Interpretation of game sounds with personal experience and auditory literacy.

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Abstract: This study concerns differences between two different generations of people, the younger generation born the year 2000, compared with the older generation born from the 1960s. This study compares these two groups in how they interpret sounds in video games and their affective response to them. 27 participants were gathered for the experiments and did tests in their respective group. They were asked to listen to the sounds, without discussion with each other, instead, they had to rely on their own individual personal experience from video games to answer the questions. After the sounds had been played, a discussion was held with the participants about their previous experience with video games.

The sounds used in the experiments were made from a game sound design perspective and guidelines.

Keywords: Sound design choices, affective impact, affective response, auditory stimuli, video games, the young generation, old generation, situated knowledge, personal experience, interactive media.

Introduction: The aim with this study was to answer the research question "Has the sound design choices in video games, affected the young generations audio literacy, compared with an older generation audio literacy?". Considering that video game AAA titles (*Games using the latest technology within graphics, sound and motion capture, a high budget game production*) are always striving towards the goal of making video games appear more realistic. During the early days back in 1974, with games such as "Pong" made by Atari (2) and "Pac Man" made by Namco (21) in 1980, it was the first small steps towards the foundation to make virtual worlds for people around the world to explore. In present time, we have games such as World of Warcraft made by Blizzard Entertainment (5), which had a peak of 11 million monthly active players in their community, taking part in exploring not only one, but nine different continents in the game, which all have been filled with details and assets to create a "realistic" experience. Along with immersive sound design with everything from characters using spells, interacting with items and quest objectives, to themed music to create an immersive experience in the explorative areas and environments. AAA titles such as "Hellblade: Senua´s Sacrifice", created by Ninja Theory (22) is a good example of how far the sound design in modern game development has come. Hellblade: Senua´s Sacrifice follows the story of a Celtic outcast named Senua, as she travels through a Norse mythological fictional world to bring back a loved one from the dead. The main selling point of the game was to create a simulated experience about suffering from schizophrenia and using it to your advantage. The way it has been done, is by using a 5.1 audio system, to let the user hear different voices and whispers all around the players

audio perspective. A short example would be hearing voices directly behind the player or right next to the player's ears. These voices created the immersive experience that fits in with the main character´s background and suffering, but also guiding the player with clues and suggestions on what to do in puzzles in order to progress through the game.

(figure 1: Hellblade: Senua´s Sacrifice (See References))

With the growing popularity of video games around the world, with more advanced technology being used during the game design process to strive towards a even more immersive experience, this study wants to look into the hypothetical effects of this advancement. The question pursued is if there could be a possibility that the personal experience gathered from video games, affects the interpretations of sounds?

An example of this could be the lightsaber from the Star Wars Franchise (18), with the sound of a lightsaber swinging. If someone would start to mimic the sound of a lightsaber vocally, the personal experience from the Star Wars movies would be able to give a reference to what the sound is and what the context is. If someone would have made a lightsaber sound before the franchise became introduced at all, hypothetically it would have been difficult to interpret the sound.

With so many hours being spent in video games across all ages (16), those hours suggestively build up more personal experience surrounding video games and different scenarios, or situations encountered in video games. For example, difficult boss battles in which the player must figure out the weaknesses off the enemy, solving difficult puzzles or exploring around the virtual worlds for mysteries and treasures. Video games overall has developed their sound design over the years to move towards a more informative form of use (20). Compared with older games found on older consoles such as NES (Nintendo Entertainment System) and Arcade hall games.

This study collected data from the interpretations from participants, from hearing audio designed out of a video game sound design perspective. But also collect data about their previous experiences with video games, how many hours spent and compare it between the two groups: a young generation, called “The VR generation” and a older generation in a group called “The Arcade generation”.

Related Work: The related works included in this dissertation study, is divided across five categories.

There are many steps in making video game sound design, such as ideation, how to properly grab a listener’s attention and how can sound be used in the most efficient way?

It is also important to include related works that has researched within, for example, the interpretation of sounds, Hearing, if memories are activated by hearing specific sounds and other interesting findings, which has been compared with the results discovered in this dissertation study.

The related works has been selected to be able to get angles for both the design / ideation process of game sound design, shortly about the psychology of interpreting sounds and a few additional interesting perspective angles for this study.

1: <u>Sound Design Terminology:</u> Alves and Roque (1) presented arguments for that the terminology within sound design was too loose between different forms of media. They wanted to create a "Lingua Franca" for sound designers to use as a common language, with it either being video game audio or movie audio etc. They divided in different ways of conveying information through sound, into a form of a pattern language, which created a good tool for novice sound designers to use in their studies. The reasoning for the relevance for this related work in this study, is being able to give the sound design a terminology, a definition of the sounds and their context of use within a game sound design. By having good reference guidelines on how sounds are being used in games, it made it possible to both study the sound design and make the sounds that were used in these studies experiments.

2: <u>Design:</u> Within the design-related section, Nesbitt and Ng´s text (20) is something that can be bridged along with previously mentioned Alves and Roques work (1) in order to expand more on the study's metaphorical terminology handbook. Nesbitt and Ng presented an argument (20) for that sound design in video games are gradually moving towards a more informative form of use. Nesbitt and Ng also presented different approaches on how to achieve a more direct informative sound design. The approach in this research was to use auditory icons, to avoid simple monotonic tones and noises, but instead use sounds that open for more interpretation. Baharin and Mühlberger (3) explored around with the possibilities with auditory icons and its uses, by using it within an experiment, inside an altered version of the game "The Sims". Two participants at the time, was seated in their own respective room, with the two rooms being right next to each other. When the participants were interacting with different objects or tasks in the game, within their own individual version of the game, auditory icon signals would be sent over to the second participants own version of the game, in the second room. So, as a summary: Both participants unknowingly sent signals to each other during the experiment by simply playing the game. The observations during the experiment showed that the participants reacted to the strange signals and sounds. The participants interpreted the signals to be out of place or unfamiliar within the normal sound design in the game, which grabbed their attention and curiosity to find out what the signal was and meant.

The affective reactions to sound can be challenging considering that people react differently due to individual experience. Donna Haraway (18) presented a term called "situated knowledge", which states that our choices, the way we think and perceive the world, is affected by factors such as gender, social status, sexuality, childhood and so on. Bradley and Lang (6) present a study about the affective reactions to different sounds. With the experiments, it was able to show that people reacted differently depending on what they heard. An example would be the barking of a dog, a person with good memories of dogs would find it "pleasant", while a person with bad memories about dogs, would find it "unpleasant". These two terms "Pleasant" and "Unpleasant" became a term in which can be used to measure the reaction to sounds. For example, an unpleasant sound could potentially grab a listener's attention, considering an unpleasant sound can possibly trigger a "sense of danger" reflex.

