Informant Diegesis in Videogames

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All illustrations and screenshots are done by myself, the images are from various online sources.

Front cover spectrograms is of a creaky floorboard at my house on the front and a microwave recording at 192kHz sample rate on the back, screenshot from iZotope RX4.

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Videogame is in one word, because:
http://www.wired.com/2007/11/on-videogame-ve/
and
https://games.yahoo.com/blogs/plugged-in/video-game-videogame-spellchecking-gaming-great-debate-26.html

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Foreword

As a professional sound designer I have often experienced the divide between the theories of sound design in audio visual media and the actual creative process involved in creating an interactive soundscape.
Sure there is a difference in the actual craftsmanship of creating sounds and mixing sound and music in any medium is different, but the theories also, and then again maybe not so much?

I often read about sound design, or game design for that matter, and a minor gap appears between what works in the practical world and how the creativity flows. How theories and opinions can seem to have a very strict way of seeing things.

With this thesis I intend to explain some of the differences in audio visual media, especially with focus on sound in videogames and how they function differently from other media, but also their similarities. The role of the sound designer can seem identical to that of motion picture and that of a videogame sound designer, but they are very different and yet so alike.

Through my years as a professional sound designer I have used a lot of theoretical knowledge to fuel my creative skills and work, but have also experienced that sometimes theories just doesn't work in real life and a so-called hack is needed, bending the theories so that the product, in the end, sounds perfect. Which is the goal of any product, theoretically correct or not.

Since the dawn of videogames and videogame sound in particular, a constant process was started to achieve, not only the best sound, but the most efficient sound or at least the most efficient and economic way of dealing with sound, that too goes for motion picture.

Tools have been developed to ease the creative process, but with computers in general also came something as beautiful as real-time adaptive powers, algorithms on the go and procedurally generated sound.
Procedural is such a wide aspect that it can impossibly be grasped fully in any book, but it does leave us with the fact that it is possible to create soundscapes that is shaped around the player or audience of the interactive medium that immersion becomes greater than ever before.
It is possible to have a constant conversation with your computer, just by communication through something as "simple" as a videogame.

In this thesis, I explain how sound can be used to inform, guide and help or even misguide a player, how sound can be that final and important cue needed for players to understand what to do next. Welcome to Informant Diegesis in videogames.

1.0 Abstract

Sound is used in many ways in different media, but once a medium becomes interactive it contains more layers than any linear medium, such as videogame audio as opposed to motion picture audio.

During the rise of videogames, theories for audio visual content flourished and some very standard terms, such as; diegetic and non-diegetic arose and definitely have a place in the analytical tools of any audio visual medium.
But with interactivity comes new layers and ways of communication.

As opposed to motion picture, with it's allocution type of information flow, the medium is static and leaves the audience with the inability to change the outcome on the screen. The director and sound designer of this medium may decide what is best for every scene, best for every frame and even plan ahead to manipulate the audience into a specific emotional state.

In videogames it is different, the player of the game is now in almost full control of the outcome of any scene and event in the game. The player may even control the camera, making the game a different task to set up because the world of the game must be able to live on it's own and still respond entirely as expected in as many cases as possible.

A game uses all kinds of information gathering in a constant attempt to provide the perfect feedback to the player and even to predict the player's next move, to have a slight advantage in what feedback to provide back to the player. This leaves an open space for a new type of diegesis, called informant diegetic.

Informant diegetic is the definition of the difference between any sound that supports emotion and narrative alone and sounds that are used in the actual game play, that is needed to the game to function. They may not be vital to the completion of the game, but they can provide crucial information that may guide the player in specific directions or warn or even prepare the player for what lies ahead.

I will in this thesis mark up the differences and explain these, by combining publications and papers from both worlds of the theoretical and the practical and I will follow up on these with empirical research made by having discussions and lengthy chats with audio and game industry professionals, which gives a very broad perspective on how sound in games can be used and will be used.

Using these discussions and publications, along with my own thoughts on the subject, I will put forward my theory of informant diegesis and models that will be used to describe this new term of sound analysis, as well as the narrative, the

adaptive layers and interactive parts of the individual sounds and music in videogames as well as describing the communicative process between audience and the interactive medium of videogames. The explanations will focus on both individual sound as well as music.

Alongside these theories, models and discussions, I will add a thorough technical explanation of how communication between the game and sounds can be done, also to give a technical example of what is possible. I will explain how I used informant diegetic sounds in my own work as a sound designer as well as discuss other games that has used it in the past, combined with discussions with the actual creators of some of these sounds and how they made them and what were their thoughts when doing so.

This will show how sound and music in videogames is used as an informant and a direct part or contributor to the game design and the narrative of every part of the game.

In conclusion I will find that sound in videogames as compared to motion picture is very different and yet very alike. They are many similarities, but because of the interactivity between player and the game itself, the sound in a videogame can reach much further, because of it’s ability to stand alone and guide players, instead of being a constant linear match to the individual frame no matter how many times you watch the same thing over and over.

In conclusion it is also noted that some of the things that is achieved through the use of informant audio in a videogame is also achieved in a film, but because of the lack of interactivity in a film the choice of reaction has already been chosen by the film's director and sound designer, therefore I will mainly focus on how this is used in videogames alone.

1.1 Method

As mentioned in the above abstract, I will combine the theoretical and the practical world to fully uncover how a theory may be one thing but how it is used in practice is another.

I will in detail discuss the use of diegesis as an analysis tool for audio visual material, I will do this by using the very basics of diegesis, which are defined by diegetic and non-diegetic, with some subcategories as stated in many of the references papers and books.

I will create a model for analyzing diegetic material, which primary function will be to divide the terms of diegesis into groups as well as show the need for new types of diegesis when analyzing videogame audio.

In discussions over email and interviews with game audio and game industry professionals I will discuss the subject of sound as an informant in the game design, how sound is used to inform and guide players and can help shape the constant flow of messages provided to and from the computer.

I will through a thorough technical explanation show how linking of information and connection between the game engine and the sound engine can open new worlds of communication between player and game. The technical explanation will be done in the engines available to me, that is Glacier 2 game engine and Wwise audio engine, with some referencing to other engines as well.

All these approaches together should make a sound example of how informant diegesis in games work and how they are used in both sound and music.

1.2 The reader

The theories, techniques and terms that is mentioned in this thesis are part of a very small niche in game development and sound development for all media as a whole, therefore it is expected that the average reader of this thesis may have little or no experience in the field of this specific type of audio development for videogames.

I will try to, in as many cases as possible, to be as clear about terms and subjects in their explanation, but some subjects are complex of nature and can be difficult to explain in words if the reader has not worked directly with game audio development before.
I will assist in as many cases as possible with screenshots, images and illustrations to make the subject easier to understand.

But in some cases, it will be deemed unnecessary and outside of the relevant areas of this thesis to explain several concepts. In many cases I will also assume that the reader has basic knowledge of standard terms and standard programs, such as; Wwise, Cubase, Engine, Audio Engine and NPC, as well as Diegetic, iconic, earcon and more.

2.0 Game Audio History and explanation of the subject within

Game audio has a history just like film audio has, since the 1920's when sound for film was invented, it has grown to become an artform of it's own. To begin with, just like with games, there was a reason for why many things were like they were. When sound in film was created, silent movies was also created. Because before sound was a possibility in films, there was only silent movies out of limitation, but since the birth of sound for film, using sound became an aesthetic choice.

Late in the 1920's, sound had been developed just about enough to spawn a golden era for film, for more than the next decade it would help boom the film industry forward, especially in Hollywood[1], but also here in Denmark where one of the very first film studios was created, Nordisk Film. [2]

When the first videogames were created it was without sound, sound appeared later in crude versions of beeps and clicks, not because it was an aesthetic choice as it is today, but because of limitations in the hardware and software, and that is what this chapter is about.

2.1 History

Videogames is an odd size for a medium; the amount of man-hours put into creating one to start with is astonishing. When the videogame as a commercial medium hit the public in the 1970's, the sound was crude and almost not present; with good reason as the hardware these games were developed on was at the time not intended to play sound.

The need for sound was definitely there, with good reason, and that is one of the things that we are about to dig into in this thesis.

When PONG was released, by Atari in 1972, the sound in the game may to many seem incredibly crude and harsh, but it was nonetheless one of the first experiences delivered as home entertainment which could play back sound. The sounds in PONG was none the less efficient and did what it was supposed to, as it would play a sound whenever the ball was hit and whenever a point was made; simple high pitched beeps was all it could deliver, but the pong machine was never intended to play back sound to start with.[3]

The sound in PONG was created by Atari's, at the time accidental, audio engineer Al Alcorn, who famously said "Screw this, I don't know how to make these sounds

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[1] Gomery, D. (1985) The Coming of Sound: Technological Change in the American Film Industry. In Weis, E. Belton, J. (ed) Film Sound, Theory and Practice. (pp. 181-199). Columbia University Press

[2] http://www.dfi.dk/FaktaOmFilm/Dansk-filmhistorie/1896-1910.aspx (January 20th. 2016)

[3] Atari Inc. (1972-1984) History. https://www.atari.com/history/1972-1984-0

anyway and don't have the equipment needed". The story being that Atari had ordered the game to contain sound, but had not provided any hardware for delivering this, so the sounds of PONG are from a small hack in the hardware by wiring the audio output directly to the circuitry board.[4]

Turning the TV from a passive medium, into an active medium was one of the turning points in videogame history and the engineers of the ATARI 2600 system, which is considered to be the first home entertainment console system, knew that, and to them it was super exciting to be part of. [5]

Sound came a long way since then and in 1989; Creative Labs introduced the Sound Blaster audio card expansion for PC's.[6]

Creative Labs, a Singapore based electronics company, founded by Sim Wong Hoo. Not the first release of a sound card, not even their own first release of a sound card, but the first successful release of a sound card to hit the commercial audience.
By not being the first I mean that several audio cards and game consoles had been released before, even with the same electronics, the Yamaha YM3812 chip. As explained nicely in detail by The 8-Bit Guy's youtube channel about music in older consoles and computers. [7] The YM3812 chip allowed 9 voices to be played back at the same time and all voices were independently programmable, which was different from previous consoles and computer, which had used crude binary speaker systems or three channel systems with limitations as to what each channel could play, creating some of the most fascinating tunes in the history of videogames, I can say that without offending anyone, but they were crude and a lot of them also sounded bad, even for their time and standard.

This created a market for better sound, sound was already introduced into games and sound cards had already been introduced as well, but the sound blaster was here to introduce a world of better sound. At the time good enough quality to be considered Hi-Fi – from there to where we are today, where physical modelling of sound and generation from granular synthesis is possible is a long road, but a very important road as today it is crucial to the player's experience and immersion to have high quality sound to support their gameplay. In motion picture, sound has since the birth of the audio supported motion picture, been there to support the suspense and control the mood of the scenes, to underline the current situation, even prepare the audience for the appearance of specific characters with the use of leitmotif, which we shall dig much further into later in this thesis.

