Unveiling the Impact of Sound Design on Player Engagement and Retention in Gaming: A Systematic Review

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Abstract

Sound design is an important aspect of video games that can influence player attention, immersion, emotional connection, and overall enjoyment during gameplay. However, the extent to which sound design affects player engagement and retention in gaming is unclear. This systematic review aims to synthesize the evidence on the impact of sound design on player engagement and retention in gaming. We will search electronic databases (such as Scopus, Web of Science, ACM Digital Library, IEEE Xplore) and grey literature sources (such as Google Scholar, ProQuest Dissertations & Theses) for studies that evaluate the effect of sound design on player engagement and retention in gaming. We will include studies that use any type of sound design intervention (such as music, sound effects, voice acting) and any type of outcome measure (such as self-reported or objective measures of engagement and retention). We will use predefined criteria to screen and select studies for inclusion. We will extract data from the included studies using a standardized form. We will assess the risk of bias and the quality of the included studies using a validated tool. We will synthesize the data using narrative synthesis or meta-analysis, depending on the heterogeneity and availability of data. We will report the results following the PRISMA 2020 statement.

Keywords: PLACEHOLDER

1 Introduction

1.1 Rationale

Video games are a popular form of entertainment that can provide various benefits to players, such as cognitive stimulation, social interaction, and stress relief. However, not all games are equally engaging or enjoyable for players. One factor that can influence player engagement and enjoyment is sound design, which refers to the creation and manipulation of audio elements in games, such as music, sound effects, voice acting, and ambient sounds. Sound design can enhance the gameplay experience by creating a sense of presence, providing feedback, evoking emotions, and establishing mood and atmosphere. Sound design can also affect player retention, which refers to the ability of games to keep players interested and committed over time. Player retention is crucial for the success and sustainability of games, especially in a competitive and saturated market.

However, despite the potential importance of sound design for player engagement and retention in gaming, there is a lack of systematic reviews that synthesize the evidence on this topic. Previous reviews have focused on specific aspects or genres of sound design or gaming, such as music in role-playing games or sound effects in horror games. Moreover, these reviews have used different definitions, methods, and criteria for selecting and evaluating studies, making it difficult to compare and integrate their findings. Therefore, there is a need for a comprehensive and up-to-date systematic review that covers all aspects of sound design and all types of games that evaluate the impact of sound design on player engagement and retention in gaming.

1.2 Objectives

The objective of this systematic review is to synthesize the evidence on the impact of sound design on player engagement and retention in gaming. The specific research questions are:

How does sound design affect player attention,

immersion, emotional connection, and overall enjoyment during gameplay?

What are the specific elements of sound design (e.g., music, sound effects, voice acting) that significantly impact player engagement and retention in gaming?

How can sound design techniques (e.g., adaptive sound systems, dynamic audio environments, personalized audio experiences) be used to create immersive and captivating gaming experiences for players?

How does sound design influence long-term player commitment and reduced player churn in video games?

How does sound design vary across different game genres, platforms, and contexts, and how does this affect player engagement and retention?

2 Methodology

2.1 Eligibility Criteria

We will include studies that meet the following criteria:

Type of studies: We will include any type of study design that evaluates the effect of sound design on player engagement and retention in gaming, such as randomized controlled trials, quasi-experimental studies, observational studies, or qualitative studies.

Type of participants: We will include studies that involve human participants of any age, gender, or background who play video games for any purpose, such as entertainment, education, or health.

Type of interventions: We will include studies that use any type of sound design intervention in video games, such as music, sound effects, voice acting, or ambient sounds. The intervention can be compared to no sound design, a different type of sound design, or a standard or usual sound design.

Type of outcomes: We will include studies that measure any type of outcome related to player engagement and retention in gaming, such as self-reported or objective measures of attention, immersion, emotional connection, enjoyment, satisfaction, motivation, preference, loyalty, or churn.

Type of settings: We will include studies that involve any type of game genre, platform, or context, such as action, adventure, role-playing, simulation, strategy, casual, mobile, console, PC, online, offline, single-player, multiplayer, cooperative, competitive, educational, or health-related games.

We will exclude studies that:

-        Are not published in English

-        Are not peer-reviewed or are published as abstracts only

-        Do not report primary data or are not based on empirical research

-        Do not involve human participants or video games

-        Do not use sound design as an intervention or do not measure player engagement or retention as an outcome

2.2 Information Sources

We will search the following electronic databases for relevant studies:

- Scopus

- Web of Science

- ACM Digital Library

- IEEE Xplore.

