silhouette Scores.

Table 4. Data distribution by genre.

Category	Content	Ratio
Shooting	54,426	19.52%
Music	17,110	6.14%
Strategy	21,978	7.88%
Horror	8626	3.09%
Action	86,156	30.91%
Sports	48,328	17.34%
Puzzle	42,149	15.12%

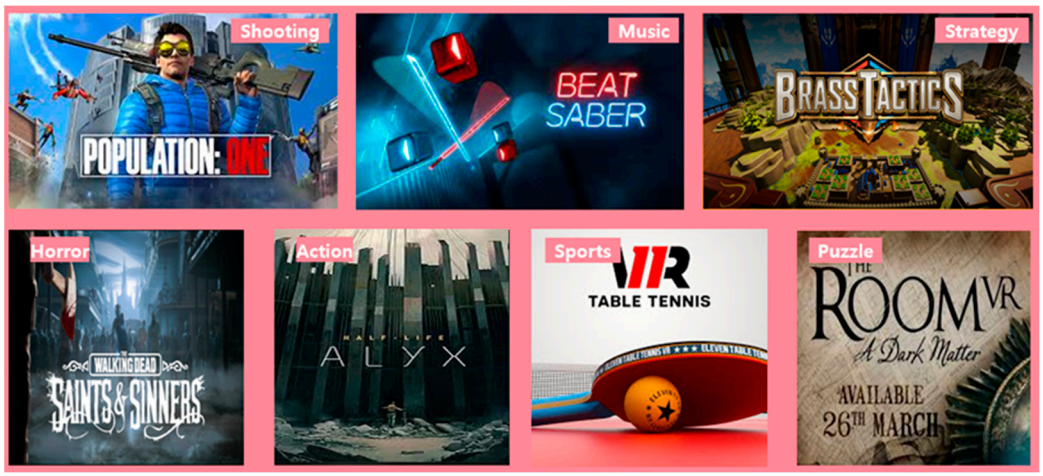

Figure 5. Representative games by genre (maximum sales criteria).

Table 5. Genre data obtained by K-means Clustering.

Category	Meta Quest Category
Shooting	Exciting shooting games, Aiming at targets, A whimsical shootout, Thrilling speed
Music	Rock Music, Music games, A masterpiece from the showcase
Strategy	Games for strategists, Brain benders, The ultimate spy, A satisfactory simulation
Horror	Survival horror, Beware, All who enter, Social VR
Action	Thrills, Action gameplay, Covert operations, Final showdown, Blockbuster action, Amazing adventure
Sports	Kinetic sports, Get in shape, Physical education class, Sports/Training, Parkour
Puzzle	Puzzle solving, Challenging puzzle game

2.2.2. Topic Modelling

Based on the 7 categories obtained from the K-means clustering, we applied topic modeling using the LDA technique to further analyze VR game review data. This allows us to identify specific themes and patterns within each category, enhancing our understanding of user experiences across genres.

LDA is an unsupervised learning technique that identifies potential topics within documents based on the distribution of words [23]. The algorithm assumes that each document may contain multiple topics and estimates the topic based on words probabilities within each topic [24]. LDA can uncover semantic relationships between documents and words, making it useful for identifying critical themes and patterns in unstructured text.

To ensure the selection of the optimal number of topics, we evaluated the model using two standard metrics: perplexity and coherence scores. The perplexity score evaluates how well the model predicts unseen data, where a lower perplexity score indicates better generalization performance. The formula for perplexity is as follows:

$$\text{perplexity score}(D_{\text{test}}) = \exp\left(\frac{-\sum_{d=1}^{M} \log p(w_d)}{\sum_{d=1}^{M} N_d}\right)$$

where D_{test} is the test document set, M is the total number of documents in the test, D is the indexing of each document in the test set, $P_{(wd)}$ is the probability of th word W_d and N_d is the number of words in document d [25].

The coherence score measures the semantic consistency of the words within each topic. A higher coherence score indicates that the topics are more semantically meaningful. The coherence score is calculated as:

$$\text{coherence score}(D_{\text{test}}) = \sum_{m=2}^{M} \sum_{l=1}^{m-1} \log\left(\frac{D\left(v_m^{(t)}, v_l^{(t)}\right) + 1}{D\left(v_l^{(t)}\right)}\right)$$

where D_{test} is the test document set, M indexes each word pair in the test set, and l indexes the other words in the pair $D\left(v_m^{(t)}, v_l^{(t)}\right)$, which is the number of times that v_m and word v_l occur together in test case(t), and $D\left(v_l^{(t)}\right)$ is the total number of times that word v_l occurs in the test case [25].

We trained the LDA model with a range of topic numbers (Z = 2 to 14) and calculated both the perplexity and coherence scores for each. The results are shown in Figure 6, where the number of topics is plotted against both scores. This comparison allowed us to balance the two metrics: we sought a model with low perplexity (indicating better generalization) and high coherence (indicating well-defined topics).

Additionally, to validate the topic interpretability, we manually inspected the top words in each topic to confirm their semantic consistency. For example, in the Shooting genre, words like aim, weapon, and target clearly represent the core theme, while the Puzzle genre contained terms like logic, strategy, and solution, reflecting the analytical nature of such games. The complete list of top words for each topic, as well as the word cloud visualization, can be found in Appendix A.

Finally, we visualized the coherence and perplexity scores for the seven selected genres, as shown in Table 6. These figures display the coherence and perplexity scores across various numbers of topics for each genre. This further demonstrates the performance of the LDA model across different categories and confirms the optimal number of topics for each genre.