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[4] Kent, S, L. (2001) The Ultimate History of Video Games. Three Rivers Press. Quoting Alcorn, A.
[5] Penn, Z. (2014) Atari : Game Over. Streaming Documentary. Netflix (January 16th. 2016). Fuel Entertainment USA. GRAiNEY Pictures. LightBox. Quoting: Warshaw, H. S.
[6] Creative Labs http://www.creative.com/corporate/about/
[7] The 8-Bit Guy. (2015) Youtube Channel. https://www.youtube.com/watch?v=q_3d1x2VPxk

These old terms and theories are still used to analyze todays motion picture and these terms and theories made by Michel Chion, R. Murray Schafer and many others through the 70's, 80's and 90's are definitely still valid, but new media requires new terms to be fully able to analyze them.

An old proverb about sound and motion picture is "Sound is half the picture", in these modern days of interactive media and videogames; I would like to state that "Sound is half the game". Sound can actively shape how we interpret the image[8]
Or how we interpret the game, would be more accurate.

Dr. Gordon Calleja described this very well in his MIT press book about game immersion and he states that sound and images, almost no matter their visual or auditive origin have an impact on the player of the game or the audience of the picture and specifies that both motion picture and games have increased their quality of graphics and sound, but that in itself has not necessarily made it more immersive or more of something that the player or the audience can relate to.[9]

Gordon Calleja and I had a great discussion once during my time at the ITU (IT University of Copenhagen) about this subject and Gordon Calleja stated that; anyone who has played a game from back in the day know; that the characters in these games were in no way resembling real life characters, yet the players immersed themselves into the world of the game, enough to make them believe that they were actually part of the action.
The 1989 Dino Dini game "Kick Off"[10] and later in 1990 “Kick Off 2”[11], a European Football game, had characters consisting of three dots, just a few pixels, and two of them could move and it was just enough to make the player think of this as a football player.

Even though it was rough graphics, it did not prevent the player from imagining what was going on from these graphics and the same counted for the sounds of the game, not only in Kick Off 2 but many of the games from that time would succeed in immersing the player into the game with just a few dots and beeps and interaction between those and the player of the game.

From the sounds of space invaders and pacman on the Magnavox Odyssey II (in Europe released as the Phillips G7000 system) to the use of the FM synthesis possibilities of the Commodore Amiga and Commodore 64/128 in the 1980's and 90's, it became clear that when something is interactive, ergodic, modern videogame

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[8] Bordwell, D. Thompson, K. (1985) Fundamental Aesthetics of Sound in the Cinema. In Weis, E. Belton, J. (ed) Film Sound, Theory and Practice. (pp. 181)). Columbia University Press
[9] Calleja, G. (2011) In-Game : From Immersion to Incorporation (pp. 18, 31) . MIT Press.
[10] Kick Off. (1989) Dini, D. Anco Software.
[11] Kick Off 2. (1990) Dini, D. Anco Software.

ludic or anything else remotely similar, the use and need for feedback audio is immense. A type of feedback not used much in experimentation before this, apart from certain interactive art installations, those of John Cage, Karlheinz Stockhausen and other similar pioneers of the electro acoustic music industry, and when hitting the number pad of the ATM or pushing the buzzer of a doorbell, the use of audio feedback was limited to such media and only considered as necessary natural feedback or the natural event when hitting the buzzer of the door as an informative medium, which where not to increase any type of auditive or narrative experience.

On a side note, and a fun fact, it is actually possible to create practically any soundscape with just a binary speaker system, since with just one bit, if you have enough of them in a row, it becomes possible to modulate any wave. as exploited on the ZX-spectrum by Tim Follin back when the ZX-Spectrum was top of the line.[12] [13]

2.2 What is an audio designer in video game development

An audio designer is a craftsman. Audio design is a craft, and it requires an equal amount of straightforward office work craftsmanship and creativity.
An audio designer can be defined as a person who creates sounds for the game currently in development, so to speak a person who crosses over from several audio production fields, such as sound technician and engineer, to foley-artist[14], composer and more. In short, many hats, many things to do.

Previously audio designers for games would work only on the creative process and an audio programmer would implement the sounds into the game, but that is simply not the case any longer. The audio designers job now (as of 2016) is just as much to implement sounds and create systems for playback of sounds or setup logic in the game engine for sound playback.

The role of audio programmer still exists, but it has changed to become a role of a tools and systems programmer rather than an audio implementor, because of

This means that the audio designer is now also in charge of how the sound connects with the game world, where this was previously a separated task. This means that more creative systems and, in my opinion, better sounding sounds and soundscapes will occur more frequently in modern games.

2.3 What is Informant Diegesis

In the world of linear media, image and audio go along frame by frame. Many theories and terms have spawned around this subject explaining it's use and

[12] http://www.animatez.co.uk/computers/zx-spectrum/sound/ (January 22nd, 2016)
[13] https://www.youtube.com/watch?v=T42WuUpBuHE (January 22nd, 2016)
[14] http://filmsound.org/terminology/foley.htm - http://www.marblehead.net/foley/whatisitman.html (January 23rd - 2016)

importance. Informant diegesis is the clear separation between sound the support emotion and narrative alone and sound and music that is hard information relevant to playing of the game.[15] I gave a talk about this at the event Spilbar #23 in Copenhagen in January 2015. [16]

Sound to follow visuals have almost been around forever, since the birth of the film, even before the audio film was invented (1929), so called Silent Movies were far from silent and to some extent contain a much more interesting perspective on the use of sound to visual media, both in terms of performance and aesthetics.
Film and sound aesthetics is a subject of it's own and I will barely touch upon this subject in this writing.

Ever since modern visual and audio media was introduced, a quest to perfect it or discuss it has been around and many practical studies and examples are available, alongside many academic studies. Most famously of these is the terms of Diegetics, explained well by Michel Chion in 1994. [17] Though the term diegesis is ancient greek and has been around since before 1BC and diegetic can be also be visuals, but this thesis is about how it is used in the analysis and creation of sound.
Diegetic and Non-Diegetic sound is the definition of sound as a companion to visuals, to categorise sound as in whether or not it follows the visuals in the actual frame or off frame, but part of the action or as part of a more overall soundscape, but not part of the frame.
Diegetic being part of the action, Non-Diegetic not being part of the action,

Background music is an ultimate example of Non-Diegetic sound, unless played by an actual band or playback device in the visuals. Diegetic sounds is the opposite and things such as footsteps, knocks on the door, noises from the neighbors, cocking a gun and more are all part of the current action. Mickey mousing is a special case of non-diegetic music that is part of the action, but I will cover that in a later chapter.

These two terms are great for analyzing sound to accompany visuals and are the only two terms needed if the visuals and sound is in a linear playback state.
There are several sub terms with these, such as internal and external diegetic; covering sounds such as voice overs but from the actual character in the frame. Acousmastic being sounds that are diegetic but with a hidden source, acousmatizing a sound means that the sound source is revealed, lse trans-diegetic, which is a term that covers sounds that “travel” between any other terms at a certain point, roughly speaking or connects between the medium and the player, which is closely related to

[15] Hollis, M. (2016) Email correspondence.
[16] https://www.youtube.com/watch?v=d1yH92UYptw (January 22nd, 2016)
[17] Chion, M. (1994). Audio-vision: Sound on screen C. Gorbman, Trans. New York: Columbia University Press.

my term; informant diegetic.

A completely new perspective and dimension arises once the medium itself becomes interactive, even the smallest interaction between medium and audience will create new dimensions in sound and visuals.
I have named these informant diegetic because they can be both diegetic and non-diegetic, but will contain information about the current situation or event in the interaction process. They may be completely irrelevant to the audience, but none the less adaptive to the interaction process and therefore be built upon information inside the medium. This information may not be of interest to the player if they are of an entirely aesthetic nature, but if used to determine which sound is to be played back or as the foundation of a procedural system to generate a soundscape the player may benefit from during gameplay; they are informant diegetic.
It may be something simple, such as the music becoming a typical horror theme when evil is nearby,[18] but in a linear medium the audience can only use this non-diegetic music to sustain the atmosphere of the medium, while in an interactive environment it may be used to inform the player to progress.

Interactive media comes in many shapes, but to simplify the terms and their use, I will mainly focus on informant diegetics use in videogames.
Information through sound is useful, not only in videogames, but also in the physical world. Listening to the click sound of a traffic light gives you information regarding the color of the light, in many sports, sound is an extremely important companion to the visual world to determine speed and timing of events.
Badminton, hockey, tennis and more, it can prove useful to listen for the hit between tool and ball, but also to used purposely to disguise the sound of your own shot. [19] [20]

Informant diegetic is therefore the third layer in the analysis tool of diegetics. In linear media a footstep may be diegetic, but in a videogame it may provide important information about the surface of which the player and his or her character is treading upon. Also a difference between linear and nonlinear media is that there is a constant list of unpredictable elements because of the interactivity in games, no matter how linear the game may be.[21]

Sound and music that change because of players health, time of day, surfaces, environment, timing events, findings, class, style and more; all shape the basics of what I call Informant Diegetic.

[18] Jørgensen, K. (2007). On transdiegetic sounds in computer games. *Northern Lights, 5*, 105–117.
[19] http://www.badmintoncentral.com/forums/archive/index.php/t-88346.html (January 22nd. 2016)
[20] http://tt.tennis-warehouse.com/index.php?threads/katrina-adams-on-distracting-dbles-foes.475299/ (January 22nd.2016)
[21] Barnabas, A. (2016) Transcribe phone conversation.

2.4 Why is informant diegesis needed by audio designers

In the two previous subchapters, I have explained the role of the audio designer and now the very basics of informant diegesis.

Since the audio designers role is now to be a combination of creative idea person, systems builder and implementer on top of being an actual designer of sounds craftsman, a better overview of how individual sounds and music can be connected to the code may be more obvious.

Audio designers, with modern tools will be able to implement sounds much more easily than in the past, meaning that there is no need for waiting time before checking if a system works and with today's modern authoring tools it has become possible to create sounds and systems and prototype them before the mechanic in the actual game is even ready.

Informant diegesis is important to the audio designer because it is his or hers gateway to having an impact on the actual game design. If the audio designer did not have this ability to communicate about informant diegesis with other parts of the development team, sound for games would be much more of a linear process and would be revealed only as icing on the visual cake rather than something that can entangle and immerse the player into the universe of the game in other manners than just the narrative and emotional.

3.0 Communication models

Communication is one of life's cornerstones; it goes all the way to the very basics of life and how prehistoric beings would use noise to either call for or warn their mates and at the same time use their hearing to identify the noises around them and giving them a clear perspective of their current situation.

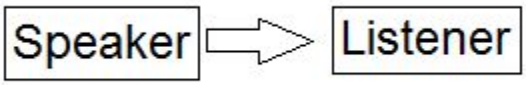
Modern communication is a thesis of it’s own and here I will only dig into communication between man and machine, player and videogame and how various situations calls for different models and how they interact with each other in eternal symbiosis while the game is on.

The models explained by Bordewijk and Van Kaam,[22] used to explain tele-communication, is perfect for this, as they explain all types of communication on their own. They do not combine them or take into account what might happen if one passes from one model to another all of a sudden and it is these models that I will use as examples to begin with and later explain how they fit into the computer game world.

[22] Bordewijk, J. L., & Van Kaam, B. (2003). Towards a New Classification of Tele-Information Services. The New Media Read, (pp. 576-582). MIT Press. Original pub: (1986), Intermedia. (pp.16-21).

