The Narrative Role of Sound in Games

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Sound is a weird beast. You mostly can't see it. It is not really tangible. Yet, it is everywhere. It is much easier to close your eyes if you don't want to see something than to close your ears if you don't want to hear something. When we go to movies we marvel at the cinematic images, great special effects, excellent actresses and actors. Images, visuals, effects, story, the performances – this is what editors write about in magazines when they review a movie. Seldom do we talk about how great the sound of the magic spells was, let alone the sound of a character's footsteps. Sound, for the most part, is just there. Invisible. Unnoticed. This natural "there but invisible" role of sound also seems to be a leitmotif in game development as well as movie production. Sound in many cases is merely an afterthought. Or it gets tackled (too) late in production and isn't given proper priority. And yet, try watching a movie with the sound turned off. It seems distant. Uninteresting. Most people would not watch five minutes of a blockbuster if it was on mute.

Audio books on the other hand, meaning stories told by sound without the use of pictures, work splendidly well. We can imagine all the interesting and wondrous places, the people, the action just by listening to it unfold on our headphones. Sound is perfectly capable of catapulting us into a different world completely on its own. No images needed.

Why is that so? Why does sound work on its own while a movie on mute does not? What is the narrative power of sound? How does it work and why does it evoke the power of imagination?

This chapter is about getting to the bottom of this mystery by analyzing the narrative power of sound. Before we do though, I want to clarify that by sound I mean sound effects, sound ambiences. Things, places, motions that make sound. I explicitly exclude music from this analysis. That is a totally different beast and chapter altogether.

To further our understanding of both sound and the following analysis, I will start with a topic we are all well familiar with: movies. From that common ground our journey continues to games and what it is that sets them apart from movies. We will then look at the practical functions sound fulfils and why it is able to do so. This understanding will help us to see the narrative qualities of sound in a new light. I am excited to take you on this journey, let's go.

SOUND IN FILM VS. SOUND IN GAMES

Although sound in film is a hugely complex manual as well as artistic undertaking, it makes a good starting point for our journey to understand sound in games.

In movies, sound mostly represents what is on the screen. Sound documents the action the audience sees. Sound in film is very direct. Only on very rare occasions would one hear sounds that are off to the side or behind the audience, given a properly equipped 5.1 sound system. The reason is that sound attracts attention. If there was a significant sound behind the audience, people would want to turn around and see what is there. But in a film, there is nothing behind them. So these sounds only confuse the audience and are therefore omitted.

As far as documenting the action goes, sound engineers sometimes go too far. There are running jokes that everything entering the screen should make a sound to "announce" itself. And sometimes this is taken to extremes. Pay attention next time you watch a movie. If there is a scene on a street and someone drives by with a bike, you will probably hear the bike bell. Even though nobody would ring the bell in that situation. If a cat enters the picture, you will hear a meow. If a car drives by, it honks. And so on.

A big advantage of sound in movies is that every sound can be hand-crafted to fit the scene, the moment, the individual event down to the millisecond. Foley artists in sound studios often perform sound with objects in the same way that musicians perform music with their instruments. Making every sound unique. This only needs to be done once as the movie sounds identical every time somebody watches it.

This is not the case with games. Games not only provide a suitable sonic ambience and document the action on a computer screen. Sound in games has a very active role in directing players and making them aware of their surroundings.

Unlike in movies, in games players *can* turn around and investigate an odd sound. As such, sound is used to communicate many things. Odd sounds draw

the players' attention and guide them to a spot they might have missed. Monsters vocalize to make players aware they are around so they don't walk into a fight unprepared. The user interface sometimes triggers sounds when the health bar drops to a low level in order to signal danger. These sounds carry information and tell players what is about to happen so they in turn can decide what to do next. If a low-health warning is played, they might turn around and try to flee the fight. On the other hand, when they have just consumed a double-damage power-up they might want to make use of the time it is active. When there is a magical sound, they might want to investigate to find a hidden collectible.

Furthermore, sound cannot be performed, recorded and placed once in the right spot in time. In an interactive medium such as a computer game, players are the directors. They trigger scenes, sounds and events by their immediate actions. Players could decide to do nothing and stand still for hours. The ambient sound for standing around for hours cannot be recorded. It would be a huge sound file. Instead, it is made up of multiple bits: wind, random bird calls, crickets, and other environment sounds. Those bits are looped at different intervals in such a way that players have the perception of a never-ending, ever evolving and changing soundscape. If they stand around long enough and the game allows for it, they might even hear the soundscape change from day sounds like birds to night sounds like owls and frogs. It is all a question of the rules put into place that allow sounds to transition from one soundscape to another. From day to night. From sun to rain. Sounds in games are shorter and put together with multiple rules to create the illusion of a living, breathing world that never sounds the same twice. In fact, every sound probably only has a handful of variations and is played over and over – but in such a way that players don't notice.

