

Auditory Hallucination: Audiological Perspective for Horror Games

Thainá Cristina Demarque
CSA – Colégio Santo Agostinho
Rio de Janeiro, RJ – Brazil
thaina.demarque@gmail.com

Edirlei Soares de Lima
PUC-Rio – Departamento de Informática
Rio de Janeiro, RJ – Brazil
elima@inf.puc-rio.br

Abstract— Horror games apply several techniques to provoke fear in players. Some games try to frighten players by including ghostly voices, screams, and whispers of unknown sources in the audio of the game. These effects make players experience a form of hallucination known as Auditory Hallucination, which is a psychological disorder that makes individuals experience auditory perceptions in the absence of corresponding external acoustic stimulus. In this paper we investigate the effects of auditory hallucinations in horror games through a case study of the games *Silent Hill*, *Fatal Frame*, *F.E.A.R.*, and *Hotel 626*. We also present and evaluate a simple horror game to verify the effectiveness of this auditory stimulus through a user study. The preliminary results indicate that this stimulus may indeed provide an attractive way to provoke fear in players.

Keywords — Horror Games; Auditory Hallucination; Audio; Fear; Emotions

I. INTRODUCTION

Fear is an emotion experienced in anticipation of dangerous or painful situations [1]. Although fear is usually considered an unpleasant emotion, it is sometimes used for entertainment purposes. A long time ago people started getting together around campfires to share horror stories as a way to have fun. Nowadays, society continues the search for new forms of entertainment based on fear. The growing number of people looking for horror games, and the increasing number of new games focusing on scary stories being released every year indicates the effectiveness of fear for entertainment purposes.

Several techniques to provoke fear in horror games have been developed through the years. Some of them are related to the visual aspects of the environment of the game (*e.g.* darkness, strangeness, obscurity), others to the narrative itself (*e.g.* nightmares, isolation, paranoia), and some to the audio of the game (*e.g.* suspenseful music, strange and scary sound effects). Most of these techniques are inspired by the methods used by cinematographers and film directors to create horror movies. Through the years several studies have been conducted to verify the effects these techniques have on the player's mind. However, there are still some unexplored aspects.

Some horror games try to frighten and scare players by including in the audio of game ghostly voices, screams, and whispers whose source is unknown. These audio effects make players experience a form of hallucination known as Auditory Hallucination. People suffering this form of hallucination perceive sounds without auditory stimulus [2]. The sounds can include primitive noises (bangs, whistles, claps, screams, and ticks), speech and music. Sometimes the person may recognize the voice as one of a family member, sometimes it may be the voice of a stranger, or even God [3]. The voices or sounds can be thought to originate from anywhere (*e.g.* walls, the ground, trees). Although it is common to find these audio effects in horror games, there is a lack of studies investigating the importance and the effects of this auditory stimulus.

In this paper we explore the effects of auditory hallucinations in games. We present a case study investigating how horror games like *Silent Hill*, *Fatal Frame*, *F.E.A.R.* and *Hotel 626* use auditory hallucinations during the gameplay. We also developed a simple horror game to evaluate the effects of auditory hallucinations in players through a user study that looks forward to verify the applicability of this auditory stimulus to provoke fear.

The paper is organized as follows. Section II presents the previous works. Section III defines the theory of auditory hallucination and its psychological effects. Section IV presents a case study analyzing how games include auditory hallucination in the gameplay. Section V describes the user study and its results. Section VI contains concluding remarks.

II. RELATED WORKS

There are several works in the literature that focus on the relationship between audio and fear in horror games. Garner *et al.* [4] presented an experimenter testing which sound parameters (such as pitch and loudness) are capable of controlling the level of fear in survival horror games. Their study confirmed that differences between sound parameters can affect the degree of intensity an individual experience while playing a survival horror game. Grimshaw [5] also explored the

potential of specific sound parameters and identified that both loudness and frequency equalization have the capacity to attenuate and amplify negative emotional activation. He also emphasized that the uncertainty about the location of a sound source, its cause or its meaning in the virtual world increases the fear emotion. Ekman and Kajastila [6] suggested that the emotional impact of sounds can be affected by choosing how to play those sounds. The authors presented the results of small-scale study that suggest that making the localization of sound difficult increases the fear factor when compared to the same sound with clearly detectable source.