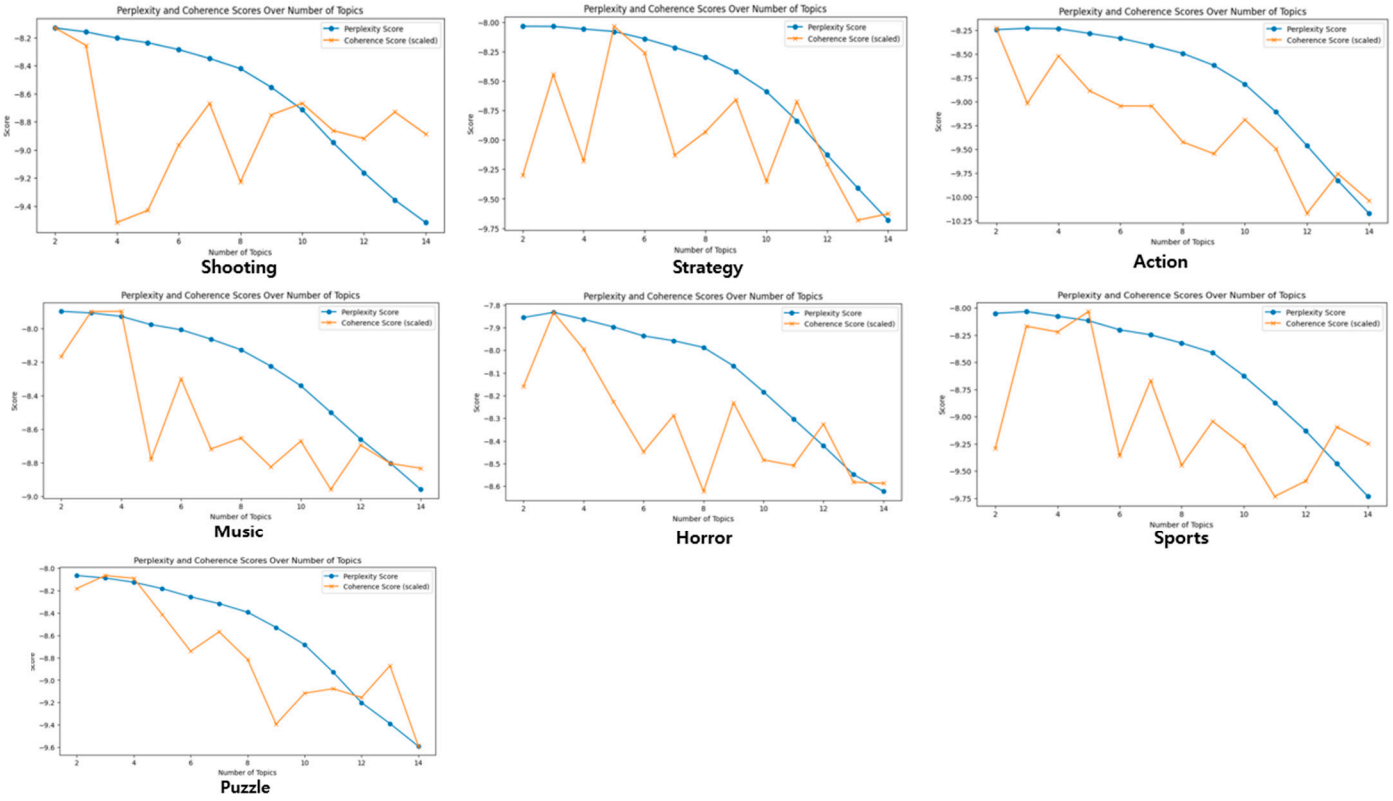

Figure 6. Coherence and Perplexity Scores for Each Genre.

Table 6. Optimal number of topics per genre.

Title 1	Title 2
Shooting	2
Music	4
Strategy	5
Horror	3
Action	2
Sports	3
Puzzle	5

3. Results

Based on the results of the topic modeling analysis (Table 6), we extracted the optimal number of topics (n = 7) using LDA topic modeling, difficulty, and coherence scores [26]. This provides an important foundational dataset for a comprehensive understanding of VR games that is not biased toward any particular genre. The content analyzed for each genre and topic provides a detailed look at the current problems and opportunities for improvement in VR games, as well as various aspects of the user experience (Table 7).

Table 7. Details by topic.

Topic Name (Number of Cases, Proportion)	Top Keywords	Related Review
Category 1: Shooting		
Topic 1: Motion Sickness (43.8%)	motion, real, track, hand, use, problem, sick	I recommend this game to anyone who doesn't get motion sick.
Topic 2: Unique Mechanism (56.2%)	gameplay, immersive, graphics, story, challenging, action, mechanics	he story is engaging, the gameplay is fun, the physical interactions are nice and immersive, the canoe set up is new and interesting

Table 7. *Cont.*

Topic Name (Number of Cases, Proportion)	Top Keywords	Related Review
Category 2: Music		
Topic 1: Customization Options (26.9%)	custom, mods, modding, level, difficulty, version, experience	I love the developer being open enough to bake-in the custom songs option rather than force users to use a completely modded version. I look forward to more music, more updates, more fun.
Topic 2: Unstable Tracking Issues (27.4%)	update, fix, problem, issue, tracking, purchased, refund	This game is completely unusable as it will not properly acknowledge hand movements. (. . .) I have tried several different tracking frequencies, updated to the latest Quest version, tried different WiFis in the house, redoing floor boundaries, etc. It won't work.
Topic 3: Combining Music and Fitness (24.2%)	song, rhythm, exercise, graphics, addictive, variety, intense, visuals	It's a great workout and has a lot of fun songs to play along to.
Topic 4: Extending Content (21.5%)	songs, pack, add, please, genres, artists, dlc, bands, variety	Whats it going to take to get more main stream songs? The free ones I know none of them. I don't mind paying for music.
Category 3: Strategy		
Topic 1: Hand Tracking Issues (21.9%)	fix, update, tracking, bugs, glitches, issue, problems, refund, hands	If my hands go out of frame, it no longer tracks my hand, and sometimes I even start to fall through the floor.
Topic 2: Enhanced Simulator Experience (19.6%)	simulator, graphics, physics, gameplay, puzzles, experience, sandbox, immersive, content	Lots and lots more content then job simulator and all in all a great addition to your games collection especially if have young kids.
Topic 3: Family Friendly (18.6%)	kids, played, family, friends, community, voice, funny	It's one of those perfect games to show your friends and family who have never tried VR before.
Topic 4: Story-Driven Immersion (16.4%)	gameplay, difficulty, controller, audio, graphics, story, reality	The story and gameplay is so intense and fun at the same time When I start playing this game I feel like I'm actually there.
Topic 5: Precise Movement (23.5%)	hand, gameplay, difficulty, controller, graphics, tracking, reality	I was on game and I tried to punch a guy with my left hand and he didnt get hurt and I couldnt pick up anything I could move and press the grip button but it didnt work.
Category 4: Horror		
Topic 1: Securing Adequate Space (40.6%)	space, remove, jump, update, scary, jumpscares, real, heart	You need a big space to play because you may get hurt I recommend if you like scary games and a big area to play.
Topic 2: Spatial Graphics (23.3%)	horror, scary, terrifying, space, graphics, atmosphere, fear, immersive	It overall had a very scary feel which was good The graphics are AMAZING for a quest game and I hope everyone that has a quest buys it.
Topic 3: Animatronics Induced Fear (36.1%)	animatronics, nightmare, dlc, scared, dark, terrifying, vent, repair, glitch	The animatronics tower over u and spreads fear throughout your body.
Category 5: Action		
Topic 1: Health Benefits from Action and Rhythm (55.9%)	rhythm, workout, dance, sweat, tracks, beats, fitness, playlist	Omg this game is so fun I play it every day for some exercisethe songs are so catchy and the music packs are worth it.
Topic 2: Challenging with Difficulty Modes (44.1%)	levels, mode, hard, easy, challenging, multiplayer	When looking at this game its fun and challenging at the same time on higher difficultys.
Category 6: Sports		
Topic 1: Immersion with Precise Motion Controls (27.8%)	controller, tracking, movement, hands, settings, multiplayer, practice, use	Arrow shooting actions suffer from tracking errors, affecting accuracy and increasing the game's difficulty unnecessarily.
Topic 2: Promoting Relaxation and Meditation (33.3%)	relaxing, calm, immersive, environments, graphics, meditation, realistic, experience	I love how I get to customize my daily meditation using this app. The environments are beautiful and immersive.
Topic 3: Achieving Realistic Exercise (38.9%)	workout, exercise, fitness, boxing, cardio, daily, gym	I've lost 2 kg in 2 weeks by doing this every day.

Table 7. *Cont.*

Topic Name (Number of Cases, Proportion)	Top Keywords	Related Review
Category 7: Puzzle		
Topic 1: Multiplayer feature desired (22.9%)	gameplay, levels, multiplayer, graphics, weapons, "story", sandbox, physics, challenges, combat	My only issue with this game is I wished that it had a multiplayer option because playing this game with friends would be a dream come true.
Topic 2: Control Issues and Solutions (18.2%)	move, hand, motion, tracking, teleport, issues, frustrating	The whole movement system is janky at best. Additionally, the game stutters and struggles with maintaining acceptable performance.
Topic 3: Combining puzzles and story (18.3%)	scary, graphics, multiplayer, horror, reviews, jump, worth, favorite	I like the storytelling the puzzle rooms the graphics the sound and the game mechanics The difficulty level rises slow and solved puzzles gives you a satisfied feeling.
Topic 4: Intense Fear Experience (18.8%)	horror, scary, animatronics, experience, fan, creepy, graphics, jump, memories, terrifying	Gotta day its even scarier when the sound is actually surrounding you because its from within the headset instead of headphones My favorite horror game so far.
Topic 5: Importance of Time Management (21.8%)	time, long, hours, levels, progress, hard, finish, level, quests	The story is so immersive and I just love walking around and all the puzzles so challenging but at the same time fun I like the time cloning ability and how cool it is

3.1. Category 1: Shooting

3.1.1. Shooting Topic 1: Motion Sickness

In VR games, one of the main reasons that users lose interest and drop out of the game is motion sickness. This is caused by the difference between the virtual environment and the feelings of the body in real life. For example, one user mentioned that sudden changes in speed in the VR shooter made him feel sick, like he was on a roller coaster. Another user reported feeling lightheaded and nauseous during complex interactions involving the pushing and pulling of objects during a game. This happens because our brains are unable to synchronize virtual and real-world movements.

