Maximizing user experience in a horror game through pitch

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Abstract--Developing a horror video game with the right audio in the right place at the right time can mean the difference between a flop and a success. But how much does sound pitch even matter in this genre? The easy part is knowing that you will need an audio clip for a certain scene, but the problem arises when you need to know how to get a reaction from the user emotionally. Is it best to use a high, medium, or low pitch audio clip for a hostage wanting to be saved from a trap or a death scene? The target audience (18+ male and female) would be able to give feedback for this problem if they could play a demo of the game. An experiment was conducted using the Unity game engine were participants played 3 different scenes each with a different voice pitch of a killer clown chasing you and a hostage that must be saved. Through experiment, survey, and observations this paper aims to answer which NPC voice pitch causes the most emotion. Then the results will be presented with my conclusion.

Keywords--Sound, Audio, Design, Horror, Video game, Fear, Emotion, Immersion, Pitch, Frequency.

Introduction

Is sound important for the user experience in a horror game? We as humans are born with the instincts of fear to protect us from dangers and this genre plays into these emotions. Your eyesight is the primary sense in a video game but without the sound to accompany it the game would be very boring and should not be overlooked during the development process. The developers of "Dead Space", a survival horror game from 2008, EA Redwood Shores explain how a horror movie is not scary anymore once the sound is removed [1].

Working on a horror video game with my team in college "Groovy Games" called "Carnival of Evil", a first-person horror game my role is sound/audio designer so I must investigate sound for all puzzles and events to gain maximum enjoyment for the user. I need to know which type of sound and pitch would be best to strike a nervous and fearful emotion in the user but there is no data in video games out there to help much. Horror movie sound works the same as in video game sound, so I researched into classic movies like Psycho and Alien where pitch is utilised to get a better understanding how I could use it [2]. The high-pitched stabbing violin that plays during the infamous shower scene strikes fear and terror for the watcher like a woman shrieking for her life. Or the low pitch drone in the Alien movies gives the watcher a sense that something untoward is about to happen. Lots of movies use a high pitch to build fear, so will it be the same for a video game?

This paper aims to investigate why sound is crucial in a horror video game and through experiment, survey, and observations, which type of voice pitch triggers dark emotions like fear, anxiety, suspense, and nervousness while playing. A survey based on a playable demo in Unity 3D was made focusing on the pitch of a hostage's voice while they are in chains waiting to be rescued. With no equipment to measure heartrate or perspiration, just their subjective views the participants played a demo level with 3 different demo scenes with a different pitch voice, low, medium, and high pitch. From their subjective views I gathered a better understanding of how pitch plays it role in a hostage situation and which people find the most unnerving.

Research Question

My initial research question was “How important is sound in a horror game?”.
As I narrowed the scope this became “Which sounds maximise player fear for the hostage in our horror game?” because after development advanced, we had a demo with a hostage. This was a good question but to be more specific and to dig deeper into something that has not been investigated much and would tie into the hostages’ voice at a certain event I added “pitch” to the question, so the final question became “Which pitch maximises player fear for the first hostage in our horror game?”.

Justification of Importance

"Carnival of Evil" is a first-person horror game being created by "Groovy Games" using Unity 3D. The team consists of Antanas Zalisauskas, Patrick Nugent, Cian O`Brien, Aleksandrs Laivins and me.
It's a Puzzle, Mystery game set in an abandoned carnival out of town where you play as a detective trying to save hostages (family members) that are chained to different rides. If you don't solve the puzzles in time the hostage dies. The carnival is divided into 3 separate distinct area's each with their own puzzle, mini game, and antagonist. If you complete a mini game like “Shooting range” you will win a coin that can be used at a “Zoltan” machine (fortune teller) to gain a hint about how to solve the main puzzle of that area. You start with a flashlight and a pistol. You can use the flashlight to help solve some puzzles and use the gun to stun the killer clowns for a moment but can never kill them outright. Depending on how many hostages you save depends on which ending you get, bad, normal, or good ending.

I am the sound designer so chose this topic to get the most out of utilising sound to the best that I can and hope to get some real fear into the players of the game by using a sound at the right time and right place. A study like mine that shows how important sound is in general was done that compared the pulse(bpm) of the heartrate while playing a horror game with and without sound. In most events a spike in the participants pulse happened when there was sound [3], which is why I needed to do a deeper dive into audio and after lots of searching about the effects of voice pitch in horror video games I couldn’t find any.