3.01 Allocution

When information flows from one individual to another, without any possibility of feedback from the receiver of the information, a so called information consumer. Dropping a leaflet upon people to inform them of a situation or more relevant, that relation of a teacher-student or general-soldier.
The information provider can provide the same information to several information consumers, still leaving the path of information to be one way.
If this happened over a dinner table this would be a monologue.



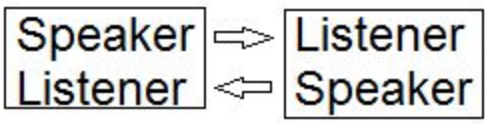
[23]

3.02 Conversation

The situation where the allocution model is insufficient because the information consumer is no longer only such, but also an information provider.
Both parties in the conversation now act as information consumers and providers, which makes it different from allocution, but the flow of information whenever one provides it, is the same.

If we assume that one of the providers is the main provider of information, a so called information-centre, the individual may have several conversations at the same time, but the consumers cannot communicate with each other without going through the centre. This makes the information-centre able to receive information from either source and use to to inform the other consumers with.

Basically the way a Server, in the computer sense, works; communicating with several computers at a time.



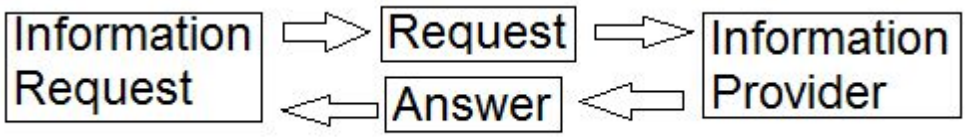
[24]

3.03 Consultation

Consultation can be regarded as a conversation by request.
But no more than the requested information is provided by the provider to the consumer who sent the request, and the provider cannot request information.

[23] Figure 1.
[24] Figure 2.

The same patterns as from the previous examples are valid, that an information-centre can be created, which can have numerous requests from various sources of consumers, and information is then delivered to the individual. The difference from communication, is that the information-centre, cannot provide anything but the requested information, thus making it unable to receive any information from the consumer / provider as in communication, therefore no new information than what is already at the information-centre, can be provided to other consumers, regardless of the number of consumers.



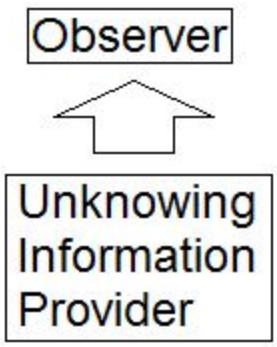
[25]

3.04 Registration

When opposites occur, which they usually do, we get a situation called registration. When the information-centre no longer holds any information to provide, but has the ability to, without request as in consultation, to obtain information about those who would previously be the consumers.

The central unit of this process now collects information as it sees fit or by command from a third party; and this is very common in modern day internet (as of 2015), to collect data about users of websites and their specific behavior on the internet.

The key here is that whoever provides the information and on what grounds they are collected by the recipient, makes the difference between the previous models and registration. There is no request, so the information provider may be unknowing of the collection of information taking place.



[26]

[25] Figure 3.
[26] Figure 4.

3.1 Using the models in combination

Computer software and in particular computer games, are all about communication; and they use all these models in combination constantly and even have several of them going on at the same time.

Text on the screen, providing the player with the information of GAME OVER is very much allocution, most likely followed by a consultation asking “Do you want to start a new game” and if the player wishes so, then doing the action required to restart the game is then the information provided back from the games request.

During a game, a constant flow of messages is provided by the games information-centre as allocution through messages, they can be in all shapes from sound to visual, written or graphical all the way to physical vibration or feedback through controllers.
Alongside that, the game may register every movement by the player and use it in it’s internal matrix of code to plan ahead or simply use it to determine which text of allocution it shall now provide the player with.

This leaves us in a very peculiar situation, as the games registration of the players actions, unknown to the player, is then “secretly” used to send information back, creating a sort of hidden conversation between game and player, in the form of registration and allocution.

Registration is very common in modern games, and games use it as valuable information for their artificial intelligence systems in the game, which controls the behavior of any Non-Player-Character (NPC) in the game.
Registration in this example is what many would call Player Persona[27] [28], which is great for games to create a deeper experience for the player, creating a good profile of the player, which is the player persona, gives the game a better chance of foreseeing what will happen next. This can be used to make the game harder to beat, but certainly also to create a better experience for the player by adjusting itself.

Kumar and Herger’s example of the best way to gather information about a player, is to observe them in their natural environment. In this case, the natural environment being the character in the game, so the situation provided by the game is now the natural environment for that character whose behavior is controlled by the physical player.

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[27] Canossa, A. (2009). *Play-persona: Modeling player behaviour in computer games*. Unpublished PhD thesis, Danish Design School of Copenhagen, Denmark.
[28] Kumar, J. M., Herger, M. https://www.interaction-design.org/literature/book/gamification-at-work-designing-engaging-business-software/chapter-3-58-player (January 17. 2016)

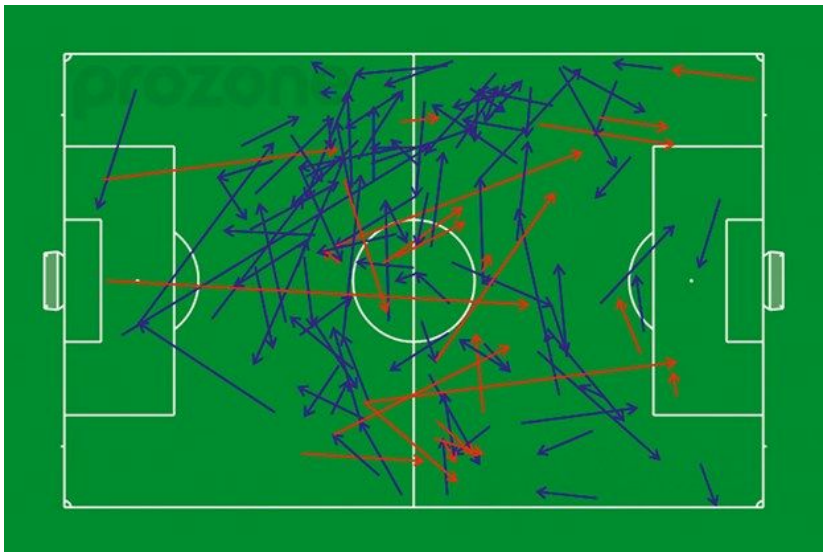
But the information gathered by the game may also be of a completely different nature, such as the game checking what else is on your hard drive, your physical location and more. A great example is from Metal Gear Solid[29] where the game would register which others games you had been playing and confront you with that information at a late stage in the game.[30]

3.2 The Constant Conversation

A game may be considered a constant conversation, created from the actions, player persona and everything from the player, registered by the game.
Various requests are made from the game to the player, asking the player to make choices and depending on the answer; the game could change the visual and audio experience provided as feedback to the player's persona and controls / movement.

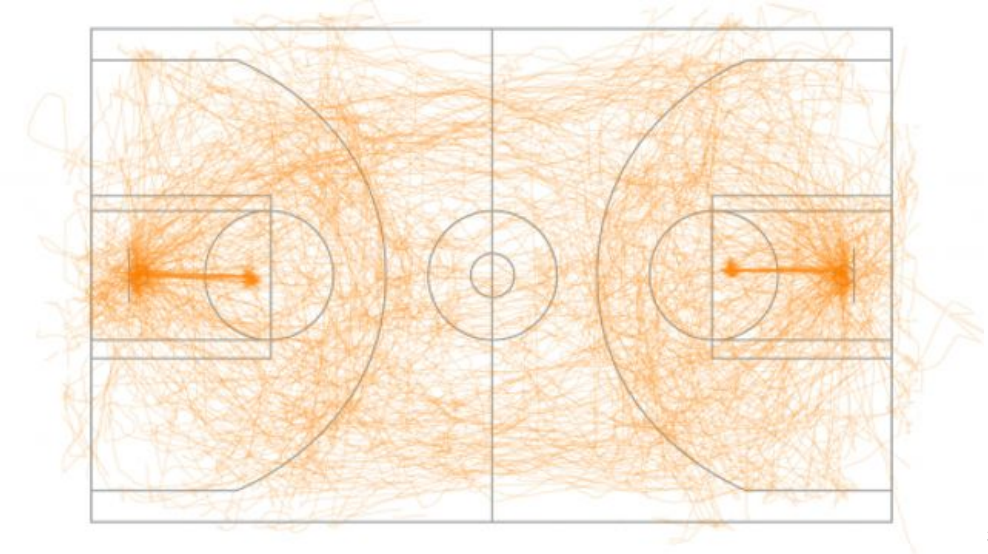
The constant consultation takes it form from the moment that the player steps up and starts the game, the player most likely being aware of any input he or she provides to the game through the controls, but unaware of the constant registration of other data going on under-the-hood.

This also goes on in the physical world and registration of almost everything is happening. Football matches player movement, actions performed and when by almost anyone involved in any setup is being tracked.

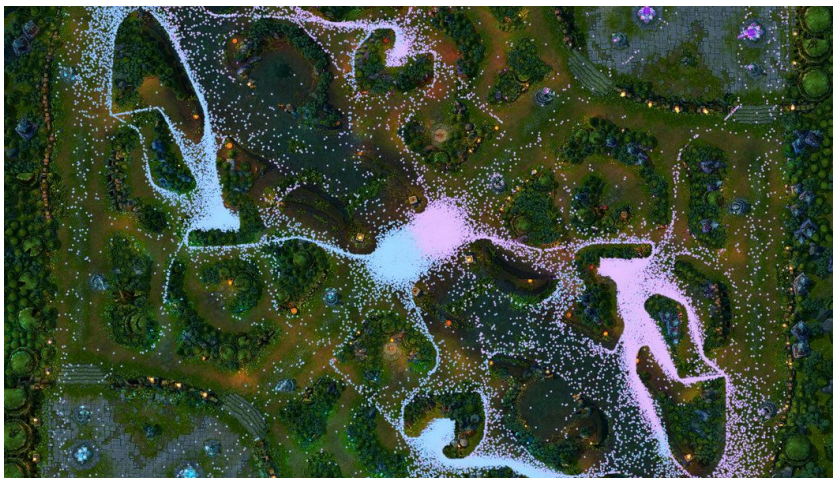


[31]

[29] Metal Gear Solid. (1998) Konami. Kojima, H. https://www.konami.com/mgs/
[30] http://www.wired.co.uk/news/archive/2010-04/01/the-10-meanest-tricks-videogames-ever-played-on-us
[31] http://www.wired.co.uk/magazine/archive/2014/01/features/the-winning-formula
The winning formula: is data analytics of player movement.



[32]



[33]

By tracking players like this, not only does the game get information about us, but as in these three examples, other people may also study this data.
They may even get a computer to analyze it for them and provide them with automatically generated suggestions as to how to tackle their opponent, thus making this an automated registration of data, then when consulted for the computed results generated from registered data the person or computer using this information later is now part of a constant conversation as they may have planned their next step, but so might their opponent making this a an more constant conversation.