We will also search the following sources for grey literature:

- Google Scholar

- ProQuest Dissertations & Theses

We will limit the search to studies published from 2000 onwards to capture the most recent developments in sound design and gaming technology.

2.3 Search Strategy

We will develop a comprehensive search strategy based on the research questions and eligibility criteria. We will use a combination of keywords and controlled vocabulary terms related to sound design, gaming, engagement, and retention. We will adapt the search strategy to each database using appropriate syntax and filters. We will also use citation tracking and reference checking to identify additional relevant studies. An example of the search strategy for Scopus is:

(TITLE-ABS-KEY (sound OR audio OR music OR "sound effect*" OR "voice act*" OR "ambient sound*") AND TITLE-ABS-KEY (game* OR "video game*" OR "computer game*" OR "digital game*") AND TITLE-ABS-KEY (engag* OR immers* OR emotion* OR enjoy* OR satisf* OR motiv* OR prefer* OR loyal* OR churn*) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (PUBYEAR , 2000))

2.4 Data Management

We will use EndNote software to manage the records retrieved from the searches. We will remove duplicates and import the records into Covidence software for screening and selection.

2.5 Selection Process

Two reviewers will independently screen the titles and abstracts of the records for eligibility. Records that are clearly irrelevant will be excluded. Full-text articles of potentially relevant records will be obtained and assessed for eligibility by two reviewers independently. Any disagreements or uncertainties between reviewers will be resolved by discussion or consultation with a third reviewer. Reasons for exclusion at the full-text stage will be recorded. A PRISMA 2020 flow diagram will be used to report the number of records identified, screened, included, and excluded at each stage of the selection process.

2.6 Data Collection Process

Two reviewers will independently extract data from the included studies using a standardized data extraction form. The data extraction form will be pilot-tested on a sample of studies and refined as needed. Any discrepancies or uncertainties between reviewers will be resolved by discussion or consultation with a third reviewer.

2.7 Data Items

The data extraction form will collect the following information from each study:

- General information: study ID, authors, title, year, journal, country, funding source, conflict of interest

- Study characteristics: study design, setting, duration, sample size, inclusion and exclusion criteria

- Participant characteristics: age, gender, background, gaming experience, gaming purpose

- Intervention characteristics: type of sound design intervention, comparison group, delivery mode

- Outcome characteristics: type of outcome measure, measurement tool, timing

of measurement, results, effect size, confidence interval, p-value

- Risk of bias and quality assessment: risk of bias tool, risk of bias rating, quality rating

- Other information: main findings, strengths, and limitations, implications for practice and research

2.8 Risk of Bias in Individual Studies

Two reviewers will independently assess the risk of bias and quality of the included studies using a validated tool or checklist appropriate for the study design. For example, we will use the Cochrane Risk of bias tool 2.0 for randomized trials, the ROBINS-I tool for non-randomized studies, and the CASP checklist for qualitative studies. We will rate the risk of bias for each study as low, high, or unclear. We will also assign a quality rating for each study based on the GRADE approach. Any disagreements or uncertainties between reviewers will be resolved by discussion or consultation with a third reviewer.

2.9 Data Synthesis

We will synthesize the data from the included studies using appropriate methods, depending on the heterogeneity and availability of data. If possible, we will conduct a meta-analysis to pool the effect estimates of sound design on player engagement and retention across studies using a random-effects model. We will use the inverse variance method to weigh the studies according to their precision. We will assess the heterogeneity among studies using the I2 statistic and explore potential sources of heterogeneity using subgroup analysis or meta-regression. We will also assess the publication bias using funnel plots and Egger's test. If a meta-analysis is not feasible or appropriate, we will conduct a narrative synthesis to describe and compare the characteristics, results, and quality of the included studies. We will use tables and figures to summarize and present the data.

3 Literature Reviews
3.1 Summaries

Sound design is an important aspect of video game development that can enhance the player's experience and influence the player's behavior and emotions. However, sound design is often overlooked or underestimated by game developers and researchers, resulting in a lack of understanding and appreciation of its potential and impact. This literature review aims to survey the existing research on sound design for video games, focusing on the following aspects: the process and technology of game sound design, the sound design for visually impaired players and blind AI, the sound design techniques and architectures from the entertainment industry, the sound design for causing fear and anxiety in video games, and the informative sound design for video games.