Good sound design in a horror game is probably the best thing to spend most of your energy on to create the best user experience you can. Sound is the second most important human sense after sight and is basically common knowledge [4].

An article published by S. Graja, P. Lopes and G. Chanel "Impact of Visual and Sound Orchestration on Physiological Arousal and Tension in a Horror Game" proves how important sound is and why it’s worth doing more research about it. In the article an experiment was conducted to see which game effect caused the strongest physiological reaction, light effects, sounds or in-game events. For the emotional reaction experiment an adaptation of the video game “P.T.” by Konami 2014 was used and the participants were monitored by the galvanic skin response which reads the perspiration from the skin. The more you perspire the greater the emotional reaction. Sounds obtained the highest rates out of all three effects [5]. Basically, a horror game without sound would not be a horror game.

Research Method

I chose to use literature/material that focused on Audio in video games specifically in the horror genre. By doing this I can hone down quickly what I'm looking for. I collected information by using the Qualitative Research case study method. I used IEEE and ACM to find lots of literature study's, journals.

User research was carried out using the "context of use methods" specifically "context of use analysis" and "contextual inquiry" with an explorative element for the experiment and survey [6].

Planning for the survey could go ahead once I narrowed down my research question. I choose a survey to help get feedback on which voice pitch to choose for a specific puzzle I was working on as audio/sound designer. I thought it would be a good idea to get participants to play 3 scenes each with different voice pitches, low, medium, and high for the NPC's and then fill out a survey afterwards. I asked 2nd year games development students during their class with consent from the lecturer if they would like to take part in our experiment. They gave me their college email addresses and I told them I would contact them with a time and place when we finished making the demo.

I started some research on the physics of pitch and human voices. We can hear between 20Hz and 20,000Hz(20kHz). Pitch can be measured by analysing a waveform for its frequency in Hertz (Hz) because a high pitch corresponds to a high frequency sound wave and vice versa. Pitch is the sensation of a frequency the human ear picks up [7]. Our voice can span a range from about 125Hz to 8,000(8kHz) but a male and female speaking voice is only a fraction of this were anything above 2kHz would be higher than someone shouting for help so between 125Hz to 2kHz would be appropriate for this experiment. The low pitch bracket I chose from 125Hz to 750Hz as this is the low speaking frequency. 750Hz to 900Hz as the medium and 900Hz to 2kHz based on the Frequency Range and Speech Formants image at the website "AV INFO" [8].

I needed 12 voice clips in total. 3 audio clips for the killer clown laughing each one at a different pitch, low, medium, and high. 3 audio clips for the hostage saying, "Help me", 3 audio clips for the hostage saying, "Thank you" and 3 audio clips for the hostage death sound. Initially I searched online for the voice clips and found some at "Freesound.org" but could only find the high pitch voices [9]. My team members Patrick Nugent and Antanas Zalisauskas who have completed many sound modules in their Games Development course voice acted with a script I wrote for the low and medium pitch clips respectively using a "H1n Zoom" recorder because it is handheld, mobile, and professional [10]. These voices needed to be trimmed to get the specific words, normalised to be a consistent volume throughout the length and analysed to check that the frequency, hence pitch was within their correct bracket, so I used "Audacity", a free open-source audio editing software [11]. Audacity has an analyse tool called "Plot Spectrum" where you can analyse a waveform you select [12]. By choosing the "Enhanced Autocorrelation" algorithm I was able to tell the average frequency of each clip and verify their pitch bracket.

After resourcing the clips and setting up the demo I searched for a room big enough to have at least 2 participants participating at the same time to save time in the college. When I found a room and time slot, I emailed the students to ask if the time suit and that we can change to a different time if needed. All students from 2nd year agreed upon the time and place and I confirmed the appointment information.

My team members Antanas Zalisauskas, Patrick Nugent and myself were involved in planning and making the demo and survey because we could all get feedback from the same demo. The survey consisted of four parts, the first part was basic information like age and video game interests. Then the other 3 parts belonged to each one of us individually.

The questions were:

- What is your age?
- What is your gender?
- What are your preferred game genres?
- How interested are you in the horror genre?
- What is your experience with horror games?