3.1.2. Shooting Topic 2: Unique Mechanism

Users find VR games to be a highly immersive experience, and despite some technical challenges, they respond positively. In the shooter genre in particular, there are mechanics that slow down or speed up time based on the player is movements to allow for strategic play, combine rhythm games and shooters to kill enemies to the beat of the music, allow the player to freely manipulate weapons with hand gestures, or move their body to dodge enemy attacks. However, in many games, the disparity between the virtual and real-world movements can lead to motion sickness. Some users have commented that they do not recommend gaming if you are prone to motion sickness. However, most users appreciate how immersive and enjoyable VR games can be.

3.2. Category 2: Music

3.2.1. Music Topic 1: Customization Options

Users often express frustration with the lack of customization features that allow them to create and share their own content in-game, and they want to play games with music that fits their personal tastes beyond the built-in music. Some games have built-in features that make it easy for users to add and share songs, making them simple to create and share. For example, users can create their own playlists and share them with other players, or edit the beat of a particular song to create their own rhythm game. However, most games do not offer these official customization features, forcing users to create and share content informally through private communities or to rely on the game is built-in content. To obtain a more diverse musical experience, users may turn to custom songs on private sites; however, the process is complicated and requires additional effort.

3.2.2. Music Topic 2: Unstable Tracking Issues

There have been many complaints regarding the tracking accuracy in VR games. For example, one user noted that even after the update, the tracking instability, frame drops, and persistent lag did not improve, making the game unplayable. In another review, a rhythm game reported poor tracking of the right hand when certain actions were performed, resulting in missed notes. Some users experienced gameplay stuttering when moving their hands in time to a fast beat because the tracking could not keep up. These tracking issues can make it difficult for users to adjust to the gameplay, which can lead to negative game reviews. Nevertheless, most users have positive experiences with VR games.

3.2.3. Combining Music and Fitness

Users have found VR games to be a new way to combine exercise and music for a positive workout experience, with some noting that some music and exercise games have helped them burn significant amounts of calories and lose weight. For example, cardio games involving dancing to a rhythm provide users with an exciting and enjoyable workout experience. Another example is a game that gives users the ability to upload their own music and workout to it, allowing for a personalized workout experience. Users can "punch out" to a fast beat or perform various movements to the music for a full-body workout. These games offer a new way to stay active at home without the need for a gymnasium or specialized exercise equipment.

3.2.4. Extending Content

Users request the official expansion pack to include songs from different genres and artists within the game. For example, they ask for more popular current songs or classic hits and call for the ability to create and share their own content through in-game workshops. Currently, custom content is mostly created through private communities with limited participation, owing to copyright issues and technical barriers. Users experience slowdowns and security issues when downloading songs from private communities, and they find these informal methods cumbersome.

3.3. Category 3: Strategy

3.3.1. Strategy Topic 1: Hand-Tracking Issues

Users have expressed concerns that hand-tracking errors in VR games have a significant impact on immersion. Frequent interruptions in hand tracking or inaccurate interactions can be very disruptive to the user experience, especially in games that rely heavily on the use of the hands, such as strategy games. For example, one user noted that they had trouble picking up objects accurately during a game, missed important items, and had to restart their level. Another user reported that in a complex-strategy game, hand tracking was inaccurate and that they had difficulty placing enemy troops.

3.3.2. Enhanced Simulator Experience

The users were highly satisfied with the experience of playing different roles in the VR simulator. Although they enjoyed the existing simulator games, they were particularly pleased with the ones that were enhanced with downloadable content or sequels. For example, in the flight simulator, one user noted that the update made the physical responses of the airplane more realistic, which significantly improved immersion. Another user reported improved hand tracking in a farm simulator, making harvesting crops and tending animals feel realistic.

3.3.3. Family Friendly Environment

Because it does not require as much strenuous movement as other genres, there is a cornucopia of content for families to engage in together. For example, one user noted that playing games with their children to care for farm animals or cooking in VR increased

family interactions. Another user reported that working together with their children to solve problems in puzzle games helped them develop logical thinking and creativity.

3.3.4. Story-Driven Immersion

The users noted that the visuals and story-driven experiences within the game created a deep sense of immersion. For example, in a game set during medieval times, they felt like they were in the world as they explored colorful castles and towns. Another user reported that in a space exploration game, the experience combined vivid graphics and an epic story that made them feel like they were exploring the universe.

3.3.5. Precise Movement

Magic, card, and tactical strategy games require users to perform precise movements and strategic thinking. For example, one user mentioned that in a card battle game, the unreliability of hand gesture tracking prevents them from placing their cards correctly at critical moments, making it difficult to execute their strategy. Another user reported difficulty in casting spells in a game that uses magic because hand gestures were not properly recognized.

3.4. Category 4: Horror

3.4.1. Horror Topic 1: Securing Adequate Space

Users frequently mentioned borderline injuries while playing VR horror games. For example, one user reported that while playing a horror game, he was injured when he slammed into a living room table while trying to dodge a monster that suddenly appeared out of nowhere. Another user mentioned that he had a violent reaction during a game, slammed his hand onto a wall, and dropped his VR controller. These games can trigger violent reactions because of the spatial and visual elements that deeply immerse the user, and there is real potential for injury if you leave the play area because you cannot see your surroundings while wearing VR gear.

3.4.2. Horror Topic 2: Spatial Graphics

VR horror games use high-resolution graphics and spatial effects to provide users with a deeper sense of immersion. For example, one user noted that in a horror game set in a dark forest, the swaying branches and moving shadows made them feel as if they were actually in the woods. Another user reported that in a game in which they were exploring an old mansion, the textures of the worn wallpaper and creaky floorboards were so realistic that they felt an intense sense of dread.

3.4.3. Horror Topic 3: Animatronics Induced Fear

Users find great horror in the grotesqueness of animatronic characters. For example, one user noted that, in a horror game, when an animatronic character suddenly appeared in front of them and loomed over them at a huge size, they were overwhelmed and felt tense before they started the game. Different modes of interaction with animatronic characters in a game provide players with a deep sense of immersion and fear.

3.5. Category 5: Action

3.5.1. Action Topic 1: Health Benefits from Action and Rhythm

Action games that combine music and exercise offer users a new type of exercise experience that differs from traditional workouts. For example, one user noted that a rhythmic punching game helped him lose weight and improve his fitness while exercising for 30 min every day. Another user reported that she relieved stress by choosing a challenging mode in a game that moves to dance music and enjoyed an intense workout.

3.5.2. Action Topic 2: Challenging with Difficulty Modes

Different modes of difficulty within the game keep users challenged and engaged. For example, one user noted that the beginner mode allowed him to learn basic combat skills and build a foundation for the game. Another user reported that the experience of dodging enemy attacks and responding strategically in high-difficulty mode greatly improved his reaction time and tactical thinking.