[32] http://gizmodo.com/entire-nba-game-movements-visualized-1536754289
An entire game of basketball in the NBA tracked.
[33] http://www.nytimes.com/interactive/2014/10/10/technology/league-of-legends-graphic.html
An entire game of League of Legends shows player movement.

3.3 Game Communication model and The Constant Conversation

The previous points about the constant conversation and how everything is registered and a mish mash of all the communication models at the same time, it's time to bring it into the view of game design and feel. The game design communication models by Steve Swink prove excellent for this.[34]

Swink defines game feel into a few examples and the first one being *Real Time Control*; Real Time Control is interactivity between player and game and it requires at least two participants, regardless of the fact that one of them may be a computer.

As explained earlier in the Constant Conversation chapter, the player has intent or behavior which is expressed to the game through the user's input. That be both the willing controls of the player and his or hers character or object in the game or by the registered data collected by the computer.

The computer receives this information and treats it with it's internal algorithms and setups, thus creating an output which can then be provided back to the player.
The player may again perceive this output and respond to it, creating a new cycle of information between the computer and the player, therefore a conversation.

No matter the output of the computer or the player, either reaction to the other participants output will again become input to feed the cycle. Outside of the videogame this could be considered a normal conversation between two parties; one speaks, two listens; two thinks; two speaks; One Listens; etc.

Between people it would most likely be words that is used as both input and output, but because of immersion into the game and audio visuals provided by the game this may be perceived entirely different than a normal conversation between two people, therefore we cannot necessarily compare this straight up to a normal conversation that fits into the models of Bordewijk and Van Kaam, since they only provided us with individual models that does not take this form of multiple communication forms into account.

3.4 Conclusion of the communication models

I have mentioned and used all of Bordewijk and Van Kaam's communication models to show how these work both separately and when linked to each other. videogames utilize all of these all the time as mentioned and the combination of them all resulting in what I call the Constant Conversation shows how videogames and their communication with the player cannot be neglected as just a monologue

[34] Swink, S. (2009) Defining Game Feel. Game Feel, (pp. 1-33) Elsevier, Morgan Kaufmann.

and a one-way show to an audience, it is a constant conversation and use of all the techniques of communication, some obvious, some hidden.

Swink's model and writings about the subject, as well as my use of the term constant conversation creates a way to explain what is going on and how the computer may receive and respond to any information as it sees fit to deliver the perfect experience for the player of the game.

4.0 Informant diegesis, leitmotif and earcons in game design

As explained earlier, there is a constant conversation going on between the game code and the player. This means that there is a constant need for information to be passed on, in both directions, and if we limit that to only text or only graphics, we are missing out on an important factor; that of the fact that our ears and our sense of hearing is one of our primary and that it is constantly active.

With psychoacoustic phenomena like the cocktail party effect, the ear will self-adjust to the audible environment and leave out sounds with no important information.
In this case, it's the information that the ear and brain finds relevant, not what we as audio designers and game designers find relevant, therefore it is extremely important for anyone who is involved in developing videogames and in particular sound in videogames, to take into consideration that sound can never be monotonous, unless wanted, sound can never be repetitive without it being so on purpose.
The cocktail party effect may seem confusing to many, but there is a great reason for this in our everyday life "...spatial separation of sounds improves the intelligibility of signals in a background of noise or other voices.",[35] meaning that without this, our normal life would be difficult to cope with, because if everything was audible and part of the psychoacoustic soundscape in our brains, then it would be a mishmash and confusing, rather than informant of our surroundings and therefore not useful.

"The cocktail party effect is complex, and involves a whole range of factors. And, we can become aware of a steady sound if our attention is drawn to it ("listen to the fan")." [36]

If information is to be carried through a so-called earcon to the player, informing him or her about the situation of the game which can lead the player in the right or wrong direction on purpose or simply support the game design and give a better experience if taken into account by the player, then these sounds must be carefully selected and made perfect to do just that and avoid the human autofilter; which the cocktail party effect is a great example of. Guiding people is not an unknown subject within audio

[35] Wenzel, E. M. (1994). Spatial sound and sonification. In G. Kramer (Ed.), Auditory Display: Sonification, Audification, and Auditory Interfaces (pp. 127–150). Reading MA: Addison-Wesley.
[36] Moore, B. C. J. (2012) Email correspondence. Appendix: Email Discussions

design, malls and train stations have used plenty of music to guide their shoppers and commuters.[37] [38] [39]

"A repetitive pattern doesn't carry information, so the brain doesn't lose anything by ignoring regular patterns. It is very good at detecting changes or deviation from patterns" [40]

As Brian C. J. Moore points out in our chat from 2012, sounds are to be non-repetitive or at least have deviations from their patterns, for them to not become part of our autofilter and become almost non-audible. Or as others say, it is the ear's ability to adjust to our surrounding environment and tune in on the important parts and ignore the less important parts.[41]

As mentioned earlier, Earcons are sounds of nonverbal nature, which carries information. Also as said before, this is because verbal communication in itself is considered informant from participant to participant, no matter if it is a monologue or a dialogue, or more precisely a conversation, as also explained.

4.1 Games is a giant earcon

For a game to even exist, there must be game design and mechanics in it that makes the game play "fun". As I will touch upon, earcons in games are very important and an important factor to include in this, is that for an earcon, in a game, to be considered informant in the informant diegetic sense, and it can be plotted into the fields of direct or indirect informant then it must have a place in the games design content, not necessarily in a ludic, user created content, or ergodic sense, but as a part of the flow of information from the game's core to the player.

As said before, Earcons carry information nonverbally, and then we need a way to define the differences between verbal informations handed over to the player, it may very well be direct informant, as the information handed over is most likely directly in the words. But verbal information in games, could be anything, from the protagonist having a comment about the situation, but could also be the protagonist's voice with the function of a voice over, or a narrator voice over or it would be more precise to name that a sort of supervisor commentary, as this kind of voice often functions as a voice strictly used for information handed over in small comments and not so much a longer narrated explanation.

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[37] http://www.bbc.co.uk/news/business-35154100 (January 19th. 2016)

[38] http://www.thesoundagency.com/2012/julians-blog/music-is-not-a-veneer/ (January 19th. 2016)

[39] Treasure, J., McGregor, I. (Unknown specific year of publication) Music is not a veneer: The effects of music versus non-music soundscapes in retail. The Sound Agency, School of Computing, Edinburgh Napier University.

[40] Moore, B. C. J. (2012) Email correspondence.

[41] Pierce, J. (1999, 2001 MIT Paperback Edition) Hearing in Time and Space. In Cook, P. R. (Ed.), Music, Cognition and Computerized Sound. (pp. 90-91). MIT Press.

As Steve Whetman states in our email discussion, then games and film are much alike, and film may just as much as games have telltales and other cues that support the narrative, but this is different from this discussion, as I am not aiming at finding the similarities or explain how the same thing may be used in both film and games, I am explaining how certain sounds may be part of the game design and interactivity, which is something that the film cannot have. [42]

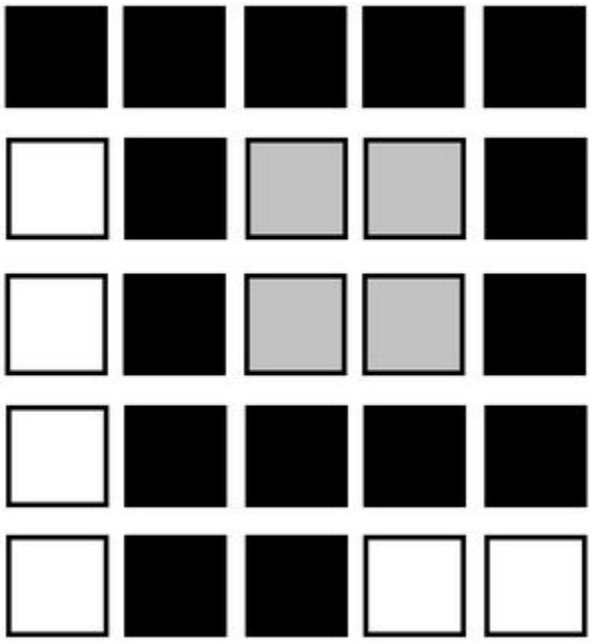
This could be as simple as the very old-school direction "trick" of setup and payoff,[43] [44] where one scene, sound or anything else serves as a way of grabbing the audience attention and then later at the payoff have the answer revealed. A setup in a game could be a sound that reveals the coming something, a so-called telltale sound and the payoff is when the object or answer to the sound appears.
One of the really good examples mentioned by Whetman is the three last bullets sounding different than the other bullets fired, which is a direct informant of that you are running out of ammunition or that it is time to reload. Also; this type of sound may be used in both film and games, the difference is that in games you make the decision, in a motion picture someone has already made the decision for you and edited the result of reactions in the scene. As Schreiber said, *"The When, is under player control".*[45]

Another simple earcon could be the use of footsteps to guide the player. In a later game example given there is only sound and the whole point is not to go into the water, therefore you must listen to the sound of your footsteps and in that particular game, your footsteps is practically everything you have since there are no visuals.

Footsteps used to guide the player can be explained like this; and the use of a so-called switch to make this work is explained later during the technicalities chapter, there is a constant knowledge in a game about where is the player located, not like a simple GPS coordinate, but it knows everything you want it to know. A common way of doing this is having a so-called map hidden from the view of the player, but with colors or values on it, which whenever the game needs it can check for this value. Color is a great way of getting a value, since you can with a simple 8 bit image file, which will take up practically no disk or memory space, can contain 256 different values per. pixel, meaning that the game and designer can use this to alter a sound in 256 different variations if wanted. The game object, that is the player's character has a so-called pivot point, and you simply check for the value on the map with the location on the map of the pivot point.

[42] Whetman, S. (2015) Email Discussion.
[43] http://www.stevenpressfield.com/2012/10/setups-and-payoffs/ (January 24th. 2016)
[44] http://thescriptlab.com/screenwriting/voice/connection/107-planting-and-payoff#
[45] Schreiber, I. (2013) Facebook conversation.

For footsteps it could be a fraction of a map like this:



[46]

This given example shows a row of pixels from a fictional game, some of the pixels are white, others are black while four of them are grey. We can setup our system so that white represents a wood sound, black represents a wood sound but with a squeak addon, so that you can hear that the floor is different there and the grey pixels are representing the sound of hollow wood. A similar example of dealing with materials and their way of providing values to a switch system is given by Jakob Schmid in our discussion about the subject. [47]

Most handymen and women will know that a hollow sound, means that there is space behind it. This could easily be an informant from a game where the point was to figure out where to dig for the treasure which is located underneath the floor or where to drill through the wall. The footsteps, the hollow knocking sounds, etc. are earcons, because they are nonverbal and they are definitely direct informant diegetic about the current locations status.
In the earlier Hitman games, an attempt was made to guide the player by using a combination of blinking lights in neon tubes and the sounds of these blinks, to show the path that would lead the player to the correct location. As well as helicopters in Kane & lynch[48] being audible at incredibly unnatural distance to warn the player of their arrival,[49] almost like the hand in Don't Starve which is mentioned later[50]

This will be discussed further in one of the coming examples as well.