My section was about sound. Designing the first part of the survey we wanted to know their age as it was a game for 18+ users. Their video game genre was important as it strengthens their feedback if they liked the horror genre. The sound section I based the questions around the emotionally feelings the user was getting specifically from the hostage. If they felt nervousness, fear of relief for a certain event from the puzzle. It would be important to know whether the user felt more fear from either a low, medium, or high pitch voice while the hostage screamed for help as this would help me improve the user experience in this genre.
The questions and options I designed that relate to my research paper were:

- Which voice pitch made you feel more nervous from the killer clown laugh?
    - Low pitch laugh?
    - Medium pitch laugh?
    - High pitch laugh?
- Which voice pitch made you feel more nervous from the hostage crying for help in the carousel puzzle?
    - Low pitch voice?
    - Medium pitch voice?
    - High pitch voice?
- Which voice pitch made you feel more fear from the hostage death in the carousel puzzle?
    - Low pitch screams?
    - Medium pitch screams?
    - High pitch screams?
- Which voice pitch made you feel more relieved from the hostage rescue in the carousel puzzle?
    - Low pitch voice?
    - Medium pitch voice?
    - High pitch voice?
- How important do you think sound is compared to visuals in a horror video game?
    - Visuals are everything and sound is not important at all.
    - Visuals are about 70% and sound is about 30% important.
    - 50 / 50
    - Visuals are about 30% and sound is about 70% important.
    - Sound is everything in a horror game and visuals don't matter at all.
- Should noises that the player makes like, shooting, running etc. within the killer clowns location alert him to chase you?
    - Yes to all sounds and actions made by the player.
    - Only shooting and loud noises.
    - Only running.

- No, the player can make any noise and the clown cannot hear him.

- Please leave some feedback about the sound design so we can use it to make a better game. Thank you.

We prepared for 20 students to arrive to the experiment room but only 13 showed up. The students queued up outside the room as we took in 2 at a time. I set up my laptop with headphones and mouse and opened the Unity engine 15 minutes before commencing. We wrote down the keyboard controls on sheets of paper and left them beside each laptop. I explained to them that they must start with the first scene "LowPitchScene" which had all the low pitch voice clips for the killer clown and hostage, therein they must meet the lose and win conditions to hear all sounds. The puzzle is based on a carousel with six horses each with a number and a colour. Around the carnival there are 6 different coloured levers, red, yellow, green, purple, grey and blue. To solve the puzzle and release the hostage who is chained to the centre pole of the carousel you must pull the levers corresponding to the coloured horse in the order of which number is on the horse within 2 minutes, so if the horse was red with a number 1 on its side, then the first lever to pull would be the red one. The win condition is met when you solve the puzzle and the hostage says, "Thank you". The lose condition is met when you fail the puzzle and the hostage dies, making a death sound like "aaaaaahhh". The hostage shouts "Help me" when the timer of the puzzle begins. After that I told them to double-click on scene two "MediumPitchScene" with the medium pitch sounds and then the scene with the high pitch sounds "HighPitchScene". I told them to remember the different sounds you hear while playing the demo as there will be questions about it afterwards. I informed them how to solve the puzzle so they could hear the win condition voice pitch.

Once all the demos and surveys had taken place the data was analysed for my conclusion and used to improve the video games quality.

Results (including analysis)

After all participants had completed the survey the data was analysed, and the results were gathered. Out of the 13 students, all over the age of 18, 2 were female and 11 were male.
Only 3 students preferred horror games which came in last with RPG and Adventure genre winning with a count of 9 each.
When asked about how interested they are in the horror genre though with the options ranging form Not at all interested to very interested, 46.2% or 6 students voted for interested.
69.2% or 9 students when asked how familiar they are and have they played the horror genre before said they are familiar and have played the horror genre before so most of the participants would be able to judge well what sounds would fit better.

The data about sound design was the most important to my research paper.
The results of which pitch voice to use for the hostage events of our horror game "Carnival of Evil" strongly leaned towards a high pitch voice. It was good to see a majority answer as it verified a solid consensus to use the high pitch voiced clips.

The first question was "Which voice pitch made you feel more nervous from the killer clown laugh?", most students (9) 69.2%, said the medium clown laugh made them feel more nervous.