3.6. Category 6: Sports

3.6.1. Sports Topic 1: Immersion with Precise Motion Controls

Accurate motion control is critical in sports games. Users have expressed frustration with the inaccuracy of tracking in VR environments. For example, one user mentioned being frustrated by the inability to hit a ball accurately during a VR tennis game. The moment the ball hit the racket did not feel realistic; it broke the immersion.

3.6.2. Sports Topic 2: Promoting Relaxation and Meditation

VR experiences for relaxation and meditation offer users a different level of psychological calmness and well-being than traditional games. For example, one user noted that fishing from a small boat on a lake in a VR fishing game gave him a deep sense of calm while enjoying the sounds of the water and the natural scenery.

3.6.3. Sports Topic 3: Achieving Realistic Exercise

Fitness and exercise experiences in VR offer users a new dimension beyond traditional workouts. For example, one user noted that a VR boxing program improved his fitness by providing him with gymnasium-level training at home. The program guides users through precise movements, as if taught by a real boxing coach, and includes a variety of cardio exercises to increase the users cardiorespiratory endurance.

3.7. Category 7: Puzzle

3.7.1. Puzzle Topic 1: Multiplayer Feature Desired

Many users have expressed that they want multiplayer support in their games. Some games have limited or no multiplayer support, leaving users unable to share their gaming experiences with friends. For example, one user mentioned that they wanted a multiplayer mode in a VR puzzle game where they could team up with friends to solve problems but were disappointed that it did not exist.

3.7.2. Puzzle Topic 2: Control Issues and Solutions

Users often complain about issues with movement and feel during gameplay. Although these issues do not directly limit gameplay, they can break user immersion and detract from the overall gaming experience. For example, one user said that in a VR puzzle game, his hand gestures when picking up objects were not properly recognized, making it difficult to solve the puzzle.

3.7.3. Puzzle Topic 3: Combining Puzzles and Story

VR puzzle games combine stories and puzzles to create a deep sense of immersion for users. For example, one user commented that in a game in which they explored ancient ruins to solve puzzles, it was fascinating to explore each room and discover the story. Another user said that, in a game set in a futuristic city, the experience of traveling back and forth between the past and present to solve puzzles through time manipulation mechanics was very unique.

3.7.4. Puzzle Topic 4: Intense Fear Experience

VR offers the possibility of combining horror elements through both spatial and visual effects. For example, one user noted that exploring dark corridors in a VR frustration puzzle game and encountering ghosts that suddenly appeared out of nowhere caused

his heart to skip a beat. Another user reported that in a puzzle game set in an ancient mansion, the detailed graphics combined with an immersive sound design kept them on edge throughout the game.

3.7.5. Puzzle Topic 5: Importance of Time Management

Time management is an important factor in puzzle games. In VR puzzle games in particular, the strategic use of time can significantly enhance the immersive and challenging experience. For example, one user noted that the ability to freeze time when performing certain actions helped them solve complex puzzles, allowing them to strategize how to solve the puzzles.

4. Discussion

In this study, we analyzed reviews from the Meta Quest store to identify key themes across VR game genres.

RQ1: How do user experiences differ across various VR game genre?

RQ1-1: What are the main differences in user experiences across VR game genres?

RQ1-2: How can user experiences be improved for each genre?

Our analysis of key features and user experiences across VR game genres are based on the characteristics of each genre and user feedback. The analysis revealed the following key characteristics.

4.1. Shooting Games

Motion sickness, caused by sudden movements and speed changes, presents a significant challenge in shooting games, often leading users to abandon the experience. Unique mechanics such as time manipulation, which allows for strategic play, and the combination of rhythmic elements create an immersive experience. However, intense movements contribute to motion sickness. To mitigate this issue, gradual movements and technologies that limit the user's field of vision can enhance immersion and stabilize the experience, preventing jerky movements. Addressing motion sickness will increase user retention and satisfaction, encouraging longer playtimes and broadening the game's audience.

4.2. Music Games

High demand exists for content creation and customization in music games, yet official options remain limited. Complaints regarding inconsistent gameplay, often related to tracking issues, have also been noted. Music and exercise-based games offer an enjoyable way to engage with fitness, providing opportunities for calorie burning and weight loss. The need for additional music content highlights the demand for expansions. Improvements in tracking technology, as well as expanded customization and multiplayer modes, would increase social interaction and allow users to collaborate. Enhancing customization and personalization options would significantly improve user satisfaction and engagement, meeting the high expectations for personalization in music games.

4.3. Strategy Games

Inaccurate hand tracking creates significant challenges in strategy games, where precise movements are essential. Interruptions and inaccuracies disrupt the experience, though the simulation aspect of the games has been positively received. The lack of intense movement has also contributed to the genre's popularity as family-friendly content. Accurate hand-tracking technology is necessary to facilitate precise interactions, while family-friendly content can engage broader age groups. Improving hand-tracking precision will enhance immersion and gameplay quality, making strategy games more appealing to diverse audiences while addressing the needs of both younger and older players.

4.4. Horror Games

Spatial constraints in horror games have been frequently cited as the cause of physical injuries during gameplay, such as players dodging suddenly appearing monsters. Despite these concerns, high-resolution graphics and spatial effects contribute to a deeply immersive experience, evoking significant dread through animatronic characters and other visual elements. Horror games must integrate spatial awareness systems to monitor user movement and prevent injuries, while maintaining graphical fidelity for an immersive experience. Addressing safety concerns while maintaining immersion ensures a balance between user safety and the intense, immersive experience characteristic of the horror genre.

4.5. Action Games

Action games combining music and exercise offer a unique nontraditional workout experience. Players can improve fitness and lose weight through rhythmic movements, such as punch-throwing mechanics. Multiple difficulty modes cater to varying levels of challenge, promoting deeper immersion and encouraging regular play. Expanding exercise modes and implementing feedback systems can further motivate players to engage in physical activity through gaming. Providing customizable workout modes and real-time feedback systems will enhance the game's appeal, positioning it as a valuable tool for fitness-focused players.

4.6. Sports Games

Accurate motion control is critical in sports games, particularly in virtual reality (VR) environments where immersion heavily depends on precise tracking. Inaccuracies in motion tracking significantly reduce the quality of the experience. Games that integrate relaxation or fitness elements, such as fishing simulations or exercise routines, offer psychological and physical benefits, with VR fitness experiences having effects comparable to real-world exercise. Improving motion tracking enhances user immersion and provides more realistic exercise feedback. Enhancing motion tracking precision maximizes the benefits of exercise in sports games, making them more effective fitness tools while maintaining immersion.

4.7. Puzzle Games

The absence of multiplayer functionality in most puzzle games limits shared experiences, though story-driven puzzles offer deep immersion. Games combining horror and puzzle elements have been particularly effective in creating intense experiences. Effective time management mechanics also play a key role in maintaining the strategic aspects of puzzle-solving. Adding multiplayer modes and incorporating time-based challenges could further enhance collaboration and competition in puzzle games. Multiplayer integration and competitive elements enhance the appeal of puzzle games, improving engagement and extending replayability.

In conclusion, our analysis has highlighted key differences in the user experiences across various VR game genres, along with specific improvements that could enhance the overall user experience. By addressing these genre-specific challenges, VR game developers can create more immersive, enjoyable, and accessible gaming experiences tailored to the needs of their diverse user bases.

RQ2: What correlations do users show between genres?

To explore the user correlations between VR game genres, we constructed a Genre Affinity Matrix based on the LDA topic keywords (Figure 7). This matrix quantifies the relationships between different genres by measuring the similarities in user experiences and common themes extracted from user reviews. Additionally, we conducted a more detailed analysis by referencing the word cloud, LDA topic lists, and user comments provided in the Appendix to support our findings. By incorporating these elements, we ensured that the correlations were thoroughly reviewed and substantiated, providing a deeper and more comprehensive understanding of the relationships between genres.