[46] Figure 5.
[47] Schmid, J. (2015) Transcribed discussion.
[48] Kane & Lynch. (2007) IO Interactive. Eidos Interactive.
[49] List, S. H. (2016) Facebook discussion.
[50] Marteinsson, M. (2015) Email Discussion.

4.2 Leitmotif as informant

Leitmotif, is a term describing the use of, usually, music to be linked with specific characters, situations or objects in motion picture. The term is also used in literature, but in a different way which is irrelevant to this subject.
A simple explanation of the term could be “Symbolism in Music”, but in this section I will dig deeper into the term and explain how it can also be used for individual sounds in games.

There are many great examples of leitmotif in motion picture; the approach of the shark in Jaws,[51] directed by Steven Spielberg and brilliantly composed by John Williams has a simple two note melody playing whenever the shark is near the scene or will be approaching soon. Bob in Twin Peaks hiding behind the couch, which has a very unique sound playing just before the cut to the angle in which he becomes visible, a leitmotif of Bob. To many a leitmotif of being quite scared, the music for this was written by Angelo Badalamenti along with director David Lynch and served as a great example of how music in a tv-series or motion picture could be used to scare the audience or pre-warn them about the coming of the specific character, Bob. [52] [53]

Also, it is possible through “basic” manipulation of certain psychologists to make people think of certain things and also make them believe that they spawned the idea themselves, yet it was planted in their head, like Jan Hellesøe does in some of his manipulation experiments in his Danish TV program “Fuckr med din hjerne”, this would also mean that it would be possible to manipulate a person into relating a specific part of the music to a specific item without enforcing it and having the player or audience believe that they made the connection themselves.[54] [55]

John Williams contributed to many great soundtracks and with excellent leitmotif such as the Star Wars series.[56] Alan Silvestri also composed excellent music for be easily recognized with specific situations in the trilogy; Back To The Future.[57]
These compositions could easily be said to just be themes of the entire production, but because of their occurrences at very specific moments, then these are leitmotifs as well.
In Back To The Future, the theme is not only played during the intro sequence of the picture, but also at the specific situations in the plot, such as when the main character, Marty McFly, achieves the final objective of the story before he can progress or be “victorious”.

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[51] Jaws (1975) Spielberg, S., Williams, J. http://www.imdb.com/title/tt0073195/
[52] Twin Peaks (1990) Lynch, D. Badalamenti, A. http://www.imdb.com/title/tt0098936/
[53] http://www.filmmusicnotes.com/what-is-a-leitmotif-and-how-does-it-work-in-films/
[54] https://www.dr.dk/tv/se/fuckr-med-dn-hjrne/fuckr-med-dn-hjrne-4-8 (unavailable for watching)
[55] Schutze, S. (2015) Skype Discussion.
[56] Star Wars (1977) Lucas, G. Williams, J. http://www.imdb.com/title/tt0076759/
[57] Back To The Future (1985) Zemeckis, R., Silvestri, A. http://www.imdb.com/title/tt0088763/

The same goes for Star Wars; here the empire and famous character Darth Vader has a very known theme, known as The Imperial March.[58]
Luke Skywalker, another famous character in Star Wars, has his own theme, a leitmotif, which plays when he is either revealed for the first time or when he is involved in specific situations.

In video games, there is much more than just characters, situations and objects to have unique sound and / or music directly connected to them.
A great example is the videogame X-Wing, which is a videogame spinoff from the Star Wars film series, developed in 1993.

[59]

The game lets you play as a pilot of one of the iconic X-Wing fighters, as flown by the rebellion, in the series.
During game play, music much alike the original music by John Williams is played, but during battle and reinforcements arrive to support your opponent; specifically when the larger ships arrive to change the situation of the battlefield, the Imperial March theme is heard, giving the player a clear indication and non-diegetic direct informant diegetic about the situation.
This is the leitmotif of the imperial fleet approaching, just like in the film series, but in this specific case it is also a clear indicator of progression, change of situation and

[58] http://tvtropes.org/pmwiki/pmwiki.php/Main/Leitmotif
[59] X-Wing. (1993) LucasArts. http://lucasfilm.com/games

that enemies are inbound. More in this specific case it is a leitmotif and “theme” directly linked to an event which is closely linked to the motion picture theme of the Imperials, a sort of recognition link between the motion picture series and the game.

In a game this could be much more adaptive and changing, since music in games is often adaptive to the game's situation and could be the only adaptive part of the game to the situation, therefore becoming the leitmotif of that situation.
It could also be specific sounds which directly indicate a certain situation or that an objective is near.
The music in a videogame can easily be adaptive to the amount of progress towards a goal and it would be quite a simple setup; to make the game play either a specific tune or even a specific version of a tune just because of a choice made earlier or because the player is at a place where he or she is doing something right or wrong. The leitmotif of the progress in the game. This type of music is not a necessity, I am simply stating it’s possibility of existence.

In the game that I am working on right now, HITMAN, music changes depending on the situation of the player and the technical specifics of this will be explained later, the player can be in situations where there is no danger at all or the game is crawling with danger. The player might also find the protagonist being in a situation where he or she is hidden in the correct way, but is approaching a situation where the current disguise is no longer valid to cover your moves, making this the leitmotif if the insufficient disguise or vice versa.

As explained, any sound and part of the music in a game can be an informant and part of the constant conversation, thus giving every sound in a game the ability to function as a leitmotif. Leitmotif may be an old term and primarily used with music, but I see no need for making a new term, since the combination of leitmotif and informant diegetic works fine, as it is important to notice the use of the term leitmotif, but not necessarily label everything as a leitmotif, but recognise that in a game, every object and sound may have the purpose of the leitmotif as used in motion picture. Not only does music and sound in games support the narrative as they do in motion picture but they take part in the constant conversation.

It’s not just that music or sound can be a leitmotif that is relevant; it is the acknowledgement of the fact, that in videogames, any object in the game, situation or mechanic can be combined with the music and the soundscape of the game to push forward game information and aesthetic and narrative information. The leitmotif of the enemy being nearby, be it music or a sound, even a diegetic sound from a the object or character, the purpose is still the same.

4.3 Examples of earcons, leitmotifs and informant diegesis

Earcons, iconic sounds and leitmotif are all terms that have been coined to label certain sounds or music as how they fit into the soundscape of a medium, how they support the narrative, but they are all created for the linear medium of motion picture and therefore it is important that their use in videogames is explained, some of this explanation we have just gone through, but we need concrete examples.

Earcons are labelled as non-verbal carriers of information, for a motion picture that could simply be the sound of an acousmatic gunshot, to symbolize that the war or battle has started. Iconic sounds are iconic to a character, meaning that they are to sound objects what leitmotif is considered to music, as leitmotif is a term used to describe parts of the musical composition specific to a character, situation or object as explained earlier in this chapter as well.

The two note of E and F to symbolize the approach of Jaws, in Jaws, is a perfect example. But in videogames it can be much different, since the approach of danger might not necessarily be part of the musical score, it may just as well be a sound or a voice that can be diegetic or non-diegetic to indicate the danger or the coming of a peaceful area in the game.

In the Uncharted series, which will be discussed in this thesis as well, the "exit-combat stinger" that is played when the last opponent has been shot, clearly indicates that the player is now safe, therefore it could be set to be an earcon of nonverbal information because it carries the information about the state of the battle. It is also iconic to the situation, that is the end of the battle, but also could be labelled as the leitmotif of the same or the leitmotif of the end of this chapter or leitmotif of the progression. Definitely not an unknown phenomena in games, to use a sound to indicate the end of battle, as it is used in a lot of games and even mentioned in commercial videogame journalism, meaning that it is relevant to fans, and of interest of fans of games, which is equivalent to being extremely common knowledge in the game development world.[60]

4.31 Diablo II

A great example is Diablo II, with a voiceover that is seemingly the voice of the main character, but it functions just as much as a guide of simple information being handed over.
Information such as: "I am overburdened", "Not enough mana", and so on. All which is information handed over directly to the player in the form of verbal communication, as there is no immediate graphical indication that either is the case. You have a graphical HUD in the game, where you can see your amount of mana, but there is no

[60] http://www.giantbomb.com/victory-gong/3015-4743/ (January 17th, 2016)

special indication of it being low when trying to trigger a spell when you are low on mana and therefore cannot.
It is unsure if it is the voice of the character, it most likely is, but you will never know if it is said directly from the visual character or if it is a voice over, therefore no way of determining if this is a diegetic, internal, external or a non-diegetic voice. By definition a voiceover would be nondiegetic.

So if an earcon is nonverbal, what could this be then?
It may certainly be determined as acousmatic, since it's in the grey area of being non diegetic, but could quickly be revealed as diegetic, but it could also be classified as a thought from the character which would make it an internal diegetic sound. In either way, it is direct informant diegetic as well, placed at the very top of my informant diegetic model because of it's informant purpose.

This is important information while playing the game, and therefore goes well in hand with Whalen's notice of that sounds like this, is enriching the player's experience and is essential to the player's progression through the world.[61] This could be cross analyzed with Karen Collins Discussion of the interactive, adaptive and dynamic in games, yet she speaks mostly about music. This could be considered a, what she calls an, interactive diegetic or non-diegetic sound, depending on how this specific incident would be placed on the diegetic scale; As they are produced as a result or is directly derived from a player action, but is or is not part of the diegetic soundscape of the game.[62] The sound may be triggered when the player pushes the correct button to pick up an object, but we can't say if the sound is triggered by the button press or is a result of trying to add the object to the player's inventory, which then returns a false result, that triggers the actual audible sound.

The use of a voiceover to inform the player of the protagonists inability to carry any more items is according to Wenzel,[63] a much faster way of handing over information than any visual cue, without saying that a visual cue isn't useful, only slower and could be confused or misunderstood when performed, especially in games like Diablo II which is of an age where graphics were not in very high resolution, meaning that an item being thrown in the air wouldn't necessarily be understood as the inability to carry more of this type of obj
"The combination of veridical spatial cues with good principles of iconic design could provide an extremely powerful and information-rich display that is also quite easy to use." [64]

[61] Whalen, Z. (2004) Play along -- an approach to videogame music. *Game Studies, 4*(1) February 20, 2005, http://www.gamestudies.org/0401/whalen/
[62] Collins, K. (2007). An introduction to the participatory and non-linear aspects of videogames audio. In S. Hawkins & J. Richardson (Eds.), *Essays on Sound and Vision* Helsinki: Helsinki University Press.
[63] Wenzel, E. M. (1992). Localization in virtual acoustic displays. *Presence, 1*(1), 80–107.
[64] Wenzel, E. M. (1992). Localization in virtual acoustic displays. *Presence, 1*(1), 80–107.

4.32 Uncharted series[65]

The Diablo II example is very different from the voice in Naughty Dog's Uncharted series. With the main character; Nathan Drake, almost constantly having a comment on his current situation, but this is not at all informant. You never really get to see the characters lips moving so it is up for debate whether it is a voiceover or a normal diegetic voice from the character, but I would say the in the case of Uncharted, it is a diegetic voice.

In example, Nathan Drake (the main character) says “A tank? What would they need a tank for?” when you get to a point where a tank is actually relevant to the situation you are in and he has many more, rather humorous, comments throughout the game. This voice is also enriching the players world, as pointed out by Whalen, but is not in any way helping the player progress, it is part of the narrative and the core of the game, being part of the humorous approach to any situation that the protagonist may find himself in.