You can see in Figure 1 below that when asked "Which voice pitch made you feel more nervous from the hostage crying for help in the Carousel puzzle?", the majority voted for the high pitch

voice with the medium pitch voice coming in second place.

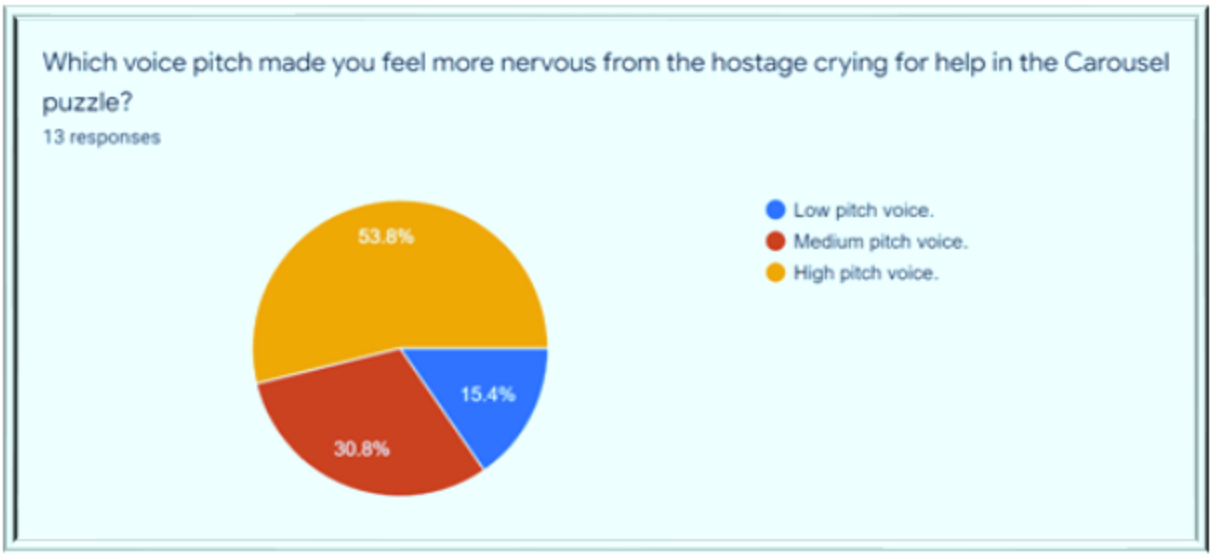

Figure 1: Shows that a high pitch voice crying for help made the user more nervous.

Then the third question shown below in Figure 2 shows that students preferred the hostage death voice pitch to be high pitch to get a better scare and immersion. 7 students choose High while 4 choose Medium and 2 choose Low.