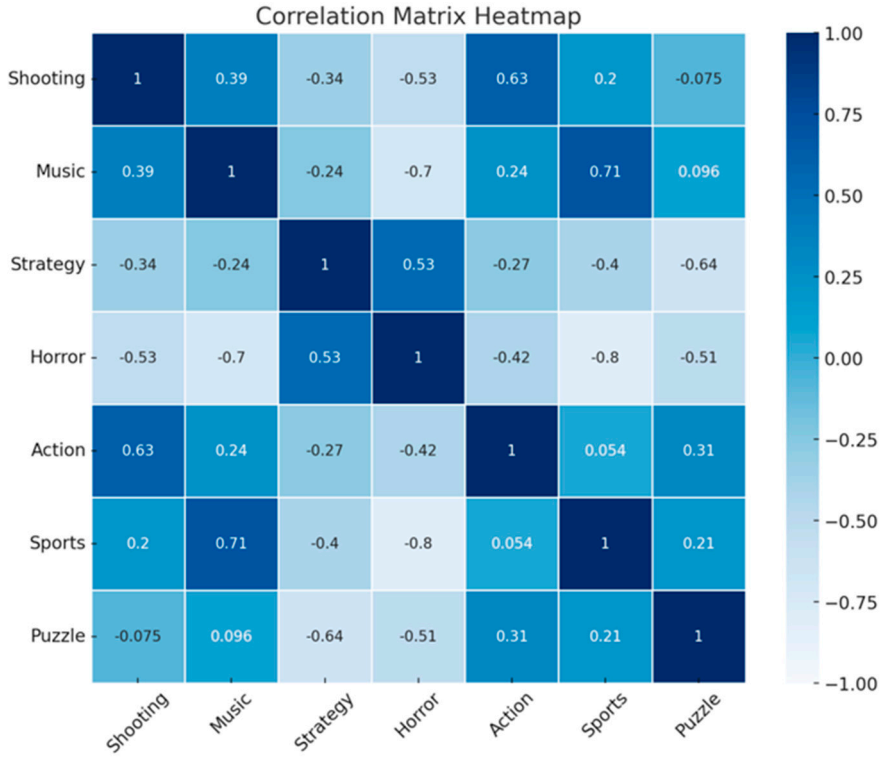

Figure 7. Similarity Matrix between Genres.

4.8. Music and Sports (0.71)

The highest correlation was observed between the Music and Sports genres, with a similarity score of 0.71. This strong correlation suggests that these two genres share common gameplay dynamics, particularly in how they incorporate physical movements and rhythm into the gaming experience. In both genres, players are often required to follow a rhythm or pattern—whether it is hitting musical beats or performing precise sports-related motions. This alignment in physical and rhythmic engagement likely explains the strong correlation. The word cloud and LDA topics for the Music and Sports genres highlight keywords such as "motion", "speed", and "track", reinforcing the idea that both genres demand a similar level of physical involvement and synchronization. This similarity suggests potential for crossover between these genres, where hybrid VR experiences could blend musical and sports elements, further enhancing player immersion by combining music-driven movement with sports mechanics.

4.9. Horror and Sports (−0.80)

The lowest correlation was found between the Horror and Sports genres, with a score of −0.80. This substantial negative correlation indicates a significant contrast between the user experiences in these two genres. While horror games focus on inducing fear and tension through spatial awareness, eerie atmospheres, and jumpscares, sports games are centered around precision, physical activity, and relaxation.

In the word cloud and LDA topic lists, horror games are associated with terms like "fear", "dark", and "jumpscare", while sports games are connected to words such as "motion", "exercise", and "relaxation". These differing thematic elements explain the inverse relationship between the two genres. Developers should maintain the distinct qualities of each genre, as blending them may create conflicting experiences that detract from both the immersive, fear-driven elements of horror and the calming, physically engaging nature of sports games.

4.10. Shooting and Action, Strategy, and Sports: Similar Issues

Shooting and action games are both VR genres characterized by intense movement, where motion sickness is a particularly prominent issue. While all VR games face motion sickness challenges, these two genres experience a higher frequency of it due to fast and sudden movements being central to gameplay. However, the difference between the two genres lies in the variety of games they encompass. Action games include a wide range of sub-genres, resulting in slight variations in the causes of motion sickness. For example, rhythm-based action games and combat-based action games require different movement patterns, which may lead to varying levels of motion sickness.

Similarly, strategy and sports games both require precise movements, but the nature of these movements differs. Strategy games demand fine hand movements and accurate positioning, while sports games emphasize full-body movements, such as throwing or hitting. Both genres require improved tracking technology, but with different focuses: strategy games need enhanced hand-tracking, while sports games would benefit from better full-body tracking and motion control accuracy.

4.11. Unexpected Correlations between Puzzle and Strategy Games

It was anticipated that puzzle and strategy games would show a high correlation, as both typically involve fine motor movements without large-scale motion. However, the analysis revealed a low correlation between these two genres. This is because puzzle games frequently extend beyond traditional puzzle-solving by incorporating direct movement and special effects (e.g., horror elements, super jumps). These elements offer a distinct immersive experience compared to strategy games, which led to the lower correlation. Puzzle games, particularly those incorporating horror elements, combine sensory stimuli and movement to enhance immersion, distinguishing them from strategy games, which focus primarily on fine motor control.

This analysis highlights that while different game genres may share similar issues, the solutions required can vary. Furthermore, the unexpected correlation results between certain genres can be explained by the unique gameplay mechanics specific to each genre.

The insights gained from this analysis have significant implications for both VR game development and academic research. High correlations between certain genres, such as music and sports, suggest opportunities to create hybrid game experiences that leverage the strengths of both genres. On the other hand, low correlations, like those observed between horror and sports, indicate that these genres should remain distinct to preserve their specialized gameplay mechanics.Further research could expand upon these findings by exploring how specific gameplay elements, such as user movement and interaction types, contribute to the observed correlations. Additionally, developers can use these data to design games that align better with user preferences, ensuring that genre-specific challenges and mechanics are fine-tuned to enhance immersion and satisfaction.

5. Limitations and Future Research

Although this study was conducted to gain a deeper understanding of user experience across VR game genres, it had some limitations. Accordingly, the future research tasks are as follows:

First, we are limited to data collected from the Meta Quest store; therefore, the user experience on other platforms may be different, which limits its generalizability. To compensate for this, future studies should collect data from various platforms, including Steam VR, the Google Play Store, and PlayStation VR [27]. For example, Steam VR has a wider variety of hardware and software combinations; therefore, the data obtained could reflect a wider range of user experiences. The Google Play Store will also provide a better understanding of the experiences of mobile VR users. By performing a cross-platform comparative analysis based on the data collected from these different platforms, we can better understand the characteristics and challenges of each platform [27]. This can lead to a more universal understanding of the VR user experience that is not platform-specific. You should also

consider utilizing a variety of data collection and research methods, such as focus group interviews and surveys, to add depth to your user experience. This will compensate for the limitations of quantitative data and provide a deeper understanding of the detailed feelings and thoughts of users.

Second, text-mining techniques cannot fully interpret the subjective expressions and linguistic diversity of user reviews. For example, reviews contain analogies, metaphors, slang, and other expressions that are difficult to analyze accurately. Future research should incorporate sophisticated natural language processing (NLP) techniques, such as deep learning models, to better capture this complexity [28]. For example, deep-learning-based NLP models can be utilized to better understand the context of user reviews and capture subtle sentiment shifts and nuances. In addition, to understand the emotional nuances of reviews, qualitative methods such as interviews need to be complemented to accurately interpret meanings that text-mining techniques may miss [28]. This way, a quantitative analysis of text mining can be combined with an in-depth analysis of qualitative methods for a more accurate and richer user experience analysis.