An ideation method for game design that was presented by Hagen (19) showed an ideation process which was to actively ideate and discuss with multiple people and gather more point of views (Can be compared with a verbal

brainstorming session). “The Lodestar” displays a method of bouncing ideation ideas back and forth, in an attempt at pursuing a vision, like how sound design is being processed, it becomes a design process of giving audible life into a virtual model. Through open discussions and experimenting with different sounds until the sound brings the desired emotion or gives an accurate informative context of what is going on. Although with Nesbitt and Ng´s research (20), it could provide evidence that the ideation process has changed over the course of time as well, to a more informative use to decrease overwhelming game display elements. Jørgensen (15) presented a study that analysed how sound effects and sounds are being used in video games, also how it manages to achieve the informative use in which Nesbitt and Ng (20) arguments for. Additionally, discussing around player interaction in video games along with the response to sound cues.

In Sonnenschien´s study (28), he presents a more analytical view and discussion about sound design and effects in cinema along with hypotheses. Examples of this are that he presents many ways of how we hear, what we listen after and functions as well as a guideline for making appropriate sound design. This text ties in well with Whittington´s study (30), by giving more of an historical overview of cinematic sound design throughout the years, by using movies such as “Star Wars” or “2001: A Space Odyssey” as an example to be able to give a brief overview on their respective design processes within sound design.

As this study concerns the design choices of sound design, these related works are relevant for the sake of being able to get a historical overview on how sound is being used in video games, how it has developed and also if there are old design techniques that are still being used. Hagen´s study (20), specifically about his section about the ideation phase, is something that can be reflected upon in the sound design process. Making a sound effect or sound cue that is aesthetically pleasing, but also informative enough to tell the player of what is happening, or what is going to happen. Ng and Nesbitt (20) give indications that game sound design in the ideation phase has started to be more aimed towards an informative use, which was important to include to put more emphasis on how sounds can be used, to guide a player instead of using flashing screens or signs. Jørgensen (16) gives a more historical overview of the game sound design in games and can be bridged together with Ng and Nesbitt´s study (20). Showing the importance of “hearing and Listening” from Baharin and Mühlberger´s study (3), by putting it within a RTS (Real Time Strategy) perspective, as those games demands that the player is able to keep an overview of the map, but also be able to manage the players base and troops simultaneously. With the addition of Haraway´s study (18), it became clearer on how personal experience is being created and what the suggestive factors of change are. Finally, with the terms presented by Bradley and Lang (6), it can be bridged together with Haraway´s term (16) as an addition for audio literacy. Finally, with Baharin and Mühlberger´s terms (3) “Hearing and Listening”, it gave an interesting perspective on how to look at the interpretation and audio literacy on sounds. In the sense of that individual's filters out the sounds, they hear and listens after the sounds they are actively listening for. Sonnenschein and Whittington´s studies (28, 30) can be bridged together with Hagen´s study (17), in the sense of the game design ideation phase use more common themes being used in cinematic works, same goes for sound and music design in video games.

3: <u>Audio Stimuli Response:</u> When it comes to how acoustic stimuli affects the response of players in video games, the cognitive and affective impact so to speak, similarities can be drawn across from sound design within cinematic works into sound design works. As the present designs with video games try to achieve an interactive movie design. Where the player, acts as the protagonist, through an interactive game with cinematic scenes and a movie dramatical writing. One of the early works on sound in cinematics comes from Chion´s study (8) where he argues for that we do not see images and sounds, as separate channels, instead they work along together to create an understanding of it, or to apply focus to a specific point within a scene. The term for this was named "The Audio-visual Contract".

Another interesting perspective, that games and cinematic movies has in common, is the extensive use of music. Music in both games and cinematic movies sets the tone of the environment and wants to deliver the desired emotion to the scene presented. Schaffer presented an interesting research study (27) that brought up the discussion in whether music can be considered as science or art, also its relations to humans. For example, discussing how music has changed over the years with the ever-growing advancing technology such as electronic music and music editing with third-party software etc, compared to live music with real instruments.

With a more in-depth research on the studies of the impact of music, the literature "Handbook of Music and Emotion: Theory, Research, Applications" edited by Juslin and Sloboda (14), brings many different perspectives and interesting discussion around the emotional impact of music. everything from neurobiological studies of the emotional impact of music, with different forms of experiments to show people´s cognitive connection to music, to studies on how emotions surfaces from music (recalling a memory, a moment etc.) and how music acts as an important piece in setting the emotional tone in different genres of music, cinematic scores or other forms of expressive art or media.

Having references on audio stimuli is an important part of this study, as the stimuli both affect and some of the texts in this section can be bridged together with Haraway´s term (19). Since personal experience factors can affect the audio stimuli, In the ways of audio literacy and interpretations in the cognitive process.

Chion´s term (8) is interesting in the sense of that it can be bridged with the definition of sound cues, applying more focus on what is currently important to take notice at. Chion´s term can be bridged together with Baharin and Mühlberger´s terms (3), in the way of making a player focus their attention by encouraging the player to listen for the sound that broke the common sound environment being heard.
Schaffer´s study (27) can also be bridged along with Juslin and Sloboda´s literature (14), as music is being extensively used for setting the tone and emotion in either a cutscene in the game or the area the character is currently exploring.
Finally, the "Handbook of Music and Emotion", edited by Juslin and Sloboda (14) gives more explanations and shows experiments, as well as tests, on the psychological and emotional reactions to music.

4: <u>Interactive Media Design:</u> In Costello and Edmonds study (10) they discuss a relevant topic for interactive media: putting a focus on creating pleasurable and playful interface within an interactive art context. They also discuss what the designer finds pleasurable and playful, can be different from what the user experience.

This is relevant in the study, as sound design must find a balance between being aesthetically pleasing, but also informative. As individuals potentially interpret sounds in different ways, it can create miscommunication between designers and the users, on what is informative and what can be misleading. This can also be used in the discussion of the connection with the visual reference and the sound to it (The audio-visual contract) (8) .

5: <u>Visual Response to Audio Stimuli:</u> Chen, Takahashi, Okita, Hirata and Suguria (9) had a different approach on measuring auditory stimuli, by using two different sounds and assessed the results with AAE (Anterior Asymmetry and Emotion), also CV (Comfort Vector) models. The two sound stimuli used was "soothing" and "scary", the results from this study showed that the stimuli "scary" gave more noticeable facial expression response than the stimuli "soothing".