Now that we have established the difference between sound for film vs. sound for games, let's look at the types of sounds in games and their influence on an interactive medium such as games.

SOUND MOTIVATORS AND HYGIENE FACTORS

During my economy studies I came across Herzberg's motivation-hygiene theory (Herzberg/Mausner/Snyderman 1959). Although partly outdated today, this theory makes some valid points, stating that job satisfaction in the workplace is dependent on motivational factors as well as hygiene factors.

Motivational factors (e.g. recognition by a superior, fulfilling work, responsibility, etc.) increase your satisfaction and give you joy and pride in your work. If these factors are present and strong, they create a sense of happiness and make

you want to stay in the company. If those factors are lacking, you are neither happy nor satisfied.

Hygiene factors (e.g. the salary, working conditions, vacation etc.) are merely what you expect. Their presence does not lead to higher satisfaction. But if absent, they drag your satisfaction down.

Think about this for a minute. When hygiene factors are all present and you have a super-shiny and clean workplace, coming to work is simply "OK". Nothing more. If you are thinking about getting another job anyway, that clean workplace is not going to be high on the list of advantages that keep you in the current company. But if the workplace is really dirty, it significantly lowers your motivation to come to work at all.

On the other hand, if you are seldomly recognized by your superior, that is no reason to quit your job straightaway. If the hygiene factors are satisfactory, you might consider staying in the company. However, if you are recognized and you feel that you are making positive contributions within your team, your morale gets a substantial boost. You are working in a company that can probably count on your loyalty for a long time.

I believe these categorizations are also applicable to sound. There are hygiene sounds that have to be there because their absence would adversely affect the perception of the game. On the other hand, there are motivational sounds. If executed well, these sounds significantly boost immersion and the player's perception of the game. Additionally, there also are the "nice to have" sounds. These are sounds that are completely optional and might have a positive effect if noticed, but go unnoticed if they are not present.

HYGIENE SOUND

Hygiene sounds constitute the vast majority of sounds in a game. They absolutely have to be present in order to keep players immersed in the game. In my opinion, this is the primary goal of hygiene sounds: to maintain immersion.

Games are masterpieces of engineering and artistry. A huge amount of work goes into every discipline: game design, story, art, animation, programming, sound and music, each of them utilizing countless iterations. All these disciplines have a common goal: creating a great game. And games are great when players are able forget reality. Just like a book. Once you start reading you become so immersed you can't stop and thus totally forget time. Great games might have great gameplay, a story well told, an unforgettable experience, magical moments when you finally win a hard, epic fight. But if one aspect in this mechanism of

all these game development disciplines is out of place, players are quite literally jolted out of the experience. The whole building of immersion falls apart. The magic of being absorbed by a game, forgetting time: gone. All because of one element. This may be a graphical glitch. For example, in *Assassin's Creed: Unity* (2014), heads of characters disappear and you then talk to floating wigs with eyeballs. Or maybe a voice-over glitch where one of the recorded voice lines was a temporary placeholder meant to be replaced, but was accidentally retained. Thus, a character suddenly talks with a completely different voice for one sentence and then returns to normal.

Some sounds start to become annoying after a time. There may be a tiny mistake in the editing, or the repetition pattern. Or they sound great at first but are ever so slightly over the top that, after enough repetition, their effect of sounding great turns into the opposite. They start to sound annoying. As stated above (cf. "Sound in film vs. sound in games"), games heavily rely on repeated sounds, sprinkled with variations to cover that fact. The goal with repeated sound is to have enough of a variation to make it seem different, while at the same time having enough of a similarity for it to be recognizable by players as the same type of sound.

Diablo 3 (2012), for example, has excellent sound in general, but in swamp levels, when player characters walk through shallow water, there is one footstep sound which sounds dramatically different from the others in that repetition group. If a player pays attention to details such as the sound of footsteps, the immersion may potentially be broken every time this strange footstep sound is triggered.

These glitches remind players that they are not really in that fantasy world. That the thing in front of them is just a computer game.