Third, it is difficult to track changes in user experience over time based on data collected at specific points in time. With the rapid evolution of VR technology and the constant release of new games that have a lasting impact on the user experience, it is important to conduct longitudinal studies that reflect dynamic changes through regular data collection and analysis [29]. For example, data can be collected on an annual or semi-annual basis to identify changes and patterns in the user experience over time. This will facilitate anticipation and response to changes in user expectations and satisfaction as VR technology evolves [29]. These longitudinal studies can also be useful for analyzing the impact of specific events or updates on the user experience. For example, by comparing user reviews after a major game update or new hardware release, one can obtain a clearer picture of how these changes actually impact user satisfaction or the gameplay experience.

In conclusion, although this study provides useful insights into the VR user experience, more extensive data collection, sophisticated analytical techniques, and longitudinal studies would further improve the understanding of the impact and evolution of VR games. Such comprehensive future research is essential for the development of VR games that better reflect user needs and preferences and will ultimately contribute to more immersive and satisfying VR experiences.

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Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A LDA Output

Appendix A.1 Shooting

Appendix A.1.1 Topic 1

people, add, time, free, gun, update, see, go, motion, want, thing, know, work, way, think, back, please, try, coasters, need, mode, sick, stars, give, say, tried, sickness, shoot, things, times, lot, help, start, two, roller, little, something, weapons, around, bought, screen, trying, shooting, headset, maybe, right, use, real, every, since, never, track, sometimes, problem, rides, friends, needs, theres, multiplayer, find, level, without, star, ride, let, keep,

devs, big, hand, bit, kids, maps, getting, guys, move, fine, players, option, everything, take, ill, gave, mean, put, app, look, hard, wont, review, annoying, money, player, open, made, instead, overall, actually, reason, far, possible, another, fix, stuff, paid, behind, either, team.

Appendix A.1.2 Topic 2

experience, played, worth, time, super, levels, buy, definitely, well, graphics, gameplay, hours, different, space, shooter, makes, mode, story, short, lot, use, content, modes, price, easy, hot, action, bullets, link, far, bit, level, every, feels, bought, way, favorite, version, try, hard, keep, highly, perfect, immersive, challenging, simple, matrix, enemies, top, workout, think, made, enough, mechanics, say, around, free, never, weapons, overall, absolutely, anyone, family, little, looking, back, lots, move, arcade, money, endless, campaign, nice, long, dodging, real, full, fantastic, especially, purchase, see, guns, john, tracks, wick, style, world, dodge, fast, day, replay, motion, enjoyed, pc, find, feeling, getting, friends, always, thought, coming, sound, variety, blast.

Appendix A.2 Music

Appendix A.2.1 Topic 1

songs, custom, time, rhythm, use, level, mode, expert, want, link, way, go, need, hard, sabers, hit, blocks, multiplayer, levels, mods, easy, people, add, something, lot, well, see, difficulty, without, bit, think, version, synth, experience, played, different, makes, things, theres, riders, mod, nice, feels, move, option, right, notes, space, tracking, look, try, maybe, players, sometimes, every, score, perfect, maps, thing, find, back, give, thumper, online, dance, friends, enough, made, around, referral, hand, gameplay, little, community, say, overall, support, player, simple, start, work, modding, change, speed, actually, another, sound, always, getting, times, download, especially, track, miss, seems, quite, long, come, bmbf, controllers, devs, far, probably, instead, visuals.

Appendix A.2.2 Topic 2

update, bought, played, back, tracking, app, please, headset, fix, time, since, buy, tried, work, every, wont, know, refund, let, review, use, times, stars, problem, never, money, ago, issue, family, keep, want, help, stop, able, everything, reason, screen, give, try, go, start, tag, block, right, year, version, years, account, day, last, download, shoot, purchased, star, gorilla, code, ill, days, says, found, wanted, multiplayer, started, anything, came, psvr, store, updated, working, thanks, tell, share, soon, hours, couldnt, fixed, see, long, level, click, trying, return, devs, support, people, hope, two, months, sharing, said, minutes, later, old, show, device, load, thank, put, boss, meta, fine, install, already, absolutely, keeps, recently, using, friends, com.

Appendix A.2.3 Topic 3

songs, buy, worth, workout, time, free, packs, must, definitely, played, want, levels, lot, well, add, bought, super, experience, think, money, favorite, say, people, every, hours, way, gets, graphics, rhythm, exercise, gameplay, highly, hard, easy, pay, getting, different, day, give, makes, absolutely, price, keep, thing, never, far, content, addictive, pistol, little, buying, purchase, know, work, need, bit, friends, everyone, whip, dlc, already, enough, challenging, looking, anyone, stars, go, see, try, boring, fast, addicting, sweat, thought, campaign, id, without, wick, fantastic, feels, something, added, extra, visuals, mode, selection, recommended, pack, theres, bored, yet, lots, variety, moving, overall, use, expensive, start, dragons, intense, demo, probably, put, full, always, made, actually, hope, totally.

Appendix A.2.4 Topic 4

pack, songs, add, please, rock, guitar, packs, classic, hero, see, park, need, billie, drums, eilish, maybe, know, bts, metal, band, pop, artists, drum, think, life, etc, sickness, older, green, headphones, imagine, added, guys, old, dlc, needs, album, bands, want, metallica,

come, thing, beetle, stuff, beats, country, thank, rap, kpop, heavy, day, mixtape, understand, motion, fan, years, tracks, world, queen, smash, real, punk, hip, ur, sounds, bring, theme, trailer, fans, adrenaline, rush, popular, artist, interested, title, variety, thought, acdc, disco, jackson, misleading, put, favorite, mix, justice, genres, sick, big, dad, bass, absolutely, michael, haptics, strap, ninja, included, vibrations, prepare, hop, living, eminem, plz, senses, idea.

Appendix A.3 Strategy

Appendix A.3.1 Topic 1

time, fix, back, update, know, work, please, stars, tried, try, every, tracking, wont, problem, bugs, go, refund, sometimes, give, start, times, thing, anything, let, screen, trying, bug, headset, glitches, among, issues, star, fixed, button, minutes, people, annoying, want, hands, stuck, played, something, reason, couldnt, gets, save, glitch, everything, issue, says, black, review, help, way, progress, put, started, level, five, right, tasks, getting, find, voice, say, match, load, restart, stop, working, went, think, bought, open, fine, ill, since, keeps, never, else, someone, glitchy, hard, day, left, lost, lot, see, theres, need, app, hours, saying, room, hour, boring, crashes, problems, wrong, makes, join, little, anyone, money, wouldnt, menu, whenever, reset, chat, leave.

Appendix A.3.2 Topic 2

job, simulator, played, story, worth, buy, graphics, physics, hours, definitely, vacation, puzzles, well, sandbox, experience, time, little, lot, price, bonelab, gameplay, boneworks, think, use, link, things, super, perfect, overall, everything, bit, must, want, say, around, every, absolutely, never, favorite, highly, bought, made, far, money, puzzle, content, short, theres, works, mode, world, relaxing, way, looking, thought, magic, since, long, boring, day, try, yet, anyone, space, lots, honestly, bone, stuff, buying, campaign, go, see, wait, different, real, motion, getting, thing, review, easy, store, lab, sim, mechanics, probably, challenging, code, hard, makes, work, totally, referral, wanted, com, reviews, nice, incredible, discount, bored, secrets, beautiful, levels, explore, bugs, always, enjoyed, immersive, feels, fantastic, come.