On a completely different note, but still in the verbal diegetic sense of the Uncharted series, the player can gain a massive advantage in battles, by listening to the shouts from the NPC’s when they are reloading; as they once in awhile will shout out information about their ammunition situation.
“I am reloading”, “Reloading”, “I’m out of ammo”, and more is being said constantly when in battles. Such a shout out from the NPC’s regarding the ammunition situation would be entirely of an informant nature, giving an advantage in battles of when they might not be firing for a brief moment. Mentioned earlier in the discussion of leitmotif, I do believe that leitmotif is a musical term, but if you are a bit loose on the term and use it as I also mentioned it could be, then these shout outs of information to the player, could be that specific game mechanics leitmotif, like using the term as an overall term, where it in motion picture was a way to symbolize a situation or character in a unique way, here it is possible to “symbolize” a unique situation, that of the enemy being out of ammunition and you are able to fire now with less risk involved.

This leaves us again at the discussion of; if an earcon is nonverbal sounds of information, then as what can we label this kind of verbal information then?
That is why I have designed the Informant Diegetic model and created the term for this, specifically to be able to label any sound in a videogame (or interactive medium or installation for that matter) as an informant, regardless of its diegetic nature and describe any sound as how it is informing the player and helping the player in his or hers progression through the game and hopefully enriching the player's experience and immersion into the game world, as mentioned earlier from Whalen.

[65] Uncharted 1,2,3 and 4 (2007, 2009, 2011 and 2016), Naughty Dog, Sony Computer Entertainment America. http://www.unchartedthegame.com/en-us/ . http://www.naughtydog.com/games/uncharted/ .

4.33 Bioshock[66]

Bioshock is a videogame developed by Irrational games / Take-Two Interactive, lead by game director Ken Levine.In Bioshock it is possible throughout most of the game to gather lots of information only by listening. The “Big-Daddy” as shown in the image with the game is audible far away from his actual position in the game.

The purpose of the Big-Daddy, is to defend the character called “little sister”, who is also depicted in the image.
Before even meeting such a big daddy, or when you meet a new one in the game, the very loud and clear footstep sounds of the big-daddy is audible, this being a very distinct and unique sound for the character, along with a very characteristic humming sound, this could be said to be the non-musical leitmotif of this character, which by definition is then an iconic sound to this specific character.

The sound is very much diegetic and informant, but when the big-daddy is not in the scene and not engaged in combat with you, the sound is not irrelevant as you need to know that it is nearby, but it might be acousmatic as the source is hidden from your view as well as being in another part of the level which you cannot reach at the moment, therefore the leitmotif of the big-daddy. being the sound of the footsteps and the humming sound is supporting narrative and atmosphere as long as being informant to the player.

Usually these sounds would mean that the player should watch out, as combat with these is not an easy task.

[66] Bioshock. (2007) 2K Boston and 2K Australia. Take-Two Interactive Publishing.

 [67]

The little sister, has a high pitched manipulated voice, which is also audible quite far away from the actual character and is also extremely useful as she plays a big part in, not only the story, the game's key mechanics, which is to either kill her or rescue her, to obtain a substance called ADAM, which is equivalent to XP Points.

Bioshock also contains a generic NPC, which is called a “splicer”. This character is the common enemy of the game and you get to fight a lot of these, in many cases before meeting them you will be able to hear them.
In most cases you will be able to hear them speak to themselves and mumble stuff, which is quite important in the support of the narrative of the game, but it is a clear indication of danger being nearby and therefore you must tread more carefully when these voices are audible.

All these sounds could be considered the leitmotif of all three characters, but as mentioned before leitmotif is a term we should avoid using when it comes to voices or sounds and that is where the use of iconic sounds comes in, as an iconic sound is a statement of a sound being iconic to a character, unique to a character or situation and these sounds are very much so. An iconic sound of a specific character, if it is important to know where these are located then the very definition of an iconic sound becomes an informant diegetic sound.

[67] Bioshock, depiction of a, so called, “Big-Daddy” and a little sister. http://de.bioshock.wikia.com/wiki/Bouncer

Therefore I must conclude that iconic sound or the earcon of the big-daddy, his leitmotif, can in this case be called informant because of the need to know of the characters location, but if the location of the character was irellevant to the game's progression, then an iconic sound is not necessarily informant.
As Wenzel explains, then knowing the location of a sound is irrelevant if it carries no informant cue or if the player is unable to interpret the information carried in the sound itself. [68]
As I mentioned earlier in the Steve Whetman comment, then this game example is great to show the differences between all this, because the sound of the Big-Daddy's footsteps, could be the leitmotif soundscape or the iconic sound of the Big-Daddy which is informant diegetic because it reveals that such a character is near and you need to pay attention to that.
This could also be considered a telltale in the filmic sense, since it is a sound that is revealing something about this object, though the term Telltale is much broader and could be anything and something as simple as a small clip that shows the temperature of the room, which might later be relevant to understanding the situation.

4.4 Conclusion on earcons and leitmotif in games

I have discussed various situations where the term earcon and leitmotif is useful, but because of the verbal nature of the sounds in question, when speaking of earcons, then the term is "invalid" for this.
Games, because of their constant conversation process as mentioned earlier, need earcons as a tool to continue this conversation without the use of words, but if the conversation is actually continued through words being expressed as speech, then we need to label these as informant diegetic, regardless of dynamic, interactive, adaptive or iconic state, as these are terms that describes how the sound is played back or it's reason to be played back, but doesn't not fit when explaining if the sound is informant to the players state of play and helps the player to progression.

Games may use all the same definitions as motion picture does, telltales, setups, payoffs, iconic, dynamic, etc. the difference is that in games they are part of the constant conversation where as in film, they will be part of the monologue from the screen to the audience, they may have the same effect, but in games you have the ability to respond, whereas in motion picture, you do not; at least not physically, but you may of course respond emotionally. Again as Schreiber said, *"The when, is under player control."*[69]

[68] Wenzel, E. M. (1992). Localization in virtual acoustic displays. *Presence, 1*(1), 80–107.
[69] Schreiber, I. (2013) Facebook conversation.

5.0 Mickey Mousing, isomorphic music, In videogames

Mickey Mousing and leitmotif can be said to go hand-in-hand, the use of Mickey Mousing in any part of a musical score to moving images can be easily "mistaken" for being the leitmotif of any action in the frame.

"Another example of close coordination between screen movement and sound comes in the animated films of Walt Disney in the 1930s… This non dance matching of movement with the music in fact came to be known as Mickey Mousing".[70]

"The close synchronization of music to action is called Mickey-Mousing, a term coined by David O. Selznick to describe music in Disney cartoons where dancing skeletons play their rib cages accompanied by xylophones, etc.
A notorious example of Steiner's "catching" action musically was the two-note "crippled" motif for Leslie Howard's limp in of Human Bondage. "Mickey Mousing" triumphantly suited the animated protagonist of King Kong with descending chords "Catching" the massive tread of the approaching ape.'[71]

Some use the expression *Isomorphic* about the same issue, also in some forms about diegetics, but isomorphic covers a much larger ground, as explained by Scott Curtiss[72] and Theo Van Leeuwen.[73] Curtiss uses isomorphic and iconic to describe sound effects and music in cartoons; *"If isomorphic relations refer to those governed by rhythm and movement, then iconic relations pertain to analogous relationships between visual events and the timbre, volume, pitch and tone of the accompanying sound."*

In videogames this is slightly different, since in motion picture or animation film it is often used to describe music that is closely synced to the moving images or images synced to the music. A good example could be a character's footsteps being played in a steady rhythm, synchronized to the beat of the music.
This has been extended into musical interaction in many a videogame, the greater examples is of course Guitar Hero and DJ Hero, Rock Band and other guitar and musical instrument simulation games are also to mention, but let's keep it to the "hero" name of the games. Another interactive music game Mickey Mousing / Isomorphic example is 140, a platformer game, the player cannot alter the music but must use the music's beat to understand the logic behind the level changing. [74]

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[70] Bordwell, D. Thompson, K. (1985) Fundamental Aesthetics of Sound in the Cinema. In Weis, E. Belton, J. (ed) Film Sound, Theory and Practice. (pp. 189). Columbia University Press
[71] Handzo, Stephen. Appendix: A Narrative Glossary of Film Sound Technology. (pp. 409-410). In Weis, E. Belton, J. (ed) Film Sound, Theory and Practice. Columbia University Press.
[72] Curtiss, S. (1992). The sound of early Warner Bros. cartoons. In R. Altman (Ed.), *Sound Theory Sound Practice* (pp. 191–203). New York: Routledge.
[73] van Leeuwen, T. (1999). *Speech, music, sound*. London: MacMillan Press.
[74] 140. (2013) Carlsen, J. Schmid, J. Indie Release. http://game140.com/ http://store.steampowered.com/app/242820/

SSX[75] and other snowboarding games have had success with changing the frame rate of the visuals to always be in sync with the music, so after making a jump and a trick in the game, the frame rate of the visuals would be either lowered or increased slightly to make sure that the player would always land safely on the beat, so that the game would never lose its rhythm. This is of course not related to the interaction between player and music, but it is still an attempt to keep the rhythm of the game and the rhythm of the music closely related, therefore this could be argued as a kind of gamified Mickey Mousing.

Patapon[76] is another great example, where the music of the game and the beat of the music is in direct relation to when the player must press specific actions. These games are often spoken of as rhythm games.

In Guitar Hero[77], DJ Hero[78], Band Hero and Rock Band[79], the main genre is still to be named rhythm game (party games also apply, but that is not to be considered important for the subject at this time) the aim of the game is not to have visuals and sound to sync up, it is more the aim to sync player actions to the sound and visual; Player strive to perform a series of movements on a guitar shaped or other similar musical instrument replica controllers.
The players actions cannot alter the sound of the music or visuals being played back as they are strictly in sync, which makes it different from SSX and other games, where the rhythm of the music and sound is set, but the visuals may be altered to constantly be on the beat.
In these games it's about the players actions to fit the beat, therefore sound and visuals are constant.

So how do we deal with this new level of interaction between music and vision; when, unlike in motion picture, a videogame may alter the timeline for any of the aspects involved, be it either the sound, the visuals or the player's actions.
In the actually considered rhythm games here, which puts SSX in a different category, the only part of the music being useful is the beat which can be used to know when to strike the "chords" on the controller, but as I will approach later, this is a rhythmic sense and not necessarily a sound which is directly or indirectly informant, as it is not linked to a variable game parameter.

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[75] SSX, first released October 2000. by EA Sports. http://www.ea.com/uk/ssx
[76] Patapon, first released in Japan 2007, by SCEJ (Sony Computer Entertainment Japan). http://www.gamasutra.com/php-bin/news_index.php?story=23197 and http://us.playstation.com/games-and-media/franchise/patapon-franchise.html
[77] Guitar Hero. (2005) Harmonix, Activision. https://www.guitarhero.com/ as of 2015 a new version of the game was released. Original game was released in 2005 and developed by Harmonix, with numerous follow ups by other studios. Band Hero is from the same developers, but with more instruments to play.
[78] DJ Hero. (2009) FreeStyleGames. https://www.activision.com/games/dj-hero/dj-hero-2
[79] Rock Band. (2007) Harmonix.