The emotional impact of sound and music in games is also discussed by several authors. Ekman [7] discussed how sound is used to stimulate emotions in traditional movies and computer games. In a similar study, Livingstone and Brown [8] presented theories and results that support the use of sounds to trigger emotional reactions in game players. Lima *et al.* [9] explored the use of music to express emotions in interactive narratives. The authors combined cinematography theory and computational algorithms to effectively improve stories by expressing emotions through music and visual effects.

The relationship between music and emotion is also extensively studied in the field of psychology [10, 11], where several characteristics have been suggested that might influence the emotion of music. According to Gabrielsson and Lindstrom [12], major keys and rapid tempos cause happiness, whereas minor keys and slow tempos cause sadness, and rapid tempos together with dissonance cause fear. The choice of instrumentation, whether soothing or obnoxious, will have an effect. Music can set the stage and place the listeners in a different world, a different country, or a different time. In films and games, music is primarily designed to create a certain atmosphere or feeling. It can create a dark and mysterious world, adding tension and desperation to reinforce the seriousness of a situation.

III. AUDITORY HALLUCINATION

Auditory hallucinations are auditory perceptions that are experienced in the absence of corresponding external acoustic stimulus [2]. Such perceptions produce a compelling sense of reality of a true perception on individuals and may include whistles, bangs, clapping, screams, ticks, voices producing intelligible or unintelligible speech, and music. Auditory hallucinations can be associated with psychotic disorders (*e.g.* schizophrenia, mania), and holds special significance in diagnosing these conditions [13], being the second most common symptom observed in schizophrenia (occurring in 74% of patients [14]). Although it is often associated within psychiatric illness, not all auditory hallucinations are associated with mental illness [15]. Some studies show that 10% to 40% of people without a psychiatric illness report hallucinatory experiences in the auditory modality [16, 17].

The phenomenological characteristics of auditory hallucinations differ on the basis of their etiology, and this can have diagnostic implications [18]. The cases without mental illness tend to report mostly positive voices, as well as a higher level of control over it, less frequency and, when in process, it has less interference with activities than the ones with the

illness. According to Waters [19], individuals that are suffering from mental illnesses present characteristics that mostly consists on higher frequency of hallucinatory experiences, localization of voices outside the head, voices containing a considerable linguistic complexity, and exaggerated emotional responses [20]. Auditory hallucinations associated with mental illness have a powerful impact on the lives of those who experience them [21].

According to Semple and Smyth [22], auditory hallucinations that include voices can be divided in three main categories: (1) a person hearing a voice speak one's thoughts; (2) a person hearing one or more voices arguing; or a person hearing a voice narrating his/her own actions (3). Another type of auditory hallucination is called functional hallucination, where the individual experiences the hallucinations simultaneously through another real noise, which means it happens at the same time as other environmental stimuli, such as a phone ring, television noise, and video game sounds.

Some subjects associate and identify the voices they heard with concrete individuals of their social environment, such as relatives, friends or public figures [23]. Others either cannot associate the voices with specific persons, or associate them with deceased people. However, according to Leudar and Thomas [24], they can always describe their behavior and intentions, and in all these cases voices have certain characteristics such as tone, accent, sex, age and status.

Some researchers [3, 25, 26, 27, 28] have distinguished a series of beliefs that individuals have about their auditory hallucinations:

- **The belief that the voices have an identity:** the subject thinks the voices come from other people or entities, that is, they attribute them to an external source.
- **The belief about the purpose and meaning of the voices:** apart from inferring the identity of the voices, individuals usually search for the purpose and meaning of the voices. In most cases, the subject thinks that either the voices want to hurt him (voices with a malevolent meaning) or they want to help him (benevolent voices).
- **The belief in the power of the voices:** the individual thinks voices are very mighty and he cannot cope with them. The subject feels defenseless and unable to control them.
- **The belief in the consequences of subjection or resistance to the voices:** The individual may think they must obey the voices; otherwise something evil may happen to him or any of his relatives.

Often the auditory hallucinations provoke emotional responses on individuals, which may include negative emotions such as anxiety, anger, fear or despair, or positive emotions such as joy, frenzy, satisfaction, or love. According to Garcelán [28], these responses together with the individual beliefs can also provide a feedback of the interaction between the subject and his voices, reinforcing and creating a particular and idiosyncratic story between them. Auditory hallucinations are personal experiences. While some individuals experience them

as immensely distressing and frightening, others are reassured and amused.