Appendix A.3.3 Topic 3

mods, people, add, kids, please, multiplayer, mod, download, friends, community, want, need, year, say, go, nice, old, see, pc, know, thank, played, thing, without, sequel, ship, lot, bonelab, hope, kid, age, stuff, family, son, everyone, said, loves, think, bought, buy, free, keep, ring, years, little, children, wait, meta, daughter, find, time, toxic, click, friend, funny, mobile, needs, way, support, ford, players, updates, put, guys, competitive, ur, app, station, discord, day, saying, tag, come, install, maps, devs, yeah, tho, downloaded, phone, tell, version, nock, talk, man, cooking, made, things, since, 13, always, stop, food, called, waiting, online, person, already, theres, screaming, came, brother, ta, bro, overall, getting, making, imposter, update, rage.

Appendix A.3.4 Topic 4

things, see, time, way, magic, around, level, spells, different, story, something, maybe, lot, think, update, well, bit, want, experience, levels, players, little, thing, go, add, people, able, player, theres, find, makes, move, hands, work, feels, back, keep, city, use, mode, movement, need, right, devs, hard, natural, needs, hope, updates, developers, easy, controls, content, room, take, look, weapons, start, everything, nice, making, know, enough, system, stuff, far, using, tower, next, future, pick, seems, build, give, added, overall, point, id, without, trying, campaign, wait, building, actually, stars, climbing, looking, come, control, world, quite, simple, getting, gameplay, frustrating, small, put, part, mechanics, sometimes, two, idea, especially, times, guns, real, mech, enemies, made.

Appendix A.3.5 Topic 5

hand, tracking, controllers, use, hands, rocket, league, hard, price, easy, money, long, using, worth, melon, belly, bugs, time, need, average, gameplay, difficult, life, kids, climb, free, learn, waste, kinda, instead, grind, sorcery, short, horrible, sucks, replace, master, enough, blade, adults, annoying, link, little, buggy, audio, work, controller, house, decent, sale, knock, left, demo, skully, go, legs, itll, waltz, playground, trash, fault, look, story, found, controls, care, younger, level, okay, difficulty, meta, dark, tech, brain, word, crap, minutes, beyond, code, forget, file, ui, god, percent, dollars, moon, press, paint, reality, graphics, track, rank, animals, arrow, minor, big, crashed, watch, show, finicky, expectations, overall, stone, archery.

Appendix A.4 Horror

Appendix A.4.1 Topic 1

scary, horror, scared, worth, experience, terrifying, jump, scares, buy, definitely, played, link, graphics, scare, use, super, want, code, time, jumpscares, well, gameplay, remove, com, perfect, wait, overall, animatronics, levels, space, pants, makes, friends, every, scariest, made, looking, heart, lot, thought, fear, way, try, fan, think, money, actually, edge, pack, spaces, used, fans, people, highly, absolutely, truly, real, say, finish, immersive, referral, keep, buying, heres, level, spooky, scarier, never, far, literally, easily, getting, funny, crap, atmosphere, discount, times, mini, thinking, little, adds, intense, seat, helpful, anyone, series, horrifying, challenging, price, incredible, musthave, terrified, lots, hours, totally, especially, hard, man, different, extremely, bit, addition, scream, take, jumpscared, opinion.

Appendix A.4.2 Topic 2

graphics, time, bugs, story, gameplay, well, played, way, bit, lot, see, around, far, think, update, overall, little, stars, screen, experience, makes, times, things, look, nice, back, theres, sometimes, every, review, put, level, move, fixed, save, need, port, version, horror, something, work, hope, thing, people, definitely, star, hours, hard, everything, wait, fantastic, glitches, worth, find, want, made, add, fix, know, head, long, point, right, gets, getting, different, please, problem, use, give, start, sound, issue, try, atmosphere, devs, part, keep, looking, issues, bought, original, progress, looks, say, able, another, bug, money, already, annoying, maybe, minutes, end, trying, release, enough, quite, friend, content, seems, actually, needs, zombies, next, ill, camera, hand.

Appendix A.4.3 Topic 3

dlc, night, nights, wanted, help, know, time, played, see, parts, animatronics, thing, scared, since, please, back, fan, want, service, go, came, come, everything, steel, foxy, waiting, say, fix, repair, wool, every, mode, progress, scott, finally, bought, give, curse, never, level, vent, right, thank, look, terrifying, door, little, terrors, always, dark, hard, close, levels, way, long, buy, think, big, try, people, dread, made, stars, day, tried, keep, bonnie, problem, bear, need, wait, coming, glitch, life, favorite, work, let, whole, actually, wont, series, tapes, bit, took, add, take, nightmare, something, making, start, franchise, gone, job, wasnt, trying, saw, soon, year, halloween, head, said, original, away, rooms, probably, animatronic.

Appendix A.5 Action

Appendix A.5.1 Topic 1

songs, buy, bought, please, add, played, people, want, friends, custom, update, super, money, pack, know, app, packs, worth, time, free, need, day, every, link, use, tried, try, headset, say, wont, family, back, since, never, fix, favorite, work, go, refund, give, think, dlc, multiplayer, buying, everyone, stop, mods, help, workout, must, version, code, let, sabers, lot, purchased, stars, thank, thing, old, kids, year, download, pay, purchase, years, friend, ago, getting, made, online, reason, problem, days, thanks, fishing, exercise, way,

says, support, started, remove, said, mod, space, rhythm, review, scary, came, definitely, months, put, guys, thought, anyone, come, community, regret, rock, wanted, boring, start, beatsaber, screen.

Appendix A.5.2 Topic 2

time, experience, levels, way, played, well, mode, graphics, level, real, story, makes, gameplay, lot, see, think, hard, hours, little, worth, definitely, different, far, bit, around, short, super, thing, easy, want, back, every, move, overall, things, feels, guns, something, use, people, must, keep, gun, right, theres, enough, realistic, times, modes, need, find, world, looking, able, work, nice, long, fish, perfect, buy, absolutely, maybe, stars, highly, without, say, immersive, challenging, know, made, everything, content, fishing, never, give, look, getting, add, life, try, hit, actually, weapons, start, take, player, simple, multiplayer, gets, shooting, room, mechanics, sometimes, table, price, hope, players, version, always, action, devs, put, id, developers, end, hand, quite, matrix.

Appendix A.6 Sports

Appendix A.6.1 Topic 1

ball, time, see, way, back, app, right, hit, go, update, hand, know, think, work, times, hard, option, need, mode, want, little, find, bit, move, tried, start, please, stars, able, tracking, give, sometimes, seems, help, something, use, lot, maybe, around, issue, every, try, thing, things, people, trying, problem, keep, turn, change, theres, review, without, hands, using, issues, movement, real, player, since, always, id, point, take, instead, makes, let, follow, two, level, used, fix, long, well, controllers, actually, look, set, voice, never, getting, needs, add, last, seem, ai, end, etc., far, overall, left, head, practice, tutorial, match, multiplayer, put, nice, fast, settings, players, side, ill, speed, another, racket, minutes, opponent, works, working.

Appendix A.6.2 Topic 2

fishing, fish, experience, time, graphics, see, well, relaxing, real, add, multiplayer, friends, keep, beautiful, different, meditation, nice, content, developers, calm, people, environments, world, realistic, mode, look, go, buy, want, able, every, looking, played, thank, far, way, bought, find, forward, hours, day, worth, life, thing, hope, lot, favorite, work, relax, think, locations, around, something, wait, visuals, updates, future, things, added, never, please, absolutely, say, gameplay, easy, courses, devs, immersive, perfect, scenery, made, physics, little, definitely, always, family, experiences, dlc, super, put, update, highly, everything, level, especially, come, back, fantastic, job, thanks, course, catch, options, away, team, feels, makes, maybe, sports, another, adding, use, wonderful, together, top, water, environment, enough, lifetime, actually.