Keeping up this immersion is what hygiene sounds are about. Every ambience, every door, every footstep has to "sound just right". It has to sound believable, realistic, as if a sound engineer was there – in the game! – and recorded the sound as it happened. If such a thing was possible …

The sad truth is, if the sound team manages to do a good job, nobody will probably notice. As noted above, "it sounds just right". Hygiene sounds don't make players feel special, they primarily prevent players from losing immersion. Allowing them to stay in the illusion. Enjoying themselves.

MOTIVATIONAL SOUNDS

Motivational sounds are rare. They are the highlights of sound work. A sound so well made that it feels great to hear it, which results in players wanting to repeat it. For example, an awesome sound of a very powerful weapon, a magic spell or a hard-to-pull-off move in a fighting game. These sounds, if designed correctly, placed correctly, catapult players into an emotional high, sometimes accompanied by thoughts such as "Whooa what just happened?! Haha, crazy! Awesome!" This type of sound.

Although I was not going to talk about music in this chapter, I shall make an exception here. *Doom* (2016) had one of the greatest intros in the history of games, combining storytelling, cutscenes, music and sound into a magical moment. After about eight minutes of gameplay, after the first few fights, seeing the Mars Station destroyed, all scientists dead, the Doom Marine (the player) steps into an elevator. During the ride, the well-known Doom theme starts playing faintly in the background and an NPC explains that he takes full responsibility for the catastrophic events on that station. The Marine, he says, has to understand that everything was done for the betterment of mankind. At this moment, the camera pans down casually to the floor of the elevator, where one of the scientists lies dead, covered in blood. Betterment of mankind, the irony! In the cutscene the Marine then destroys the screen through which the NPC talks. Publisher and developer logos fade in. Then the Doom logo, and a heavily modernized Doom theme by Mick Gordon played in full force. After the logos, we are back in the elevator, hearing the last raging beats of the music. The Doom Marine lifts up a shotgun and cocks it. This cocking is in-sync with the last beats of the music, creating an intertwined link between story, music and sound.

Star Wars Battlefront (2015), *Star Wars Battlefront 2* (2017) and *Star Wars Jedi: Fallen Order* (2019) all contain extraordinary weapon and explosion sounds. Of course, a lot of the credit has to go to Ben Burtt, the main sound designer on the original *Star Wars* movies, but the sounds were masterfully modernized and optimized for maximum impact, as well as newly created for these games. Lightsabers, laser cannons, explosions – many of them sound so good, impactful and powerful that you will want to hear them over and over. It makes you feel very powerful as a player. A big plus in a game where one is supposed to wield "The Force".

Sometimes ordinary sounds slowly make it into the realm of motivational sounds by virtue of repetition. *World of Warcraft* (2004) had distinct "quest completed" and "level up" sounds heard frequently by the players. Probably eve-

rybody who has played the game at one point would still recognize them as they are tied to the positive experience of having completed a quest or gained a level.

Baldur's Gate (1998) did not only have the sound effects of its D&D spells. Before every spell, the in-game character uttered magical words to conjure it up. Thanks to an echo effect and being spoken with great pathos, it became a landmark sound which is easily recognizable even today.

NICE-TO-HAVE SOUNDS

Sometimes I notice sounds that are nice and add to an existing atmosphere, but whose absence would not be missed. If a game already features a dense sonic atmosphere, say crickets at night, a lush wind, some owls and so on, a dog barking on a faraway farm might be added for flavor, but if it was not, nobody would notice.

So there is this category of surplus sounds that add to a certain atmosphere, yet are only small factors within an overall, greater picture. They are not crucial for its maintenance.

CONCLUSION

Putting sounds into these categories supports the notion that sound plays a very active role in games. Not only does it work as a guiding system, directing players to certain locations, it also evokes feelings of immersion. And while hygiene sounds mostly work in the same way in movies, destroying a believable illusion if they are missing, motivational sounds have a far greater effect in interactive mediums such as games. There is something about controlling the action that is absent from movies. And when there are moments in games supported or induced by motivational sound effects, it feels like one's own success. I did that. I beat the boss. I fired that big-ass gun. I did all of this!