In some cases of auditory hallucinations, the voices often present a negative content, which can develop considerable distress, since it can induce the person to perform unacceptable behaviors or bad actions. According to Chadwick and Birchwood [25], hallucinations with malevolent voices provoke fear in some of the individuals that suffers from this illness. Some people interpret the auditory hallucinations as the appearance of traumatic memories that constantly get brought up by the voices, whispers, screams and others sounds [29].

Another auditory phenomenon that can provoke auditory hallucinations on individuals is caused by the effects of catchy tunes [30]. Involuntarily, individuals listen to many songs from advertisers every day, and sometimes, they don't even listen to it consciously. Such songs may produce an effect known as "earworm", which is a catchy piece of music that continually repeats through a person's mind after it is no longer playing. According to Sacks [31], earworms can penetrate our minds, entrench themselves and then perseverate internally hundreds of times a day, only to fade away in a day or two, or perhaps to be followed by the next earworm.

The main, and most notable, brain area that is associated with auditory hallucinations is the temporal lobe [32], specially the left superior temporal lobe, which is the area responsible for processing the language and shows clear signals of activation [33]. Depending on whether or not the person can understand what is being said, this area will be more or less activated. Another area that shows some activation signals is the limbic system, especially the amygdala and hippocampus [34].

IV. CASE STUDY

In order to verify the effects of auditory hallucinations in games, we conducted a case study investigating how the horror games *Silent Hill*, *Fatal Frame*, *F.E.A.R.*, and *Hotel 626* use auditory hallucinations during the gameplay. *Silent Hill* is a survival horror video game series published by Konami for several platforms. In this study, we investigated the games *Silent Hill* (1999), *Silent Hill 3* (2003), and *Silent Hill: Homecoming* (2008). The second game analyzed in this study is *Fatal Frame* (2001), which is a survival horror game created by Tecmo for Playstation 2 and Xbox consoles. The third analyzed game is *F.E.A.R.* (2005), which is a first-person shooter psychological horror video game developed by Monolith Productions and published by Vivendi Universal for PC, Xbox 360 and PlayStation 3. The last game analyzed in this study is *Hotel 626* (2008), which is an online horror advergence created by Doritos.

The sources of information consulted for this case study include the personal experience playing the games, reviews written by players in specialized sites like Gamespot,¹ and

IGN,² and the analysis of the gameplay of other players through videos available on YouTube.³

A. *Silent Hill*

The first game of the series *Silent Hill* was released in 1999. The story of the game is set in the town of *Silent Hill*, which also has an alternate dimension called the *Otherworld*. Occasionally, the player is shifted between the dimensions. The game is experienced through a third-person view, with occasional fixed camera angles. The visibility is always limited due to the alternating fog and darkness.

The game begins with a car accident that separates *Harry Mason*, the main character, from his young daughter *Cheryl*. The player must guide *Harry* through the town of *Silent Hill* while he searches for his daughter and tries to discover what happened in this strange community. Along the way, the player explores a hospital, an elementary school, and the streets of the town. The entire game provokes a frightening feeling in players, especially because of the dark environment of the town where the vast majority of lighting comes from a flashlight (Figure 1).



Fig. 1. Dark environment of *Silent Hill*.

The audio of the game plays an important role in creating the dark, strange and frightening atmosphere. The sound of sirens alerts the player about the imminent transition of the normal dimension to the *Otherworld*, where the player descend from almost normalcy into a nightmare vision of the town that seems old, abandoned, with metal shells filled with mutilated corpses, and blood smeared messages on walls or objects. Another interesting example is a portable radio that alerts the player about the presence of nearby creatures with bursts of static.

The first game of the series *Silent Hill* offers different kinds of auditory hallucinations while the player explores the scenarios. Examples include: whispering voices, slamming doors in the distance, moans and groans as the supposed monsters come towards the player, the sound of *Cheryl* in fear begging to save her, and the sound of someone sobbing in an empty room.

¹ <http://www.gamespot.com/>

² <http://www.ign.com/>

³ <http://www.youtube.com/>

Auditory hallucinations are also present in the others games of the series. In *Silent Hill 3* (2003), for example, it is possible to hear muffled voices, whispers and groans while the player walks through corridors. In *Silent Hill: Homecoming* (2008), auditory hallucinations are constantly used to frighten players while they explore the vast and dark environment of the game (Figure 2). It is possible to hear several strange sounds and voices of unknown sources, such as the sound of a baby crying, the voices of kids playing in an abandoned playground, dogs growling from somewhere nearby, a female voice singing a lullaby, and several types of screams, moans and whispers.