For the final additional study that gave an interesting insight into how to observe the participants during the tests, a text written by Ringer and Nicolaou (26) did a research study by doing observations on live streamers, on the streaming service "Twitch.tv". They measured the different reactions by adding them into categories, for example, "funny", "intense" or "scary" being a few of them. They later made measurements on how many events occurred during the streams and what potentially caused the reactions to those events, also measurements of facial expressions and vocalizations.

Reasoning on how both these studies (9,26) can be linked, is by using the technique mentioned in Ringer and Nicolaou study (26).
Out of interest for this study, this technique was applied to different YouTube clips of people playing "Horror" themed games, where getting scared or surprised is a common theme. Comparing the horror genre with more pleasant and casual games, suggested that fear and tension gave more audible and reactive facial expressions compared to calmer games. This connection gives a potential suggestion for that fear and tension creates a more encouraging sense to actively listen to sounds (3).

With these selected related works presented in this chapter, funnelled down into their respective categories, it makes it easier to be able to keep them apart and use them accordingly to their own areas, within this dissertation study.

Methodology: The approach to collect data, which would be used to compare it with the related works, was to gather the participants for the experiment, in classrooms / gathering rooms. These rooms had speakers available. The speakers were used to play in total 10 audio files, with a length of roughly 10 to 13 seconds long. The audio was played two times for each one, to make sure that all the participants got a chance to listen and give more thought when giving their answers in an answer sheet. The answer sheet contained two questions: "What did I hear?" and "What do I interpret the sound as? What is the context?".

The reasoning for this approach, was to make sure that the participants would use only their individual experience, such as comparing the sounds they heard, with memories of sounds from video games. The answers would hypothetically reflect an instinct response, like how animals in the wild hear sounds and use their experience and instincts to decide if it can be interpreted as potential danger or not. The sound was presented for the participants without visual context, making sure that the only thing they could rely on was their own personal experience and memories, in order to

make an interpretation on what the sound is and what it could potentially mean out of their own individual thoughts.

After they had heard all the sounds, a short discussion was being held afterwards to talk about what their thoughts were about the sounds, their previous experience in video games, how many hours they spend playing video games and try to get more reflections on how their thought process looked during their interpretation of the sounds.

Experiment Design: I made 10 different sounds for a total of 27 users to listen to. As previously mentioned, each of the sounds was maximum of 10 to 13 seconds long. These 10 sounds were a mix of sound environments, trying to paint a scene of what it potentially is or what it could be and finally simple generic game sounds (such as monotonic short musical notes, short musical sequences, a short simple auditory icon).
An example on one of the ambience sounds, was a sound creating a scene of being in an old house during a stormy night, wind and rain blowing onto the window, and the heavy footsteps of someone approaching up the stairs, as a way of simulating audio of danger approaching, with an unknown person coming up the stairs.

An example of the monotonic generic game sounds could be a “currency pick up” sound, which was displayed with the sound of rustling coins, to display someone picking up gold coins. Or a “Low Health” sound sequence, simulating the sound of a heart beating, as if out of breath.

Order	Sounds	Intended Design
1	Rainstorm, Old House, Stairs	Unknown person walks up stairs, inteded to create fear and tension.
2	Swish "Charge Up" Sound cue	Simulates a "Charge Up" sound cue.
3	Heartbeat / "Low Health"	Heartbeat with audio filters such as Flanger.
4	Stone gate in cave, opening	A stone gate opening in a cave, letting wind blow once fully open.
5	"Gold Pickup" Sound Cue	Sound displaying the pick up of gold coins or currency in a game.
6	Door Puzzle Mechanisms	A door puzzle, pulls the correct lever and sets of a symphony of sounds.
7	Laser Beam Sound Effect	A laser beam humming and then being turned off.
8	SciFi Ship Docking Bay	Engineers in background working, Ship passing by, SciFi Ambience.
9	Soldier Jogging to Frontline	A soldier jogging in forest, gunfire being heard in the background.
10	Hiding from Monster	A person opening a locker, in order to hide inside from a monster.

(Figure 2: List of sounds used in Experiments)

In the answer’s sheets, the participants were given at the beginning of the experiments, wrote down their answers into the separate question sections. With the questions, as previously mention, “What did I hear?” and “What do I interpret the sound as? What is the context?”.

For these questions, there were no right or wrong answers. Instead, the answers would hypothetically be able to make a pattern appear among the participants answers. Showing indications on how they choose to answer the questions, for example: would it be answers that can be connected closely with video game sounds? or would it be sounds that could be connected to a generic part of the everyday life?

It is individual in what can be a “video game sound” or a “generic everyday sound”. But the ambience sounds used in the experiment, used a sound design that would be informative, like how sound design in games are being made. By returning to the example with one of the ambient sounds: The sound with the old house, the storm and a unknown person approaching in the stairs, was designed to create tension or “fear of the unknown”, as the listener does not know who or what is approaching in the stairs. Through that the participants can individually interpret the

sound if it is an indication of danger with the footsteps being in focus, or if they felt no danger at all.

The point that is being made is that the ambient sounds used a video game sound design approach, in how it is putting the footsteps in focus, but would the interpretation of hearing those unknown footsteps approaching be related to video game scenarios? Or would it not be connected at all with video games?

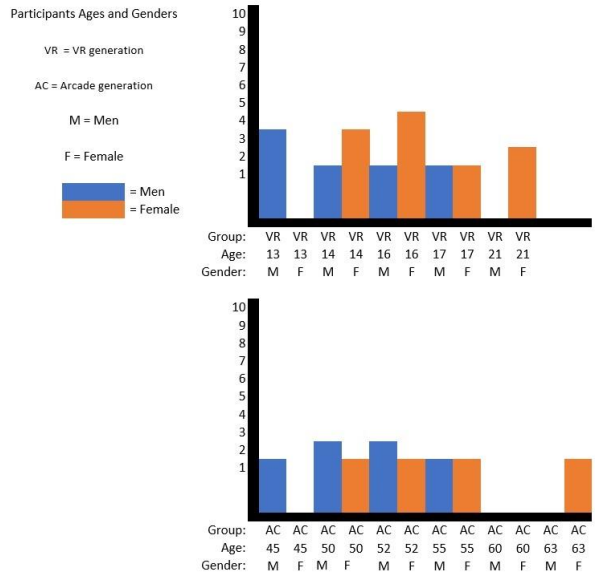
The experiments were done during three different occasions. The experiment had two different groups, who were doing the experiment on three different occasions separately. The first group with a younger generation, around the average age of 16 to 17 years old, were gathered through reaching out to a school in Mårtensdal, Stockholm, called "Fryshuset". The participants arrived on a drop-in experiment after they had received a commercial flyer through the school community site. The experiments were done in a classroom with two mounted speakers on each side of the front and two smaller speakers on the back.