Figure 1: Sound categories and their influence on feeling and immersion in video games.
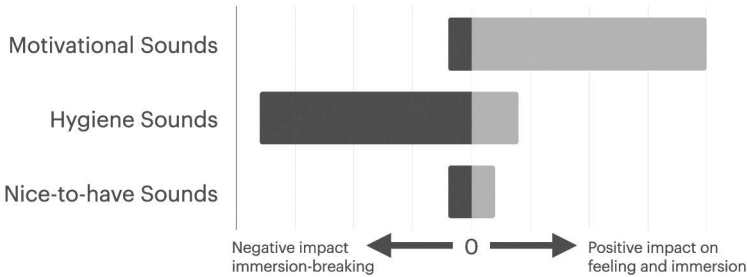
Source: Chris Polus

Every sound helps the narrative

Thus far, we have established the active role of sound in games as it guides players through a level. We have seen that sounds can be roughly categorized into hygiene sounds, motivational sounds and nice-to-have sounds, and that motivational sounds have an extraordinary power in games, a power not found in movies because they lack the interactive qualities of games. The player causes these sounds to appear, which creates a connection not possible in linear media.

Our focus in this section will be on all the things sound can tell us just by being heard. Most of the points made here will be fairly obvious. We are enveloped in sound all the time and gather information from our surroundings without even thinking about it, so that we are not aware of the extent of information we are actually obtaining through it. We take it for granted.

In my opinion, every sound adds to a narrative. A sound that does not have anything to say does not exist. Everything that happens in the physical world emits a sound. And thus, every sound tells us something about what happens. Consequently, every sound can and should be used to evoke a small, particular story.

Books are prime examples of storytelling, with a significant amount of space dedicated to descriptions of the surroundings. What time of day it is. The weather. What shoes somebody is wearing. If they are too tight. What material they are made of. If they creak or not. Sound has the power to tell this, too. Through hearing. How is sound able to do that? Let's uncover it in this part.

I will refrain from using formulas or technical terms and instead try to describe sound and what it means using examples.

Physical properties of sound

Sound has a very simple underlying physical concept. You hit your hand on a desk. The desk vibrates. The vibration is transmitted to the air. Air molecules vibrate. They travel like waves in water and reach your ear. You hear your hand hitting a desk.

Interestingly, with all the complexities and capabilities sound has in regard to storytelling, it only comprises two dimensions. One of them is the frequency, or speed, at which air vibrates. We perceive that as pitch. The higher the frequency of vibration, meaning the quicker something vibrates, the higher the pitch we hear. The other dimension is the amplitude, or force of vibration. We perceive this as loudness. The higher the amplitude of vibration, meaning air molecules moving back and forth a longer distance, the louder the sound. An explosion for example pushes air molecules a long way, even blasting away physical objects in its path. Hence an explosion is really loud.

Another well-known fact is that sound loses energy the further it travels through the air. The greater the distance from the sound, the quieter it becomes. Equipped with this knowledge, we can already make some assumptions about sound:

- *Only big things can move a lot of air to make loud sounds. Something very loud is either very close or it is very big.*
- *Something very quiet tells us it is something small or something very far away.*

Depending on how a sound changes over time, we can also perceive motion:

- *If something becomes louder, it probably comes closer.*
- *If it gets quieter, it moves further away.*
- *We can hear something passing by like the siren of an ambulance (Doppler effect).*

Information transported by the physical properties of sound:
size, distance, direction

SOUND DEFINES THE ENVIRONMENT THROUGH REVERB

When we jump into a pool on a hot summer's day, the waves we produce travel outwards in circles from the point we jumped in. When the waves hit the walls of the pool, they are reflected by the walls and move back. In that sense, just by looking at the waves and their reflections, we would be able to deduce the size and shape of the pool.

This happens to air waves in the same way. Sound is reflected by any surface it hits. A feature bats famously use to navigate in absolute darkness. The interesting part is that the surface significantly alters the properties of the sound waves. Some surfaces are highly reflective to sound, such as metal or stone. Some reflect lower frequencies and absorb higher frequencies, such as wood, thereby altering the reflected sound dramatically. Or they can absorb sound altogether, such as thick layers of cloth.

If we listen carefully, we can deduce by hearing what kind of a room we stand in. Imagine somebody talking in a bathroom with its highly reflective tiles, and you will probably know how it sounds. We can not only gauge what material the walls of a room are made of, but are also able to guess how big the room is. The bigger the room, the longer sound waves take to travel through the air, be reflected by the walls and come back to our ears. Imagine somebody talking in a bedroom vs. in a cathedral. You would most likely know which one is which.

| Information transported by reverb: |
| :---: |
| **material of the room's walls, size of the room** |

RECOGNITION OF SOUNDS

Our ears are amazing instruments that can perceive all frequencies of vibration transported through the air at the same time. The example earlier of a hand hitting a desk was simplified. In fact, the desk will not vibrate at only one frequency, but the event will spawn many frequencies simultaneously at different amplitudes.