Fig. 2. Abandoned playground of *Silent Hill: Homecoming*.

The auditory hallucinations are an important tool used in the games of the series *Silent Hill* to provoke fear in players. The games explore the player's fear of the unknown by terrifying them with voices, screams and growls that come from nowhere. The limited visibility caused by the dense fog in outdoors environments and the darkness of hallways and dungeons, increase even more the frightened atmosphere of the game.

B. *Fatal Frame*

Fatal Frame, also known as *Zero* in Japan and *Project Zero* in Europe, is a survival horror game, which the objective is essentially to defeat ghosts by taking pictures of them with the *Camera Obscura* (Figure 3). The narrative presents different kinds of mysterious disappearances, restless spirits and ritual sacrifices. The player mostly controls the protagonist, which is a young girl named *Miku Hinasaki*, through four chapters in a search for her brother, *Mafuyu*, whom the player controls only in the game's introduction. She has ventured into the *Himuro Mansion*, because she had the aim to study the mysterious mansion's history, which was the last known whereabouts of her missing older brother. *Miku* must explore the whole mansion in order to find objects and solve puzzles to progress in the game.

In *Fatal Frame*, players can experience auditory hallucinations while walking through locations that contain spirits. It can also be perceived when the player approaches magically imbued objects and while ghosts are striking and uttering different kinds of bad words and blasphemies. Besides that, an item called *Spirit Radio* let the player hear voices of spirits imprisoned in crystals that hold their thoughts. However,

white noises can make it a bit harder to comprehend what the voices are actually saying.



Fig. 3. *Camera Obscura* – an antique camera device that captures images of spirits in the game *Fatal Frame*.

The auditory hallucinations of *Fatal Frame* are composed mainly of ghostly voices, screams, whispers, and provocations. Examples of phrases spoken by the spirits include:

- “*That woman! That woman in a kimono is coming!*”
- “*Help me, help me...*”
- “*Let me out! Let me out of this mansion!*”
- “*Mr Takamine, Tomoe! Where have you both gone?*”

In *Fatal Frame*, the auditory hallucinations are used to provoke fear on players and also to warn them about the presence of spirits nearby. The combination of suspenseful background music with dark environments makes the auditory hallucinations even more effective.

C. *F.E.A.R*

F.E.A.R. is a psychological horror video game where the player assumes the role of *Point Man*, a special force soldier assigned to a military unit specialized in supernatural and paranormal incidents entitled “*First Encounter Assault Recon*” (*F.E.A.R.*). *Point Man* possesses superhuman reflexes and combats an army of cloned soldiers and at the same time uncovers the secrets of a paranormal menace in the form of a little girl called *Alma*. The game takes place in the city of *Auburn*, and takes the player across a variety of locations, such as abandoned warehouses and industrial complexes, that fit in the dark claustrophobic theme of the game.

The game is inspired by Japanese horror movies, and includes several scary moments when mysterious ghostly characters suddenly walk out in front of the player, only to disappear swiftly behind a corner or even right before the player's eyes. Through the game, the player witnesses unexplained, and occasionally life-threatening, paranormal phenomena, including hallucinations that frequently afflict him. The game is capable of instilling a strong feeling of fear in players, mainly due to the claustrophobic level design and

aesthetic, which has the player constantly walking through small dark hallways, offices, dingy industrial areas, and worn-down condemned buildings. The sound design also makes the creepy atmosphere highly effective.

F.E.A.R. is often recognized by the recurring appearance of *Alma* (Figure 4), a little girl in a red dress who torments the player with horror sequences and hallucinations throughout the game. Alma appears in tense moments in an attempt to startle or frighten the player. Some hallucinations also contain elements that can injure or kill the player, making them more than simple cutscenes, and increasing the player's tension.



Fig. 4. Scene from the game F.E.A.R.

In F.E.A.R. players can experience several forms of auditory hallucinations during the gameplay, such as the whispering voices of *Alma*, a baby crying from nowhere, noises of random objects falling and lights flickering, slamming doors in the distance, and voices coming from dark corners. Examples of phrases spoken by the voices include:

- “Kill them... kill them all!”
- “You were born here, in this place. I was there.”
- “I've tried to forget. I've tried so hard to forget.”
- “My baby...”
- “I know who you are!”
- “She is a prisoner, floating in darkness...”
- “Do you like to play games?”
- “I'm waiting for you.”