The second group for the experiment, was with a group from the older generation, around the average age of 50-55 years old. This group´s experiment was divided into two separate occasions. The first one being done in a classroom at Södertörns University, in Flemingsberg, Huddinge. On the second occasion, the participants were asked in person by sending out messages if they would like to participate in the experiment for the study. Those participants were family friends and their respective friends. The experiments were later done in a community hall in the town Sigtuna in Stockholms Län. The community hall had a small conference room with two front speakers available for use.

Participants: With the total of 27 participants, divided into two different groups for the experiments. The first group, named "The VR generation" in this study, was for the younger participants, which came to a total of 17 participants. The second group, which was named "The Arcade Generation" for this study, was smaller and split between two different occasions. The first occasion was with 3 people in the classroom at Södertörn University. The second occasion, with 7 participants in the community hall in Sigtuna.

The reasoning for the number of participants was that for having a minimum of 10 participants in each group, to be able to compare at least 10 participants with 10 other participants as a minimum.

The reasoning for using two groups, with a younger generation compared with an older generation, was due to that research shows that the younger generation are more involved with video games in their free time (16). With the younger generation spending many hours daily with playing different video games compared to the older generation, the younger generation gets to experience more video game scenarios with a sound design that is intended to be informative and aesthetically pleasing for the individual game's immersion. While numbers show that there is an older audience still playing video games in present time, the younger generation are still larger in majority compared with the older generation. By comparing the amount of time spent in video games between the two groups, it would hypothetically give reasoning to the answering patterns during the experiments, as in if they choose to answer the questions with an interpretation that fits with the present time video game sound design, or if the interpretation comes from a different perspective that is not connected to video games.



Ages and Genders in both groups. ***(Figure 3: Participants Graph)***

The participants were asked about their experience with video games shortly before the experiments were done and more extensively afterwards. Most of the VR generation group has played games before, whether it is on a mobile phone, computer or a console. The difference found between the participants in the VR generation groups experiment occasion, was that the number of hours being put into video games daily was individual among the participants. Some participants would spend more than 6 hours a day to play video games, while a few others would spend time playing video games occasionally, as a social activity with friends.

The previous experience with video games for the Arcade generation, there was few that had played games or still play games. Some participants briefly named games such as “Diablo” (4) and the game “DOOM”(13). Despite this, the discussion before the experiment showed that they knew about video games such as “Pac Man”(21) and “Super Mario”(23), but not much previous experience from playing them. After the experiment was done, most participants pointed out that they had little interest in modern games, as they appeared more complicated or daunting compared with games like “Pac Man” (21) that was commonly found in arcade halls.

By removing any visual context along to the sound, it would hypothetically let the participants rely only on their previous experience and memories from video games. The answers would potentially be able to show how the sounds were interpreted and give pointers towards on where the assumptions come from when giving the answers to what the sound was and the interpretation.

While playing the sounds during the experiment, the same sound was being played twice, to make sure that all the participants would get enough time to be able to answer the given questions and hear the sound more than once to give it some thought.

The data gathered from the participants were later analysed based on what the participants answered on the questions “What did I hear?” and the answer to “What does it mean?”.

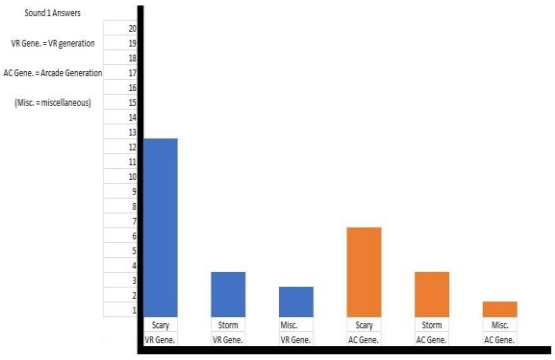
These answers would serve to show if there were any patterns emerging, for example if multiple participants would answer the same thing, or something that can be considered similar to each other. It would also show if the video game design approach would be able to give enough information through just sound.

During the short discussion sessions about the participants time spent in video games and their experience, it would be able to give some more data and paint a picture of how much video game sounds they are exposed to during a simple day. While the number of hours is individual, it could potentially once again hypothetically show patterns coming to the surface in how they choose to answer the

questions. For example, if they would answer with a lingo that can be related to video games scenarios or a lingo related more to a everyday life.

Data from the VR generation: The answers are given by the participants from the VR generation group, had a common pattern of giving short, minimalistic answers that were not well explained. Instead, they answered with a few words on each question and their interpretation of the sounds felt rushed.

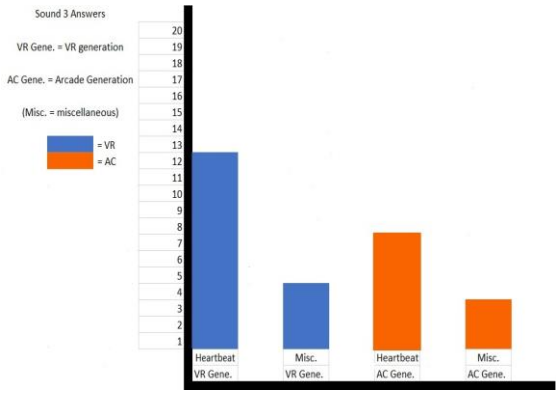
An example of this would be sound number 1 (See Figure 1). While the sound painted a scene of the participant standing in an old house, during a rainstorm and an unknown person would be loudly walking up the stairs to create a feeling of uncertainty and fear. The most common answer given on this sound was that the participants clearly heard that it was a rainstorm going on outside of the location. But the interpretation was mixed between two common simple words: either “Rainstorm” or the word “Scary”.



(Figure 4 : Graph of answers on Audio 1)

The word “Scary” was the most common answer, which could indicate that the participants sensed the danger in the painted scene, with a combined effort of audio literacy combined with personal experiences and memories (See Figure 4). This can potentially point out that the video game sound design approach was informative enough to let the listener know that the location in the sound was a dangerous and unknown place, but also that a unknown danger was approaching.