This particular event, meaning the combination of frequencies and their loudness, forms a fingerprint of this sound. Everything that happens in our physical world produces a specific pattern of different frequencies at different levels

of loudness that also change over time. However, the same things generate more or less the same frequency patterns and changes over time.

Figure 2: The frequency chart of an organ-like sound (top); you see frequency spikes at 110Hz (meaning the sound creates 110 air vibrations per second as a fundamental frequency), 220Hz, 440Hz, etc., as additional upper frequencies. The simplified fingerprint showing the frequencies and their loudness (bottom); this forms the fingerprint of an organ-like sound.
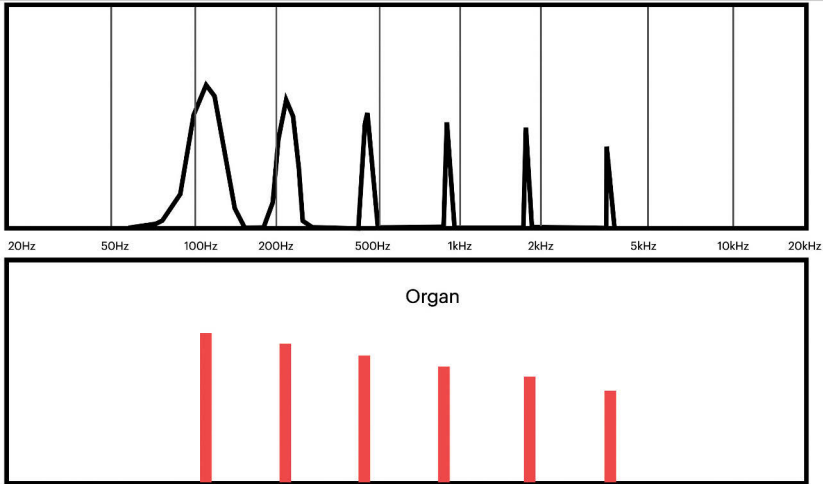
Source: Chris Polus

Figures 3-5. Simplified frequency fingerprints of a piano, flute and horn respectively. You can clearly see the differences and sometimes similarities.
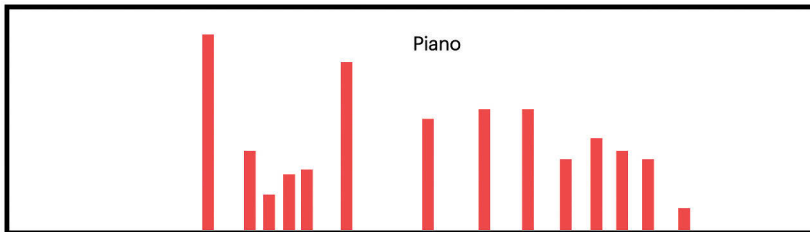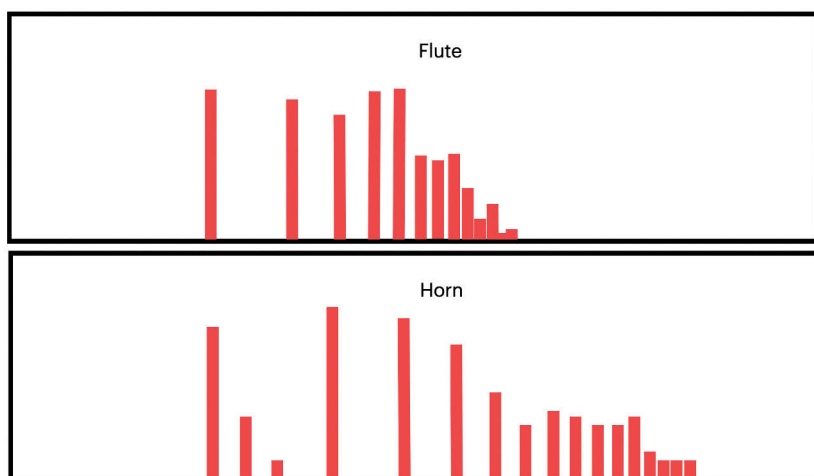
Source: Chris Polus

Now, think of somebody jumping into a pool. We can all imagine what the resulting splash could sound like. And every time a person jumps into a pool, the splash will be different. But we recognize the pattern of frequencies and can identify this sound as splashing water.