Auditory hallucinations are one of the most important elements used in F.E.A.R. to create the tense atmosphere of horror and uneasiness of the game. They usually are an indicator for approaching paranormal events, but sometimes occur without any following consequences. This causality make players act carefully even though sometimes no threat is imminent.

D. Hotel 626

Hotel 626 is an online horror advergaming created by Doritos. The story of the game is set in a haunted hotel, where the player is trapped and has to do whatever it takes to get out. The game is experienced through a first person point-of-view,

and can only be played from 6 PM to 6 AM. The journey through the hotel is comprised of 10 levels that involve different kinds of tasks and puzzles. After checking-in in the hotel, the player awakes in room and immediately starts to hear strange echo noises in a distance. The character starts getting worried, screaming and wanting to get out.

Besides the traditional mouse interface, players can also interact with the game through the microphone and webcam. Both interaction mechanisms are used to solve some puzzles and perform specific tasks, which improves the player's immersion. The game also takes a real photo of the player at some scary moment, and displays it in gallery with other scared faces. The player's mobile phone is also used as a form of interaction. Near the end of the game, players located in the United States can enter their phone numbers and receive a strange call from the game.

The game includes several puzzles and tasks, some are simple, such as locating the correct door, and others are more complex, such as singing a lullaby in the microphone to make sure a ghost baby does not wake up while the player is walking through a room. In another example of task, the player uses a camera to take pictures of a ghost woman in a dark room (Figure 5). Every time the player takes a picture, the ghost gives a loud scream.



Fig. 5. Scene from the game Hotel 626.

The game uses several types of auditory hallucinations to frighten players. In addition, one of the latest levels of the game is entirely based on auditory hallucinations. In this level, the player is locked in a room with a mad man, and it is possible to observe some random drawings on the walls with different amounts of red dots over it. As the man screams and mumbles some words, the player can also hear some whispering voices in the background, speaking a sequence of drawings. If the player ignores the mad man's words and listen to the unknown whispers, it is possible to realize the order of the drawings in which the player have to count the number of red dots to, eventually, insert a code to open the room's door and progress to the next level. While some words are being said to make it more difficult to find the answer and solve the puzzle, such as bad words or even simple meaningless noises, the player must focus on a specific voice that comes from

nowhere. Because of the auditory hallucinations, this level is considered by some players the scariest task of Hotel 626.

V. USER STUDY

In order to evaluate the applicability of auditory hallucinations to provoke fear in players, we developed a simple horror game called Haunted Hallway (Figure 6), where players are able to navigate through a maze of dark corridors using a flashlight. The objective of the game is to simply find the way out of the maze. The game doesn't include enemies or challenges, the only obstacles are the auditory hallucinations.



Fig. 6. Haunted Hallway.

The game was created using the game engine Unity3D,⁴ and the scripting language C#. During the game, auditory hallucinations are activated by a trigger system, which is composed of a trigger and actuators (Figure 7). The trigger is represented by an invisible box, and it is activated when the player enters the regions of the box. The actuators are represented by 3D sound emitters that can be activated by the trigger and are responsible for emitting the auditory hallucinations from specific points of the 3D environment. The triggers are scattered through the corridors and activated while the player explores the environment.

The audiological hallucinations incorporated in the game include ghostly voices, screams, and unidentified noises. Some examples of phrases spoken by the voices are:

- “I will get you!”
- “What are you doing here?”
- “Beware, they want to kill you.”
- “You will die soon.”
- “You will die slowly.”
- “Death is coming.”
- “Your end is near.”
- “Remember, remember...”

⁴ <http://www.unity3d.com/>

- “I will kill you!”
- “You're stuck in a nightmare... we are going to kill you...”
- “Answer me, answer me...”
- “You will suffer!”