An example of the more simple sound cues being played for the participants, which is sound number 3 (See Figure 2), simulates the sound of a heartbeat, which has been slightly distorted and modified with sound mixing filters made by myself in the sound editing program ProTools, for the reason of not making the sound too obvious, but would still be able to be interpreted as a heartbeat, after some given thought.



(Figure 5: Graph of answers on audio 3)

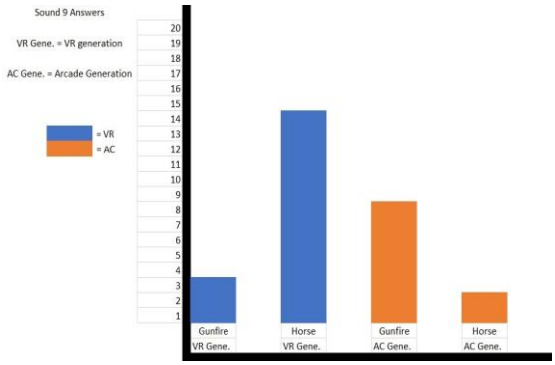
While many answered with the intended answer, which was “Heartbeat”, there was still some uncertainty in some of the participant's answers, an example of this was someone answering that the heartbeat was a “Keyboard”. Another participant interprets it as “Someone walking upstairs, while the person is sitting in the basement.”

In video game audio design, it is a common theme to use heartbeat, as a sound cue to indicate that the character has low health. An example of this would be the Legend of Zelda franchise (24), where you will continuously hear a beeping sound in the background, at the pace of a heartbeat and simulate that you should consider regaining health. This is also usually visually shown by blurring out the

screen or add filters on the screen with effects of blood. A design where both audio and visual works together to create a more urgent message.

The interpretation of what sound 3 (See Figure 5) was turned from the intended design of "low health", to the previous mention answers such as "keyboard" as example instead. Hypothetically this could show that the visual and the audio works together, by removing one part of the cooperation between the two designs, it can create confusion.

For the people answering correctly with hearing a heartbeat, they interpret it as "Being alive" or closer to another alternative to the intended design: "Out of Breath".

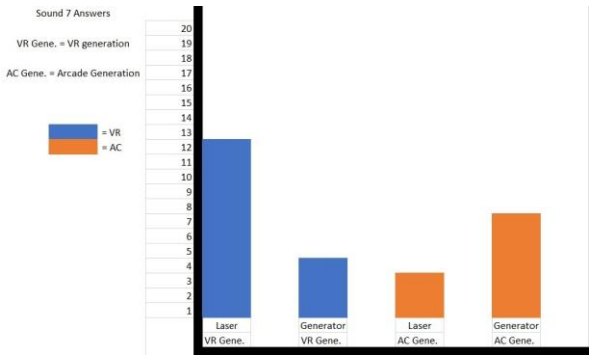


(Figure 6: Graph of answers on audio 9)

The final and most interesting example from the experiment, was sound number 9 (See Figure 2), which paints a scene of a person jogging out in the forest, while gunfire can be heard in the distance. The intended design would be to paint a scene of a soldier jogging out to the frontlines, while gunfire can be heard in the distance from the ongoing battle.

The majorities interpretation of the sound was "A galloping horse", also interpreting the sound as being "Peaceful" or "Satisfying". Only one participant in the VR generation group answered with that "Someone is running" and in the interpretation "Someone is running, someone that is shooting". (See figure 6)
The common pattern from the VR generation was their choice of words. An example of this would be sound number 7 (See Figure 2), which was a simple sound displaying a "Laser beam", which was intended to be more designed as a sci-fi sound. The participants answered with words like "Laser Wall" or "Laser Sword".

This pattern hypothetically points towards that the younger generation are more confident in using a lingo that is common in video games, or in sci-fi media (Movies, TV series etc). Altho it can be individual on what counts as being artificial sounds, compared to real sounds.

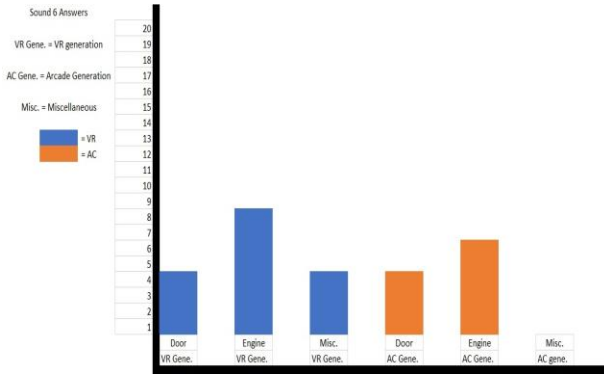


(Figure 7): Graph of answers on audio 7)

The answers given on sound number 7 (See Figure 7) has hypothetically been affected by using personal experience and memories from video games or sci-fi media. A potential reasoning for it, could be that sound number 7 was more fitting within a context of a video game scenario than an everyday scenario.

Data from the Arcade Generation: The participants gave answers and interpretations that were better thought out, the interpretations were explained in greater detail, also they asked to hear the same sound more than just two times, as they wanted to give the sounds more thought.
The answering pattern among the participants was more individual, with different

interpretations of the sounds. But sounds such as Number 1 (See Figure 2 and Figure 4) and Number 9 (See Figure 6) indicated that the participants agreed on what the sounds were and what they could be interpreted as.



(Figure 8: Graph of answers on audio 6)

Despite being individual answers, the common pattern between that can be seen, is that answers use references that are less related to video games and sci-fi media, instead choosing answers that fits more into a everyday life scenario.

An example would be Sound Number 6 (See Figure 2) which paints a scene of someone solving a puzzle by pulling levers, in order to open a closed door. Once the right lever was pulled, a symphony of rattling and clanking could be heard that was designed as a sound symphony to let the person know that they have successfully solved the puzzle. The common answers given was words such as "Factory", "Machines", "Door opening to a storage" and "Old machinery giving resistance". With these individual answers, it suggests that the participants were in an agreement that the sound displayed machinery within a factory with machinery. Compared with the VR generation, their answers were shortly given as "Car engine" or "Washing Machine", with the common interpretation "Broken". (See Figure 8).

Finally, the pattern that stood out the most, which potentially indicates a difference between the VR generation and the Arcade generation, was the answers on Sound Number 9 (See Figure 6).