But a different way of approaching this could be that this is such a unique example, that this type of rhythmic and beat oriented sound in videogames, could be named Mickey Heroing, as it is close to the old Mickey Mousing concept, but still part of the interaction with the player.

But earlier when I mentioned that Mickey Mousing could also be called Isomorphic or Iconic, Scott Curtiss came very close to what I mean about Mickey Heroing, as his mentioning of Iconic sound being the relation between visual events and the sound itself, then in Guitar Hero and these other games mentioned, the actions performed by the player could be said to be in direct relation to anything iconic coming from the game, in the form of graphics and sound.
Curtiss also speaks of film sound theory, the medium being beside the point here, that Live-action films use sound where there is a direct relation between the sound and the object, meaning that there is a direct relation between any graphical element in the game and any sound being played back. Curtiss calls this *indexical* sound.

Also explained very well in Karen Collins paper on the participatory and non-linear gameplay of videogames[80], with high emphasis on music in games, Collins points out that there are several ways of categorizing these kinds of sounds and / or music in games. She describes well; for a sound to be adaptive it reacts to the players controls and can perhaps even anticipate player controls to a certain degree. That goes very well in hand with my mentioning earlier of SSX Snowboarding game having graphics that synced to the music instead of being the other way around. This is also supported by my discussion with Andrew Barnabas; even if a game is on rails, 100% linear in narrative, the game can only come closer but never fully become as linear as a film, it will still contain the odd timing because of the interactivity based on player actions that cannot be predicted.[81] Niels Bye Nielsen agrees by saying that film music is an organic change from frame to frame, but that game music is inorganic and must be able to change at any given moment to any other given moment in the score without having abrupt transition.[82]

Collins notes that adaptive audio combined with player interactivity should be noted as dynamic audio, which is quite a broad term to label it I believe, but none the less works well when describing this kind of connection between game, play and player through interactivity and adaptivity in the music and sound.

In Guitar Hero and other of the other rhythm games here, there is a direct relation between the music being played back, the visual notes on the screen which are scrolling towards a line, at which the notes must be triggered correctly by the

[80] Collins, K. (2007). An introduction to the participatory and non-linear aspects of video games audio. In S. Hawkins & J. Richardson (Eds.), *Essays on Sound and Vision* Helsinki: Helsinki University Press.
[81] Barnabas, A. (2016) Phone Call Transcribe
[82] Nielsen, N. B. (2016(Skype Conversation

controller in the hands of the player in order to have the musical playback continue correctly, which is the point of the game.

It's Rhythmic Based Triggering, and could be compared to other games where the key is often to avoid the oncoming objects, at which it would be Timing Based Avoidance or Vertical Scrolling Avoider. Triggering at the correct time, also triggers the timeline to continue and allows the music to continue without interruption, thus allowing the isomorphic music, the mickey mousing of the game, to continue uninterrupted. According to Collins (p. 1-3), then these are Interactive Diegetic Sounds, produced directly as a result of the players actions and they are part of the diegetic soundscape of the game, but in the case of Guitar Hero, she mentioned the use of the term Gestural Interaction, which is a very correct way of labeling this kind of game, as it is gestures by the player's hand that controls the game, the game mechanics and the soundscape of the game, a direct form of sonic interaction, as Collins calls it. Some games even allow levels to be built upon the music track that the player introduces into the game, such as AudioSurf, which then creates an entire level out of the measured beats and score, making this creating a level on the fly and not a level designed, like in Guitar Hero or similar, to be of a certain difficulty. [83] [84]

5.1 Conclusion of Mickey Mousing

Using sound and music as a tool to keep a rhythm going is a thing in videogames, in an animation film, the use of isomorphic / Mickey Mousing may be a way to synchronize the music and the visuals, but in videogames it may become part of the game design itself if it is necessary for the player to trigger objectives in this rhythm.

As Collins state, naming this as Gestural Interaction means that the music becomes part of the players controls and something that needs a response, where in motion picture and animation film, the reaction whatever it may be that is synchronized to the rhythm, is impossible for the audience to change.

Surely Mickey Mousing was also invented to begin with because it was easier to record a score like this, rather than editing single sounds for the entire production.

If the music, isomorphic / Mickey Mousing or any other form or rhythm in this category is so closely linked to the interaction with the player, surely there is a form of informant diegesis involved.

[83] Schreiber, I. (2013) Facebook conversation.
[84] AudioSurf. (2008). Fitterer, D. http://www.audio-surf.com/

6.0 Informant Diegesis

Informant diegetic is a term and theory I have been working on for quite some time. I have used Gordon Calleja's model[85] [86] for Game Involvement, and with this model of immersion and player involvement, I have replaced the various immersion and involvement points which were micro and macro involvement, and within those Tactical, Affective, Narrative, Performative, Shared and Spatial involvement.

The shape of the model and some of the subjects I discussed with Gordon Calleja, while I was a student at the IT University of Copenhagen, led to the creation of this Informant Diegetic Model.

Earlier I explained how videogames, in particular, make use of a lot of terms, previously used for more linear media or communication models meant to be used on their own. Videogames melt all this together all the time meaning that a sound which is Non-Diegetic, can in the next frame be Diegetic, we do have the grey area of acousmatic to cover that, as explained brilliantly by Michel Chion.[87] Acousmatic covers the area of sounds that are diegetic but with a hidden source or an unrevealed source, such a sound later being revealed is called; "acousmatized". One could say that it had then been diegetic from the very beginning, but these grey areas must be covered, just as well with diegetic sounds being internal and external, meaning that if there is no visual representation of the sound, but it is coming from the main character or an event that is part of the action of the frame, then it is internal.

"We need to distinguish between internal and external diegetic sound… Non-diegetic and internal diegetic sounds are often called sound over because they do not come from the real space in the scene". (Chion)

"Sound may be diegetic (in the story space) or non-diegetic (outside the story space). If it is diegetic, it may be on-screen or offscreen, internal ("subjective") or external ("objective"). One characteristic of Diegetic sound is the possibility of suggesting the distance of its source. Volume is one simple way to give an impression of distance. A loud sound tends to seem near; a soft one, more distant… In addition to volume, timble may suggest the texture and dimensions of the space within which a sound supposedly takes place. In the Magnificent Ambersons the conversations that take place on the baroque staircase have an echoing effect, giving the impression of huge, empty spaces around the characters. The skillful

[85] Calleja, G. (2007), September 24—28 *Revising immersion: A conceptual model for the analysis of digital game involvement*. Paper presented at Situated Play, University of Tokyo.
[86] Calleja, G. (2011), In-Game : From Immersion To Incorporation, (pp. 33-148). MIT Press.
[87] Chion, M. (1994). *Audio-vision: Sound on screen* C. Gorbman, Trans. New York: Columbia University Press.

filmmaker will pay attention to the quality of the sound, taking advantage of the possibilities of variation from to shot shot".[88] [89]

This making thoughts subjective and actions objective.

6.1 An informant diegetic sound

By an informant sound, I mean a sound that carries information to the player, which is generally considered to be named an earcon or trans-diegetic.
Earcons are *"nonverbal audio messages used in the user-computer interface to provide information to the user about some computer object, operation, or interaction."* [90]

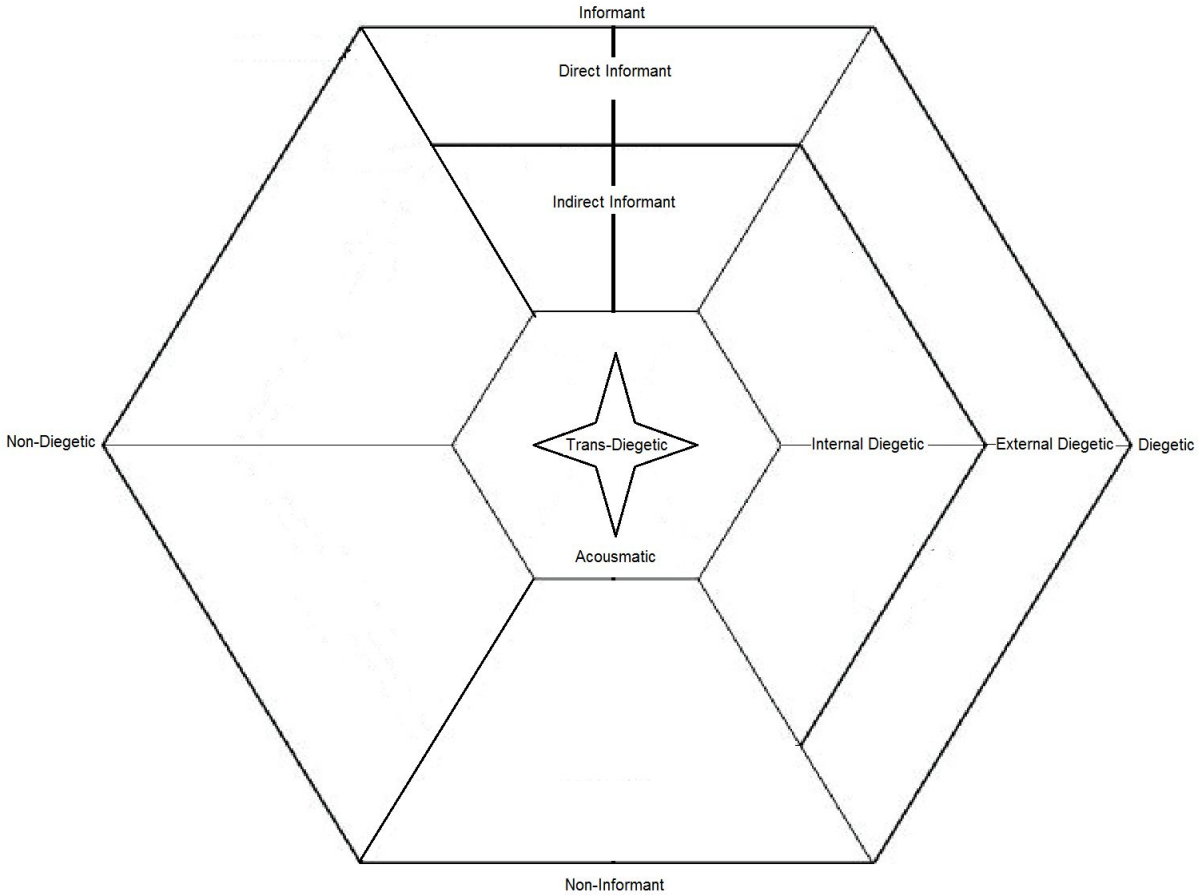
Earcons being nonverbal, because of verbal communication to begin with is informant of nature. The ability to make noises and hearing is part of humans and animals vital abilities to survive, alarm and be alarmed.
In my examples here, then dialogue of a game doesn't necessarily have to be informant diegetic, but earcon is the term to use if information is delivered in the form of a sound.

A sound can be informant regardless of its other types of diegesis, but a sound cannot be informant diegetic alone, as it is an added diegetic term, therefore a sound must also be categorized in the normal context of diegesis for it's informant diegetic parts to be labelled.