And this is what happens with everything we hear. From the moment we are born our brain perceives those frequency patterns of things happening. The voices of our parents, people walking through the room, doors opening and closing, cooking in the kitchen, people getting closer or moving away into the next room. Our brain learns to connect the sounds to what the eyes see, to the extent that we can close our eyes and still say with fair accuracy what is happening. It is something that required a lot of training in the beginning and works almost without having to think the older we get.

This means that we are able to recognize sounds because all sounds have an individual frequency pattern. A sound consists of multiple frequencies specific to this sound, and every frequency has an amplitude specific to this sound. Both frequency and amplitude change over time, sometimes significantly, but always in a similar fashion for similar kinds of sounds. This combination then makes up a fingerprint which we can distinguish from other sounds. Or to put it bluntly: We recognize sounds because we have heard them thousands of times.

Information transported by the sound event itself:

identity of the object that makes the sound

MATERIAL

Closely tied to the recognition of a sound is the identification of the material. Every material produces its own set of frequencies and amplitudes by the way it resonates. Its own sonic fingerprint! And with our growing experience we are more and more capable of recognizing what material something is made of.

Is it a wooden or plastic pen that fell on the ground? Is it a wooden or metal stick? Is it a plastic or paper sheet being shaken? Next time we hear a sound we are very likely able to tell.

Information transported by sound:
type of material

ACTIVITY

Sound carries a lot of information about what is happening. We have saved so many sound fingerprints in our heads that we recognize distinct events. We can tell if a door opens or closes. Whether it is an entrance door or a car door. Or a window. When something falls down and breaks. Or doesn't break. When there is water running in the kitchen. Or somebody takes a shower. We know exactly what context a sound originates from and can deduce what is happening.

Information transported by sound:
what happens around us

ADDITIONAL MEANINGS OF SOUND

There is yet another layer of meaning which plays a part in the recognition of sounds. It is dependent on the context we hear sounds in. We know that certain sounds only occur in a specific place. Or at a specific time.

Let's take crickets as an example. We never hear crickets in the winter. Thus, crickets tell us we must be in a warm season, and usually somewhere outside town. Birds mostly sing during the day. Owls call at night.

Church bells ring in the context of calling people to a church service. In Switzerland typically on a Saturday evening and Sunday morning. When we hear church bells we know which countries we are most likely to be in, as church bells are not common in Muslim countries, to take just one example. This means specific sounds help us determine time of day, season and place.

Let's look at another type of sound: alarms. Alarms are used to make us aware of something. Danger, a threat, or that it is time to wake up. Old-fashioned wind-up alarm clocks with mechanical bells come to mind. Or more modern digital alarm clocks with their penetrating fast-paced "beep beep beep beep". And by using the words "old-fashioned" and "more modern" respectively we again can gather information as to which decade or century we operate in. As digital or radio alarm clocks were invented around the 1940s, it is clear its sound should not be used before that time.

So, this is one alarm sound we know the meaning of – "get up for work" – but there are many other alarms. Those in buildings which give the signal to leave the premises immediately. Or the wailing alarms that are heard throughout a whole city to warn of bigger threats. This list can be expanded infinitely. We learn the context of sounds we hear and can then deduce a wealth of information from them.

> **Information transported by sound events:**
>
> **time of day, season, place, time, decade, century,**
> **alarm types, and much more**

ARTISTIC CHOICES CONCERNING SOUND

We have seen how sound is created and what kind of information and properties it carries with it. This knowledge can now be used to manipulate sound.

As stated before, we can identify sounds because we have heard them thousands of times: in different variations. We have heard thousands of different doors closing: small doors, huge doors, flimsy doors, wooden doors, creaking doors, metal doors. We know what a closing door sounds like.

And once we have learned the rules of sound, we can start bending or using them, breaking them, and expanding on them. We can alter the sound of a door to make it more menacing. Adding more rumble and deep frequencies. Or we

can give it a friendly touch by adding a short wooden creak. We can add mechanical sounds to the closing mechanism to "make it more secure".

Footsteps are another famous example. Foley artists, who recreate sounds for film in a studio, usually have a whole wall of different shoes and boots, every one of them producing a different sound. Some sound light and clacking. Others deep and firm. Some sound menacing, like the footsteps of a villain. Others resolute like the footsteps of a hero. Footstep sounds are meticulously chosen to tell the story of who is wearing them.