Appendix A.6.3 Topic 3

app, workout, use, boxing, subscription, real, exercise, day, tennis, fitness, workouts, work, worth, experience, using, focus, well, realistic, sweat, time, bike, want, fight, meditation, body, daily, table, definitely, chi, training, apps, buy, tai, life, every, way, price, demo, highly, lot, sessions, getting, years, minutes, cardio, looking, try, holofit, without, played, days, feels, gym, actually, bought, guided, need, les, exercises, session, makes, space, mills, far, helps, used, breathing, never, tried, fit, rowing, heart, say, purchase, ping, creed, pong, working, keep, must, week, link, money, sweating, arms, shape, sore, world, absolutely, supernatural, pay, super, punches, go, thing, sports, helped, since, perfect, improve, membership, anyone, virtual, trainer, thrill, excellent, started, free, routine, machine.

Appendix A.7 Puzzle

Appendix A.7.1 Topic 1

levels, buy, mode, matrix, use, link, bullets, short, story, modes, endless, space, add, code, super, campaign, people, lot, definitely, makes, worth, want, content, com, discount, remove, referral, physics, dodging, gameplay, dodge, enemies, action, graphics, boring, need, time, weapons, think, price, guns, replay, different, overall, thing, multiplayer, version, lots, theres, free, shooter, played, level, guys, feels, wick, needs, things, shooting, stuff, sandbox, hours, little, mods, gun, please, ability, bullet, go, main, hard, combat, friends, perfect, red, spaces, way, extra, bit, rift, friend, kill, kinda, store, favorite, works, shoot, meta, buying, unlock, challenges, say, introduce, realistic, bonelab, credit, everyone, complete, fast, delete, helpful, speed.

Appendix A.7.2 Topic 2

move, around, sometimes, hand, time, level, things, birds, tracking, bit, area, motion, right, objects, back, way, little, go, times, use, thing, point, hands, angry, frustrating, work, room, need, trying, sickness, moving, hard, find, makes, lot, something, space, head, teleport, movement, overall, think, problem, stuck, left, issues, update, annoying, walk, well, take, using, instead, theres, pick, gets, try, issue, without, slow, people, start, place, sick, stars, works, red, hit, hold, everything, levels, main, see, throw, inventory, grab, seems, often, button, turn, end, reason, option, screen, made, actually, items, controller, moves, found, light, stuff, floor, idea, locomotion, getting, look, give, behind, bug, bugs, wall, always, object, small, difficult, away, maybe, moon.

Appendix A.7.3 Topic 3

puzzles, story, puzzle, experience, well, shadow, played, challenging, world, graphics, beautiful, time, gameplay, hours, levels, point, easy, worth, definitely, immersive, interesting, mechanics, enjoyed, way, nice, must, fantastic, far, looking, job, enough, different, end, patrick, highly, little, level, every, long, think, voice, absolutely, short, simple, perfect, lot, yet, room, style, stewart, keep, solve, quite, made, difficult, see, price, bit, overall, excellent, unique, simulator, take, mind, hope, around, felt, acting, content, makes, buy, finish, never, developers, storyline, full, say, wonderful, visuals, look, art, thought, environments, difficulty, find, times, next, complete, anyone, hard, finished, clever, incredible, away, took, use, engaging, favorite, want, go, super, challenge, solving, tetris, id, always, satisfying, longer, experiences, narration.

Appendix A.7.4 Topic 4

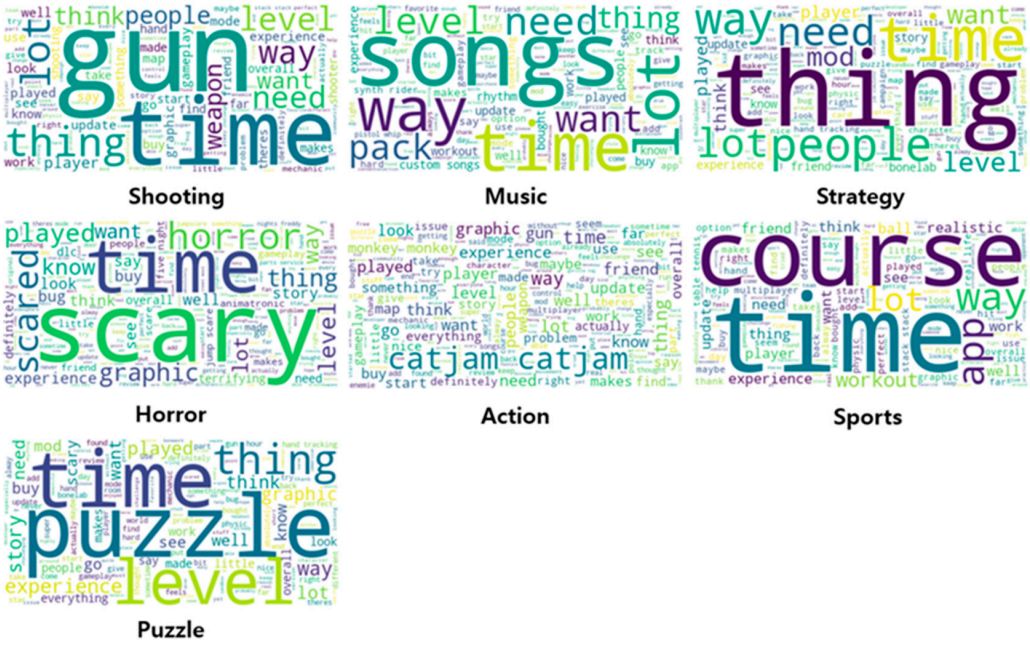
played, scary, horror, scared, life, plot, fan, graphics, jump, version, original, real, little, wanted, experience, dlc, made, definitely, actually, bird, people, night, favorite, makes, think, always, especially, parts, heart, scares, watched, terrifying, job, know, never, feels, funny, years, nights, face, thought, since, big, friends, super, remember, port, far, freely, well, scare, animatronics, wires, wow, old, age, want, phone, freddys, pet, pigs, absolutely, creepy, watching, way, came, say, christmas, probably, video, look, huge, lot, memories, console, ur, true, theme, dark, overall, hard, mobile, bit, spooky, coming, series, whole, sooo, looking, disturbing, see, hell, looks, liked, alone, year, watch, everything, boy, perfect, kids, self, dream, views, mini, franchise, oh, nonvr, highly.

Appendix A.7.5 Topic 5

time, super, played, back, bought, hot, save, worth, try, please, stars, buy, every, know, say, money, update, give, stop, levels, tried, let, never, want, progress, star, day, start, go, long, five, times, wont, reviews, days, hours, thing, way, review, come, see, headset, finished, getting, put, wanted, since, help, level, wait, last, reason, hope, came, people, need, hour, buying, demo, devs, refund, hard, said, took, fix, finish, already, title, started, keep, next, screen, problem, spent, anything, tell, ago, something, two, app, ill, regret,

work, finally, thought, else, everything, think, reading, soon, another, lost, couldn't, went, probably, trying, saw, thinking, right, quests, minutes, paid, bonus, friends, half, part, old, decided, wasn't, saved.

Appendix B Word Cloud



found that when tracking is inaccurate, immersion is significantly reduced [6]. VR experiences for relaxation and meditation have also provided psychological relief and well-being. For example, users can enjoy natural landscapes while fishing in VR fishing games. Finally, fitness and exercise experiences in VR provided similar effects to real-world exercise, improving.

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