The arcade generation showed signs of that they were in a strong agreement that the sound displayed someone jogging, while a few answered with "galloping horse" like the VR generation, but also include the answer of "Gunfire" without visuals signs of hesitation during the observations in the experiments. This comparative difference between the groups gave some interesting insight into the hypothesis about the sounds of gunfire becoming saturated by the influence of certain war-themed video games. While this hypothesis remains small, it can be a interesting research to further pursue with a larger group of participants in a separate research.

There were indications on that the Arcade generation was more determined to figure out the sounds by analysing more details in the sounds heard in the scenes painted by the audio, with more detailed interpretations of what the sounds could mean.

The answers on the sounds that were designed to be simple sound cues, such as Sound Number 3 (See Figure 2), suggested that it was more difficult to understand the meaning of it. While the participants agreed on that it was either a heartbeat or a rhythmic banging, it appeared that the interpretation on what it meant, was difficult to answer. (See Figure 5)

A hypothetical reason for this, could be due to their answers during the discussion with video game experience was slim, with less hours being spent on video games or none at all. When being exposed to video games sounds without enough personal experience or memories of video game scenarios, it can become difficult to put an interpretation on a sound that is unfamiliar.

When comparing the previous experience in video games and number of hours being spent in video games between the groups: it showed that the VR generation was more familiar with video games and felt more confident in using a lingo that can fit into a video game scenario.

While many in the VR generation group would spend around 6 to 8 hours a day roughly with playing video games daily, the Arcade generation spent much less time playing video games or next to none.

Some in the Arcade generation mentioned that they are more familiar with older games such as "Super Mario" (23) on the NES (Nintendo Entertainment System) from 1986 as an example.

The sounds found in such games are iconic and dubbed "8-bit" for the reason of that the game cartridges had very limited space available, so the sounds and music for such games took up roughly around 8 bytes of memory. With the video game design in modern games aiming towards making a more immersive and pursue a more realistic immersion, the sounds used are mostly auditory icons. An example is a character walking through a field of grass, which gives a visual and a audio response by playing the sound of rustling grass with footsteps.

With this, it could hypothetically give some reasoning to why it was harder for the Arcade generation to interpret the modern video game design approach in the sounds used in the experiment design, as they have more experience from the "8-bit" monotonic sounds.

Analysis: The data suggests that the VR generation, compared with the Arcade generation, was more confident in relating the audio from the experiments, more to scenarios that can be related to video games and sci-fi media. By giving answers that can relate to a video game situation. The Arcade generation chose to interpret the scenarios presented through audio, by answering with sounds and interpretations that can relate to everyday life instead of choosing scenarios that can be found in video games.

An additional suggestive difference, is that the Arcade generation was studying the sounds heard during the experiments, more thoroughly compared with the VR generation. With the arcade generation asking to hear the sounds more than two times, appearing as they wanted to dissect the sound from the visual observation during the experiment. It was suggested that they wanted to take the sound scenario being presented, take it apart to pieces and then puzzle together on what can be interpreted from the sound. The VR generation suggestively appeared to be more certain and confident when answering the questions on the sheet given to them during the experiment. With hearing the sounds two times was enough for them to make an interpretation of what they had just heard.

Sound number 9, with the audio painting a scene of a soldier jogging through the woods with gunfire in the background, there was a suggestive difference between the two age groups. While the VR generation answered with "a horse galloping" and leave out the gunfire in the answers, it can hypothetically suggest that the sound of the man jogging took more focus away from the gunfire being heard in the background. The Arcade generation answered with both "a man jogging" or, the same as the VR generation, "a horse galloping". But they also included the gunfire sounds in their answering while the interpretations themselves was individual, in the way of some answering that it was army

practice or that there was a war going on in the interpretations.

The VR generation suggestively had more experience with video games compared with the Arcade generation, also it suggests that the VR generation spends more time playing video games during their free time. With many participants from the VR group answering with that a majority played more than 6 to 8 hours a day in different kinds of games, while the Arcade group gave answers to that they used to play video games a long time ago, or none. It can hypothetically explain the difference between the VR group and the Arcade group in how they chose to answer the interpretations of the sounds. With the VR generation suggestively appearing more confident that the sound displayed a scenario found in a video game, while the Arcade generation answered with scenarios that are more connected to everyday life scenarios.

Discussion: With the differences in how much experience both groups has when it comes to video games, the VR generation suggestively shows to have more hours than the Arcade generation. With this in mind, it can hypothetically have an effect on how the VR generation answered in their questions about the interpretations and with their answers. With more experience with different scenarios from video games, such as a difficult fight with a boss, or solving a puzzle, there is a suggestive possibility that the memories from those scenarios, was easier to use in order to reflect upon the sounds heard during the experiments. In Haraway´s text (18), the term "Situated Knowledge" is being presented. The term states that the way we think, make decisions, interpretations and so on, gets influenced by previous experiences and knowledge gathered through the form of memories. With the VR group having more experience with video games than the Arcade group, there is a suggestive possibility that they had the upper hand in being able to be more accurate in answering the questions, as they could relate to the video game scenarios.

The term (18) "Situated Knowledge", within a video game scenario, can be further connected with the term presented by Baharin and Mühlberger (3), "Hearing and Listening". The term (3) suggests that we are unconsciously sorting all sounds, through "hearing" sounds, which is sounds that are ambient and gets treated as background noise. "Listening" homever, is when the sound we are actively trying to hear and find more important to pay attention to, as those sounds gives information in which we seek. Furthermore, the two terms (18, 3) can also be bridged together with two additional terms presented by Bradley and Lang (6). With the terms being "Pleasant" and "Unpleasant". Pleasant being sounds that we suggestively find soothing or relaxing, compared with Unpleasant that creates emotions such as stress or discomfort. The definitions of those two terms can become individual, for example if a dog is barking, it can be pleasant for one individual, while it recalls a bad memory with dogs for another individual, which makes the sound unpleasant. This once again ties in an individual's own "Situated Knowledge" (18).

A perfect example of how all these terms comes into play, can be explained further by presenting a scenario from the video game franchise "Monster Hunter" (7). The character you play as in this game is a "Hunter", that goes out to slay giant monsters that are being a big threat to the ecosystem, according to the story of the game, to give it some context.