This can be said about all sounds. Not only is it important to choose a physically probable representation of sound for an object. Within those boundaries of possible sounds, sound designers choose a sound that adds an extra layer of feeling. Threatening, friendly, uncertain, funny, gritty, and many more.

In the indie game *Inside* (2016) by Playdead, the sound was extremely well chosen from an artistic perspective. Some people, when asked, would say *Inside* has no sound, that it is a quiet game. But Inside is full of sounds. There are even sounds that are a key to the puzzle that needs to be solved. Players have to listen for a certain sound event to traverse a bridge. If they don't listen, they are blown away by a mysterious shockwave. Only by listening and timing the character's steps can the bridge be traversed. All those sounds blend perfectly with the dark, sinister atmosphere of the visuals, making them virtually "invisible".

In *Far: Lone Sails* (2018), players control a tiny red character. The character travels through a beautifully abandoned world in a huge machine which they need to operate and keep running. The machine feels almost alive. It has various needs: power to set itself in motion, pressure that needs releasing through a valve. Sometimes a system overheats and develops a fire that needs extinguishing. With all the machine's quirks, very nicely represented by its many sounds, creaks and metal impacts, it comes alive and becomes a friend on the long journey. Artistically, the choice was made to create a machine with many quirks and imperfection: something that is represented in the sound layer of the game. Sound here tells the story of a journey, of a friendship, a symbiosis. The little red character needs the machine to travel, and the machine needs the red character to function.

In the creation process of all games, it is the responsibility of the sound artist to make a decision as to how something should sound, and to find, recreate or design the perfect sound for that purpose.

CONCLUSION

Looking at the examples above it is clear that every sound holds the key to what happens in the physical world. Because we have heard everyday sounds thousands of times, we are able to tell the size of an object, how close it is, if it moves, what material it is made of, what room we are in, what it is that makes the sound, and even a mood or a feeling. We have been learning these properties throughout our lives.

That means that every sound tells a story and hence is deeply relevant for storytelling. If sound is to represent something in a movie or game, all of the aforementioned aspects need to be represented "just right". In other words, the size, material, type of sound, etc., need to be correct to create a believable illusion, or you run the risk that your audience will see through the smoke screen and drop out of the experience.

SOUND AS A COMMUNICATIONS DEVICE

I have already mentioned some of the relevant aspects in the section on "Sound in film vs. sound in games". In an interactive medium, sound is a very strong communications device. Because we have come to know what certain sounds mean, if they happen in a game world, players can react to them. Every sound has a meaning. So let's look at the communication aspects sounds have.

Simulation of the physical world

On a basic level, sound represents the physical world of the game. Objects players can interact with should produce expected sounds. When players throw a glass bottle, the glass should shatter. When players open a door, the door should make the respective sound. They are the hygiene sounds of the world and are needed to keep up the illusion. These sounds communicate what is going on.

Feedback from an activity

Players constantly perform actions in the game world. They walk, open doors, interact with objects, or fight and shoot. Every action should result in some kind of sound, otherwise players will get confused and suffer a disconnect in the immersion.

Imagine a game where you are in a room you have to escape from. You look around and see a door. You walk up to that door and click on it. But nothing happens. The problem is not that the door does not open, but that literally nothing happens, you don't even hear a sound.

As a result, many players are not sure if they really clicked the mouse button. After all you could have missed it or the mouse didn't register your click.

At this point, the immersion is already broken and players are thinking about the technology rather than how to escape the room. Often they click a second and third time. More sophisticated players know that sometimes you have to click in the right spot. Maybe you have to click on the doorknob instead of the door itself? And so players click everywhere on that door, leaving the immersion far behind.

Had the game integrated just one feedback sound, like the rattling of a doorknob, indicating *something* happened, telling the player, yes, the game did register the click, the disconnect could have been averted.

Feedback of this sort is incredibly important as it is high on the list of immersion-maintaining hygiene sounds.

Orientation in the game world

Most people have gone sightseeing at some point in their lives. Most of them probably didn't think of sightseeing as "sighthearing". But sound takes an important part in one's orientation: This is the place where there is a lot of traffic. That's the place where you hear the bazaar ...