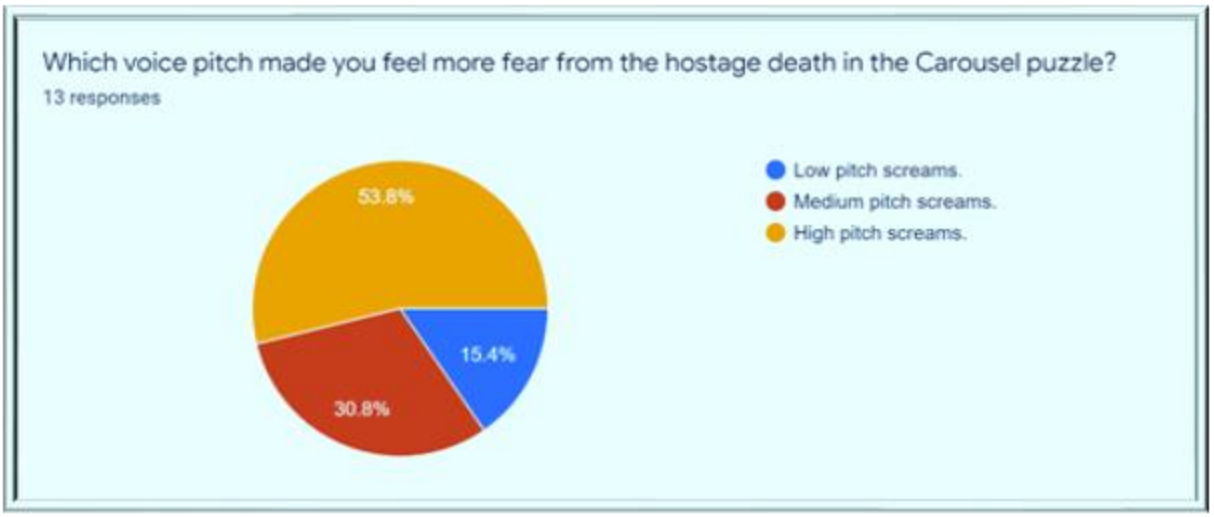

Figure 2: Shows that a high pitch voice made the user feel more fear from the hostage death event.

The results for the 4th question of sound design "Which voice pitch made you feel more relieved from the hostage rescue in the carousel puzzle?" was a bit different in that High pitch came in second place with only 4 students choosing it and 6 students choosing medium pitch and once again the low pitch voice came in last as usual.

I next question, "How important do you think sound is compared to visuals in a horror video game?". The results translate to sound being around 60% important and visuals being about 40% for the horror genre.

The next question "Should noises that the player makes like, shooting, running etc. within the

killer clown's location alert him to chase you? ", got back two answers. 7 students answered, "Yes to all sounds and actions made by the player" and 6 students answered "Only shooting and loud noises" which furthermore back up an argument of how much of a role sound plays in the mechanics of a horror game.

At the end my section of the survey I left a suggestion saying "Please leave some feedback about the sound design so we can use it to make a better game. Thank you.". Most of the comments were saying I should add some sound here or there or the voice from the hostage was not loud enough compared to other sounds, but one comment said, "For the sound design, I'd make an option for the player to switch from high to low pitch in the options menu for those who are sensitive to high pitched sounds.", which was a good point and showed that people will not just play the game because the voice pitch is high but are open to variety.

Threats to Validity

We could only find thirteen participants over the age of 18 who could fit into a small window of 3 hours on a Tuesday afternoon on a busy college day, so our construct validity might be in jeopardy because what I am trying to learn from this experiment might not be a qualifying answer as there were not many participants were thirty plus students would have been a better idea of the question.

I could have used more samples of each pitch. For the different voice pitches, the low and medium ones were male and the high one was female. The gender of the voice could have had an influence on the participants as 84.6% were male and chose the high pitch voice only because it was female and felt like protecting them. It might have been better to have had a male and female voice for each pitch. Also, the high pitch voice was found online and was a more believable act than the other two voice pitches that were made be students with no professional acting skills. So, it was hard to make a level playing field to make sure each pitch had the same validity as the other.

Not all the audio clips were in stereo but in mono which I had only realized while the experiment was taking place when I asked one participant why everyone was choosing the high pitch voice and he said that the other voices didn't sound like they were loud enough and don't seem to sound like they come through both the left and right headphone. So, I should have checked that all sounds were mastered in stereo. This could have been a big threat to the construct validity.

Empirical reliability might be questioned too on the number of participants we could find because if we were to repeat this survey with a different 13 people the outcome might be totally different so again it would have been better to have at least 30 participants.

Conclusions

I found that sound is very important in a horror game when using the right frequency for the right situation although further investigation is needed.
The results gathered from the survey lean strongly towards a high pitch voice being used for the hostage events and the medium pitch voice coming in close second so the jury is not set on a definite winner. The only thing that I can be sure of is that the survey proves that the low pitch

voice is not effective for a hostage scenario like this as it came in last in every question. That's only based on 13 participants so I'm not to sure if the answers would be the same for the high and medium pitch voices if the experiment was done again with the same amount taking part. Would have liked to have had a larger number of students arrived, 20 would be ok but above 30 would have told me a better story from the data.

From my knowledge there is no research into pitch and how scary it can be depending on its frequency in Hertz for a horror video game so in this paper I have tried to evaluate this.

If I was to do this research again I would have definitely got at least 30 participants to play the demo and complete the survey and bought a heartrate monitor and a galvanic response unity to get scientific results.

I hope that this paper will give someone a good starting point if any at all to do some further research on this topic and is an important contribution to sound design for future games. This paper adds a bit of subjective light on voice pitches during tense moments from an NPC that could be useful to someone.

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