(Figure 9: Monster Hunter: World (see References))

In the franchise, the sound design for the different monsters found in the game, are individual and creates more of an identity for the monsters themselves through the sounds of their roars and screeches. However, these sounds are just not "bells and whistles", they also act as audio cues for which attacks the monsters are about to make. When the player fights a monster in these games, it is recommended that you memorize their animations for their attacks, but also the sounds they make as they lead you a long way in telling you for example "the monster is about to sweep the front with its tail, I need to move out of the way!". When a player fails to act accordingly, the memory created is a negative memory. When the sound comes back once again, the player remembers the negative memory of how much the attack managed to hurt the player, so the player tries to act accordingly to it.

So to summarize, the player hypothetically starts to unconsciously sort out all the sounds they hear in the game in which serves no usable information, but actively listens after the audio cues for the attacks that the player needs to avoid, in order to be successful at the game. By having a previous personal experience with the monster performing a move, which hurt the players character a great amount, the "situated knowledge" from that experience comes to mind through the connection of memory and hearing the sound cue. The sound cue in turn becomes sorted as an "unpleasent" sound, as it reminds the player of the bad experience of that move, which encourages the player to act when they actively listen for it, hears it and makes their move.

It's through this that it is hypothetically possible that the answers given during the experiment, was affected by personal experience in video games, as it can be suggested that the sounds heard during the experiments, managed to remind the participants of situations from video games, which made them come to the conclusion of what their interpretation was. With the lack of experience from video games in the Arcade group, it suggestively became more difficult to make an interpretation of the sounds, as they have less experience to use in their cognitive process to use as puzzle pieces, in order to make an interpretation that would be accurate to the sounds desired design.

It is through this example, video game design starts to progressively move towards, a more informative form of use (20).

A common reason additionally to why sound is being used to pass on information in a more extensive way, is to be able to get rid of display elements in the game, such as "flashing health bars" or "power resources running out" being displayed with big flashing signs on screen etc. Or to give them more direct attention when needed, using a sound cue in which a player actively listens for (3) due to similar experiences in other video games following the same design (18). Jørgensen made a study (15) in which took a closer look into the sound design across multiple video games. This text used the same terms presented by Baharin and Mühlberger (3) and the arguments suggestively points towards that the active listening after sounds cues, goes along with how important

information needs to be delivered to the player. An example of this can be explained with The Legend of Zelda franchise (24). When the character "Link" is on a low on hearts (which symbolizes his health, fewer hearts means less available health.), the player can hear a monotonic musical tones, that simulates a heartbeat, which informs the player that the character is in a bad shape and needs to find hearts to replenish the health. Instead of relying on that the player keeps an eye on the health bar, the sound design helps they player to keep focus on what is visually happening in the current situation and use sound cues to deliver informative information to the player about the current situation.

But when games take away that informative sound design approach, it instead creates a more of a "challenging" experience, or it can create frustrations even. An example of this would be the game franchise "Dark Souls" (12) which gives no sound cue or indication on that you are on low health and are about to lose the game. Instead, it relies on that the player takes the responsibility to check the health bar accordingly.

A term which Chion presented (8), called "The audio-visual contract", simply states that "If you can see it, you should be able to hear it". It is a term commonly used within cinematic media works, in order to put the viewers, focus on the elements in the scene which is desired to be focused upon. But over time, the video game design has taken this term into account as well when creating the sound environment. For example, if a character is walking through grass, walking on cobblestone or making an action, it becomes displayed visually and also with audio to direct the focus on what is going on.

But this term gets extended into a more informative use of sounds, which can be displayed in an experiment used in Ng and Nesbitt´s research (20). For one of their experiments, they observed scenarios in the game "Counter-Strike", in a scenario of a player hiding in a corner. The player in the corner was actively listening after the footsteps of enemy players, to be able to make an assessment on how close the enemy was and where. The "Audio-visual Contract" (8) in this scenario, does not take in a visual feedback, instead uses the sound by itself to create an informative feedback and focus, to let the player know where the enemy is and how close.

This ties in with Jørgensen´s research (15) with that sounds cues and sounds can still deliver enough useful information, if it is easy to make the connection. It was suggested that during the experiments for this research, the participants would had been able to answer directly by hearing the sounds and visually see a scene for it. But since that visual element was intentionally taken out, participants were still able to make a reasonable interpretation of the sounds. Which hypothetically can be suggested that memories triggered by hearing sounds, could suggestively be enough without relying on a visual reference, or have no visual reference at all, as the personal experience in memory is able to make an interpretation that of what the sound is and what it means.

An additional interesting pattern from the experiments, is about the gunshots not being acknowledged by the VR generation compared to the Arcade generation according to the data collected from the answer sheets in the experiments.

A hypothetical reasoning of why, could be because that many popular games, such as Battlefield (11) or the newcomer Apex Legends (26) all includes guns, with realistic gunfire sound design to them. According to surveys, it

suggests that people around the ages of 18-25 spend more than seven hours a week with playing games (16). With so many hours being put in on a daily basis and being exposed to the sounds of gunfire, a hypothesis about gunfire sounds are becoming more saturated is starting to surface.

But when looking into the results of sound number 9 (See Figure 6), with the gunfire sounds being poorly acknowledged in the answers, a hypothesis of this can be further discussed by using Bradley and Langs research (5) and Haraway (18). For people that has either been in a situation with actual gunfire, would have a personal experience that is negative and the sound for those individuals would appear as unpleasant on a larger scale. For individuals that has not been in a real situation with gunfire, which means they have no previous personal experience with it, except video games, would still consider it unpleasant, but not as serious as the earlier mentioned individuals. A hypothesis for the reasoning of the poor acknowledgement from the VR group, could suggest that experiencing a real situation with real gunfire, is something that potentially feels abstract or unreal and feels like it belongs more in the video game experience. This hypothesis could potentially be researched further in a separate research on a larger scale.

On a final note in the discussion, the video game sound design, as previously mentioned with the "Audio-visual Contract" (8). The video game sound design is turning their attention to create a more immersive and interactive experience within video games, by taking notes from the sound design often found within movies. There are some related works that can be linked together in showing this progression within the sound design in movies.

The first part would be the ideation phase of sounds, in Hagen´s research (19), he presents a term called "The Lodestar", which presents the ideation phase. Video game sound design is special in this part of the ideation as it comes down to making a sound to a monster or creature, which do not exist, in which the possibilities are wide open for making something aesthetically pleasing and interesting. But the important part is how to make the sound aesthetically pleasing, but also informative (20). Much like the previously mentioned example of Monster Hunter: World (7) with making roars and screeches to fictional monsters that are both pleasing but also informative to convey information to the player on what is about to happen. With the collection of multiple sounds from very different animals for the sound production in that game, it can relate to a quote from Whittington´s book, about Ben Burtt´s experience with working on the sounds for Star Wars (30, 17):

"When I started out, it was very unusual for someone to be employed to make specific sounds for a film . . . Then along came George Lucas, who instructed me, "Here, take this microphone and Nagra, take a year and go out and collect all the interesting sounds you can think of".