In games, sound not only plays an active role in making players curious about what is behind the next corner, directing or luring them to a specific location. It also helps to passively pinpoint locations. When you roam through endless corridors in *Bioshock* (2007), for example, it helps when there are some orientational sounds. The restaurant where a broken radio still plays music, the room where water leaks in. It enables the brain to make more connections to the virtual map in your mind, and not only through visual means but also through a secondary channel, hearing.

Environment

We have looked at the informational payload about the environment which is transported by sound. How we can deduct from environmental sounds like animal noises what time of day it is. Thus, for a specific location and time, sound

artists utilize a deliberate selection of sounds to communicate to players what environment the game is set in.

Some sounds are more omnipresent background ambiences like wind noises or tree leaves rustling. Others are more in the foreground, carrying information relating to birds, crickets, wolves, dogs, traffic, or people.

Changes in the game state

All games react to player actions in some way. When a puzzle gets solved, a music stinger is played, telling players they have solved the puzzle. When they explore a vast world and an enemy creature attacks, combat music begins. When the game character is low on health points, not only might vision become clouded, but hearing might be impacted as well. Low health points could be represented by making all sounds dull, filtering out higher frequencies, as if a grenade exploded nearby and you heard everything through a thick layer of cloth. Maybe some sine beep rings in the character's ears.

Information about the state of the game is very important. Especially because in a 3D game world things can happen *behind* the player character. Nobody wants to be surprised by an enemy from behind. It is not fun and it is also frustrating. Therefore, enemies often telegraph where they are by issuing a short sound from time to time, revealing their location. This way, players don't accidentally run into them. If enemies attack, they issue another short sound communicating the changed state of the game (from exploration to fight). This indicates that at least one enemy has spotted the player and is running towards the player's character to attack it. Often this is also accompanied by a change in music.

Reducing the cognitive load

Sound is like a separate channel to the brain. We can see only so much with our eyes. But we can take in additional information through our ears and our other senses. In that respect, sound can help reduce an overload of the visual channel.

Think of a hectic battle situation in a more complex strategy game. You have to keep all the stats, units, resources and more under control. Your eyes would need to scan the whole screen all the time and read health bars and other information.

But when designed in a good way, sound can support gameplay by reducing the load. Sounds that inform players of depleting resources, of low health of important units, or that a fight has started somewhere on the map. In this way play-

ers don't need to constantly check all the stats but can concentrate on the most important task at hand and only need to react when something important happens.

This is even used in games with minimal UIs, like *Doom* (2016). The UI doesn't consist of much more than a health and armor bar. And yet, in hectic fights players have to concentrate so much on aiming, evading attacks, and killing demons that there is almost no time left to keep checking the bars. But if health drops below a critical level, a distinct "beep beep" is triggered, and you still have a chance of breaking away from the battle, looking for health kits.

Narrative elements

Sometimes sound supports the storytelling in more direct ways. If a stressful event is triggered in the game world and chaos breaks out in the streets, sound can try and underline the situation from the main character's perspective. It creates a subjective reality bubble for the game character. Environment sounds could deliberately be filtered out and the sound of people screaming altered to sound far away, with plenty of reverb. This could emphasize the helplessness of the main character. The state of mind of not knowing what is going on. Being distant. Not being in control.

A stereotypical use of this would be an explosion impacting the hearing of the game character. When something explodes, all high frequencies are filtered out, only a very muffled sound remains. Sometimes the effect is further improved by adding a very high ringing in the ears. This, too, helps to experience the world from the perspective of the player character. Perceiving the virtual world through their eyes and ears.

CLOSING THOUGHTS

Many of the elements I have presented over the course of this chapter overlap. Some are clear and obvious, others more obscure. But it is remarkable that we rarely think about sound in our day-to-day lives. It is just there. Yet, it functions as a complete channel with a direct connection to our brain, just like the eyes. And we have seen how many aspects are transported through vibrations of air molecules. They are packed with information and meaning.

Sound has a gigantic potential to add immersion, define places, introduce a light and happy mood or cover everything under a dark, sinister layer.

When the various aspects examined in this chapter are understood, artistic choi–ces can be made. A player's perceptions can be played with. Rules can be bro-ken. If sound artists omit all animal noises, birds, flies, frogs in a forest, some-thing sounds "off" immediately. Rules we are used to are broken because when we see a forest and daylight, we expect birds and other animals. This expectation can be manipulated to induce an uneasy feeling.

It is all about one's personal experience. The game world developers want to take you on an exciting journey. So go and listen carefully to the sound of the next game you play and immerse yourself in the audible world that was created for you. Enjoy :)

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