The first paper by [Processes and tools for sound design in computer games] provides a comprehensive overview of the process and technology used in-game sound design, based on interviews with game industry professionals, bibliography analysis, and examples of existing tools and games [1]. The paper also explores the possible interactions between game sound design and other fields of interactive music, such as composition, sound art, and audiovisual sound design. The paper argues that the game design paradigm can offer a new perspective and tools for interactive composition and that composers, sound artists, and audiovisual sound designers should use the game technology and the game design paradigm for their interactive works.

The second paper by [DareFightingICE Competition: A Fighting Game Sound Design and AI Competition] proposes and implements a novel competition that combines sound design and blind AI for a fighting game platform that targets visually impaired players. The paper describes the development of the DareFightingICE platform, the design of the competition tracks, and the evaluation of sound designs and AI algorithms [5]. The paper claims that the competition can promote effective sound designs for visually impaired players and blind AI algorithms that only use sound as the input, and that it can create synergy between sound design and AI research areas.

The third paper by [Videogame and Entertainment Industry Standard Sound Design Tech-

niques and Architectures for Use in Videogames, Virtual Environments and Training] applies the sound design techniques and audio architectures from the entertainment industry to virtual environments and training systems [2]. The paper reviews the methods and tools for creating sound effects and ambiences for film and videogames, compares the performance and features of different audio architectures such as OpenAL, DirectSound, DirectMusic, EAX, and Ausim3D Goldserve, and conducts experiments and measurements to assess the impact of sound on immersion, presence, and performance in virtual environments. The paper demonstrates that sound is an essential component of virtual environments that adds ambience, emotion, and a sense of presence to the simulation, and that off-the-shelf and open-source technologies can provide a cost-effective and flexible solution for creating18 and presenting spatialized sound.

The fourth paper by [Causing Fear and Anxiety Through Sound Design in Video Games] investigates how volume, timing, and source of in-game sound effects can be used to cause fear [3] and anxiety in video game players. The paper uses a combination of three theories of human emotion (Freud's id, ego, and super-ego theory, James-Lange theory, and Plutchik's psychoevolutionary theory), and a practical experiment using a Survival-Horror style level designed and constructed by the author. The paper collects quantitative data (heart rate) and qualitative data (questionnaires) from 20 participants who played the level with different sound effects. The paper supports the hypothesis that high-volume, well-timed, sourced sound effects caused more fear, while medium-volume, untimed, unsourced sound effects caused more anxiety in the players.

The fifth paper by [Informative Sound Design in Video Games] focuses on informative sound design for video games, especially for first-person shooter (FPS) and real-time strategy (RTS) genres. The paper reviews previous literature on sound design, sonification, auditory display [4] and multi-sensory display, and analyzes how sound is used in two popular video games, Battlefield 3 and WarCraft III, to identify and describe some sound design patterns. The paper proposes that sound can be used to convey information in video games in various ways, such as providing feedback, warning, notification, and

progressive information, and that existing approaches to sound design such as auditory icons, earcons and speech can be applied and documented as design patterns for different game genres.

3.2 Comparison

The papers in this review also vary in their strengths and limitations. The first paper is comprehensive and informative, but it lacks empirical evidence and evaluation of its claims. The second paper is novel and challenging, but it has a limited scope and sample size. The third paper is thorough and rigorous, but it is somewhat outdated and does not consider the latest developments in sound technology. The fourth paper is sound and clear, but it has a narrow focus and a small sample size. The fifth paper is useful and practical, but it is descriptive rather than prescriptive and does not test the effectiveness of sound design patterns.

3.3 Evaluation

The papers in this review have some implications and recommendations for game developers and researchers. The first paper suggests that game industry and game sound designers should improve their sound design process and technology and collaborate with other fields of interactive music. The second paper suggests that sound design and blind AI are important and promising research topics for fighting games, and that the competition can promote effective sound designs for visually impaired players and blind AI algorithms. The third paper suggests that sound design should be considered an essential component of virtual environments that adds ambience, emotion, and a sense of presence to the simulation, and that off-the-shelf and open source technologies can provide a cost-effective and flexible solution for creating and presenting spatialized sound. The fourth paper suggests that sound design is a powerful and inexpensive tool for creating immersive and emotional experiences in video games, and that level designers should pay more attention to the properties and types of sound effects they use in their levels. The fifth paper suggests that sound can be used to provide additional information to players in video games, and that game developers should consider using sound design patterns to create

informative sound for their games.

3.4 Discussion

This literature review has shown that sound design for video games is a rich and diverse topic that deserves more attention and appreciation from game developers and researchers. By surveying the existing research on sound design for video games, this review has highlighted some of the challenges, opportunities, and best practices of game sound design, as well as some of the gaps and directions for future research.

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