In a similar fashion during the ideation phase, similar to "The Lodestar" (19), sound designers record many different sounds from animals, objects and even strange combinations, an example would be the sound production on the game "Warframe" (29) where they made a sound for "gore", by using a toilet plunger on dog food.

A second likeness in the ideation goes back to the "The Audio-visual contract" (8), as the sound designers strives after making a immersive experience by making sounds to

even the most simple thing as leaves rustling in the trees in a video game environment. But also use sound design to catch the focus of the player to guide them.
Finally, the final sound design that is adopted from cinematic works, is the music.

In Juslin and Sloboda´s work on editing a book (14) describes many experiments and research around the psychological impact of hearing music. Also, in connection with Schaffer´s work (27) combined with Juslin and Sloboda´s book. There are suggestive arguments towards that music influences individuals and is something that is being used extensively in cinematic works. An example of this can be explained with a scene, from the movie "Silence of the Lambs": In the scene where Jodie Foster´s character is walking down a long hallway to see Anthony Hopkins character Hannibal Lecter, during the long scene, a subtle low pitch sound can be heard that is rising along with the tension and anxious feeling that Jodie´s character is feeling. The sound of the ventilation system becomes louder and the sounds direct our focus on the character to create a up step in the anxious and thrilling emotions being displayed on screen.

In video games, music is being used extensively to create an immersion within the areas a player explores, but also achieve a desired emotion to have in the environment the player is exploring. A example of this can be explained with a video game situation of walking through a dark empty house, the sound is being focused on the thunderstorm going on outside and the anxious emotion building up from the silence in the scenario. To create more tension, the player might hear distant footsteps somewhere in the house, to which music comes in to further enhance the scary experience and ambience.

Results: To summarize the results gathered from this research, the data suggests:

The VR generation was more confident in using personal experience of audio gathered from video games and media forms such as cinematic works, to use it in their cognitive process when giving the answers in on the sounds heard during the experiment, compared with the Arcade generation. A hypothetical reasoning of why, could potentially be pointed towards the difference in how many hours is being spent in video games, compared with the two groups, with the VR generation being most dedicated to spend their free time playing video games, as gathered from the discussions during the experiment.

The Arcade generation was more dedicated to give a more accurate answer to the questions during the experiment, as well as more elaborate explaining of what and the interpretation, within their answers. The Arcade generation wanted to hear the sounds multiple times instead of just two times, which was the set amount of times to play the audio for the participants. A hypothetical reasoning for this could potentially be that the Arcade generation has more personal experience gathered during their lifetime, but at the same time found it difficult to be able to interpret the sounds, compared with the VR generation. Due to the reason of that they were made from a modern video game design perspective. The Arcade generation visually appeared more thoughtful during the observation in the experiment, also it was visually suggested that they tried to dissect the audio to be able to find the puzzle pieces for their cognitive process.

Sound number 9, which was painting a scene of a soldier jogging to the frontline in the woods, with gunfire heard in the background. It was an interesting difference when

comparing the answers between the two groups as the VR generation suggestively did not acknowledge the gunfire in the background, compared with the Arcade generation mentioning the gunfire within their answers. A hypothetical reasoning of why, could suggest that gunfire sounds for the VR generation could potentially be abstract and fits more into a video game scenario. This hypothesis can be taken further in a larger scale research focusing on this hypothesis.

On a final note, the VR generation suggestively showed that they spend more time with playing video games, whether it be on a computer, a console or a mobile phone, compared with the Arcade generation. With the participants from the VR group giving answers of playing video games daily around 6 to 8 hours a day, during the discussions, the Arcade generation had a few participants that have played games before and a majority answering that they had no experience with video games. For the participants in the Arcade group that had played video games before, it was games that was common to find in arcade halls.

Conclusions: In conclusion, there was some differences found during the experiment and during the discussions. Suggesting the following:

The VR generation´s data shows that they have more experience with video games, compared with the Arcade generation. Due to the reason of that the VR generation was more confident in using words or a lingo that can be used to describe elements from video games or for sci-fi media, as an example words like “laser wall” or “lightsaber”.

It appeared as the VR generation found it easier to be able to answer the questions given during the experiments, as it was suggested that their previous personal experience with video games helped them in their cognitive process in giving an interpretation of the sounds heard during the experiment.
It was suggested that the Arcade generation showed more dedication and desire to answer the questions during the experiment with accurate interpretations and gave more elaborate answers, compared with the VR generation. The VR group´s answers mostly consisted of short answers by answering with a feeling, such as “scary” as an example from sound number 1 (See figure 4). The Arcade generation described in more detail about the sounds by including an emotion and with what sound caught their focus the most. It also visually appeared during the observation during the experiment that the Arcade generation was dissecting the sounds by focusing on different pieces, to create metaphorical puzzle pieces for their cognitive process. Compared with the VR group, they were certain on their answers and the visual observation during the experiment suggested that they needed less time to answer the questions.

The answers given on the questions for Sound Number 9 (See figure 6) suggested that the VR group did not acknowledged the gunfire heard in the background. When compared with the Arcade group, the gunfire was acknowledged and included within their answers. A hypothesis comes to light about gunfire sounds becoming something that is abstract, or saturated for the VR generation, as the only personal experience they have with gunfire comes from video games. This hypothesis can be studied further in a separate research on a larger scale.

During the discussions about previous experience with video games overall, it was suggested that the VR group had much more experience with video games and spends

around 6 to 8 hours a day, dedicated to play video games, whether it be on a computer, a console or a mobile phone. The Arcade group´s answers during the discussion about the previous experience with video games, suggested that they had very little experience with video games, or had none. This could be a hypothetical reasoning of why the Arcade generation found it more difficult to answer the questions during the experiment, as the VR group had previous personal experience from video games to rely on during their time making interpretations of the sounds, while the Arcade generation had a lacking personal experience with video games.

It was suggested that the video game design approach for the audio used in the experiments, was able to convey enough information to the participants in the VR group, suggestively due to the reason of experience with similar sounds from other video games. The Arcade generation did receive enough information to make an interpretation, while it was not the intended design of the sound, both groups had in common that the sounds used in the experiment, was able to convey enough information for the desired feelings, emotions and what they meant.

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