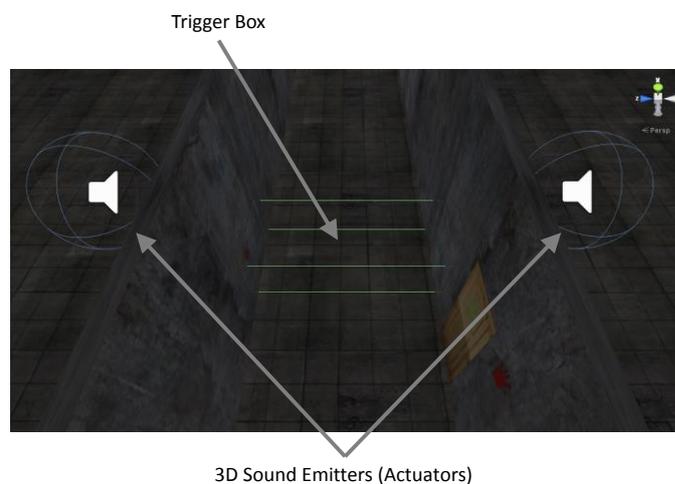


Fig. 7. Trigger system for auditory hallucinations.

In order to evaluate the game and the effects of the auditory hallucinations in players, we have conducted a user evaluation with 10 high school students, 8 male and 2 female, aged 16-17. Nine of them play video games at least weekly, and their favorite horror games include: Silent Hill, Resident Evil, F.E.A.R., and Dead Space.

We asked participants to play two versions of our game, one with auditory hallucinations (A) and other without (B). We aim to compare how the auditory hallucinations affect the game and the emotional reactions of players. In order to reduce learning effects, half of the participants used A first, and the other half used B first. On average, each session of A lasted 4.45 minutes (standard deviation of 0.81), and each session of B lasted 3.52 minutes (standard deviation of 0.59).

After using each version, the participants filled out a questionnaire with 15 questions regarding the player's emotional reactions, behavior, and immersion. Each statement was followed by a seven-point Likert scale ranging from “strongly disagree” (-3) through “neutral” (0) to “strongly agree” (+3). After having played both games, the participants were interviewed about their experience.

Figure 8 summarizes the results of the questionnaires. The version of the game with auditory hallucinations clearly increases the emotional reaction of fear in players, and also their fear behavior. Both versions produced a good sense of immersion in players. As far as the interviews are concerned, all participants pointed the version with auditory hallucinations as the scariest one. The voices made them feel frightened and anxious, thinking that something was going to happen to them. The hallucinations also induced players to act more carefully, because they didn't know what to expect next.

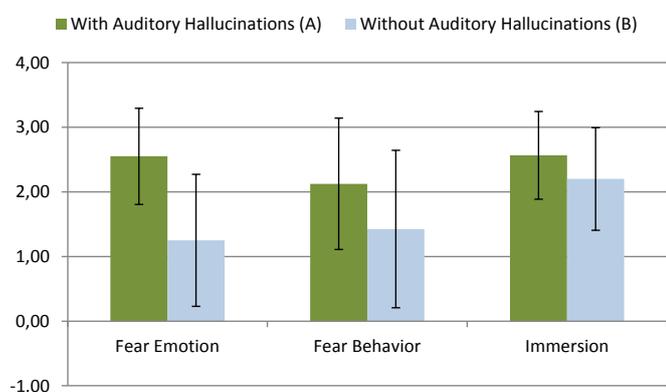


Fig. 8. Average number of points (within a 7-point Likert scale) of the emotional reactions of fear, fear behavior, and user immersion, with error bars indicating standard deviation around the mean, for the two versions of the system (with and without auditory hallucinations).

VI. CONCLUSIONS

In this paper we investigated the effects of auditory hallucinations in games. We presented a case study analyzing how the horror games *Silent Hill*, *Fatal Frame*, *F.E.A.R.* and *Hotel 626* use auditory hallucinations during the gameplay. We also presented a small scale user study in order to verify effectiveness of this auditory stimulus to provoke fear in players. To the best of our knowledge, this is the first study directly investigating the effects of auditory hallucinations in digital games.

Based on the results of the case study, we can conclude that auditory hallucinations are an important element of horror games. The emotional responses of players depend on the beliefs they have about the origins of the auditory stimulus. Usually, horror games associate them with the supernatural, spirits and ghosts, exploring the player's most basic fears. The immersion of players in the game world is another key factor that affects the player's emotional responses to the auditory hallucinations.

The preliminary results of the user study indicate that auditory hallucinations may indeed provoke more fear in players when compared to the same game without such auditory stimulus. The results, however, are not entirely conclusive due to the small number of participants. But the positive feedback of players indicates a promising direction for future research.

In future works, we intend to conduct more user studies with a large number of participants, and also to analyze more aspects of the auditory hallucinations in games, including a comparison between the applicability of this auditory stimulus in other video game genres.

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