Informant diegetic sounds can be used in a lot of different games, but some games don't need to use audio as a cue and such constantly have either none or only indirect cues which may be linked to the game's code and adaptive to certain situations; but all the information that you need otherwise is provided in different ways. Games with stealth often use this, because it is important to know where your opponent is at all times, even something as simple as small volume changes because the sound emitter is further away can become informant if the player needs to know a distance to opponent.[91]

[88] Bordwell, D. Thompson, K. (1985) Fundamental Aesthetics of Sound in the Cinema. In Weis, E. Belton, J. (ed) Film Sound, Theory and Practice. (pp. 181-199). Columbia University Press
[89] http://filmsound.org/terminology/diegetic.htm
[90] Blattner, M. M., Sumikawa, D. A., & Greenberg, R. M. (1989). Earcons and icons: Their structure and common design principles. *Human-computer Interaction, 4*, 11–44.
[91] Schreiber, I. (2013) Facebook conversation.

6.2 The Model



92

The model here is designed to be plottable, so that any sound can be plotted into it at any given moment in the games timeline and then indicate what type of sound we are dealing with. Since sounds are usually continuous over several frames, this is only valid from moment to moment and not on a frame to frame basis.

Leaving space for a sound to be marked as acousmatic, and not all the way to non-diegetic, a clever way of expressing a diegetic sound with a hidden source, which could be seemingly non-diegetic, but because of it's later reveal or obvious hidden source it is categorized as acousmatic; and transdiegetic if the source of the non-diegetic sound is revealed and has the ability to shift between any of the diegetics. Transdiegetic also covers sounds or music that can connect the game or film to the player or audience, Jørgensens definition does cover that music can give a sense of pre-warning of danger, but it does not explain how the information is provided, whether directly or indirectly; which is one of the key differences between trans-diegetic and my informant diegetic counterpart.

[92] Figure 7.

Transdiegetic covers if sound can shift type of diegesis, meaning that if a non-diegetic sound becomes diegetic, but since acousmatic may be diegetic but with an unknown or constant unrevealed source and transdiegetic crosses over from either type of diegetic to the other, which is one of the key components in the use of my term informant-diegetic, as this expression can be constantly trans-diegetic between multiple forms of diegesis.

Transdiegetic can therefore be used as a descriptor of the transition between informant and non informant states or moment within the same sound or music, meaning that a sound or music can shift from having a connection out of the medium to the player or audience to not having one.
Trans-diegetic has also been described as music which may be non-diegetic, but may still inform the player of events in the game, but I believe that trans-diegetic is not only limited to music, it may also be sound effects.[93]

Internal and external diegetic sounds have a wide area to be plotted in, since they can only be diegetic, but both informant and non-informant sounds.
The function of this subterm to diegetic, is to define the grey area between sounds that are coming from any character in the scene, but may not be visible in terms of lips moving, this could be thoughts from a character; audible but not visible, creating an internal diegetic voice and vice versa if the voice is both audible and visible, or part of the current action of the frame, making it external diegetic.[94]

It is important to state that for using the model correctly, any sound plotted into the model must have both a horizontal and a vertical value plotted. This means that a sound cannot be informant diegetic alone, it must also be clearly stated what kind of "regular" diegesis that is the state of the sound. This should clear the misunderstanding about an informant diegetic sound; that this label of the sound does not mean that the sound is diegetic per se. [95]

The correct plotting of the model and labelling of any sound could therefore only be:
An external diegetic, direct informant diegetic.
A non-diegetic, non-informant diegetic.
An acousmatic, indirect informant diegetic. etc.

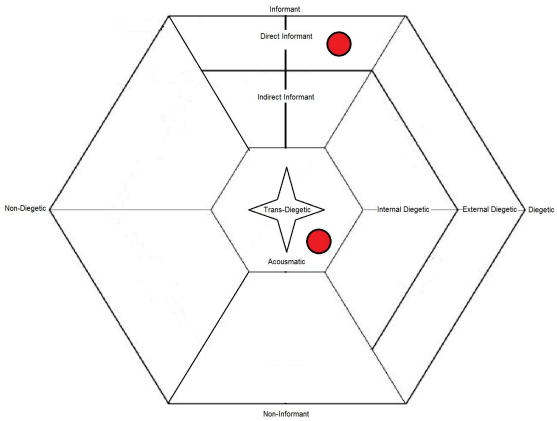
[93] Jørgensen, K. (2007). On transdiegetic sounds in computer games. *Northern Lights, 5*, 105–117.
[94] Bordwell, D. Thompson, K. (1985) Fundamental Aesthetics of Sound in the Cinema. In Weis, E. Belton, J. (ed) Film Sound, Theory and Practice. (pp. 181-199). Columbia University Press
[95] Jensen, J. B. (2016) Email discussion. - Clearing up the misunderstand about an informant diegetic sound, not per se being diegetic, but could be any other label of diegesis as well.

6.3 Examples

Examples here show how the model should be used. Marking a sound in it's correct spot or spots will define what type of diegetic sound and music it is.
A spot in a corner section can cover two sections at a time.

6.31 Example one

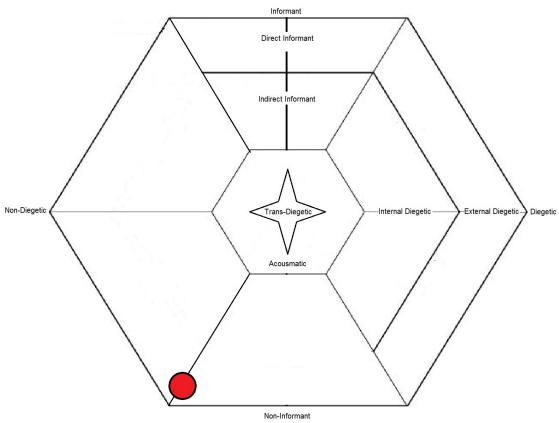
Radio noises in EVE Online that reveal information about sites in the game that can be explored. Their source is never revealed, but it is coming from the radio of your spaceship that can never be seen, thus making this an acousmatic sound and a direct informant.[96] This specific example will be explained in detail later in the chapter about my own games.



[97]

6.32 Example two

Music that does not appear for any reason other than the aesthetic, no manipulation in mix or playback from the game code in Neo Scavenger.[98] [99]
Not to be confused with that the sound has no value, it is just in the narrative and emotional sense that it does, therefore it is labelled like this in the informant context.

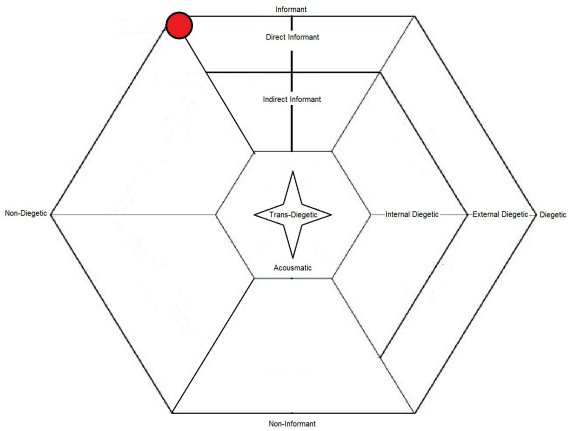


[100]

[96] EVE Online (2003) CCP Games. Bjørn Jacobsen Audio Design (2013).
[97] Figure 7.
[98] Neo Scavenger. (2014) Blue Bottle Games. Daniel Fedor. http://bluebottlegames.com/main/node/2
[99] Fedor, D. (2015) Mail Correspondence.
[100] Figure 8.

6.33 Example Three

Music in Super Mario, source is completely unrevealed and is defined as pure background music thus making it non-diegetic, but the music changes when events happen, such as; When time is running out and Mario or Luigi becomes invulnerable for a brief moment of time.



[101]

6.34 Example Four

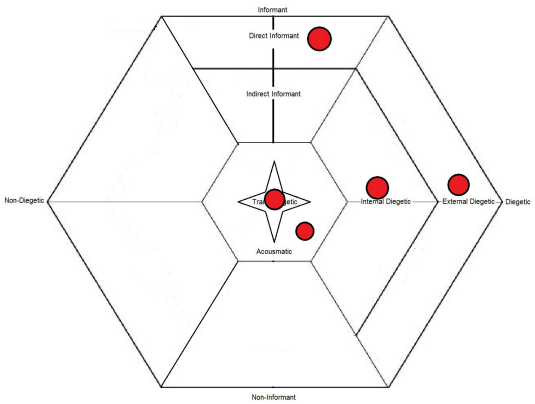
Radio music and voiceover in Fallout 3 and 4. The music in the radio will stay the same and is seemingly non-diegetic, but because of its origin being the protagonists arm-radio (the pip-boy) the sound is diegetic, but the source is hidden from the player's view at all time, therefore it is also acousmatic.
The source may be revealed from time to time, to also appear from an actual radio in the level, if the player approaches one or turns it on in the game, which acousmatizes the sound many times during game play, but the source is hidden again once the player leaves an area without an object which plays it back or does not have his or hers pip-boy activated in the view.

When the player is moving around in the world the radios source is hidden, also making it internal, but when revealed it is external.
Depending on which radio station the player is listening to, the host of the radio show playing will announce events around the world, giving a retrospect of some of the events that has happened in the game, but at the same time perhaps ask for help or reveal information that is important for the player to progress in the game, making it an extremely useful direct informant.

Example four being a very good example of Kromand's paraphrasing of Jørgensen, that transdiegetic sound and music appears as responses to player actions or as

[101] Figure 9.

feedback of such which may provide the player with knowledge of an altered game state or future events they may alter the game state.[102]



103

6.4 The different types of informants

There may be many ways of creating an informant diegetic sound in a game, also what is the difference between direct and indirect. Through a number of discussions with audio professionals there was revealed a number of cases:

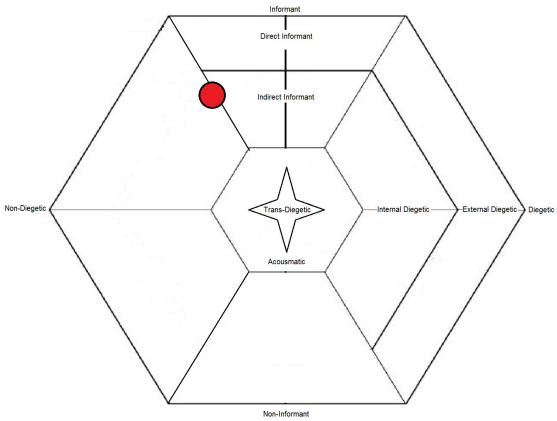
1. The Intended - they hear what we sonified
2. The Exploit - They use the unintentional to provide information
3. The Illusion- the belief that there is information in the sound when there isn't!.[104]

A sound may be directly informant, it requires the game to have made it clear that the sound is so, as in 1, or if a sound is connected to a value which may be directly telling the truth about the state of the game it may be 2, but unintentional from the game and sound designs original perspective, which we in many cases may never know about.

A sound may be indirect informant, if it provides information about the current state of the game, but without providing crucial information to the player for him or her to progress, but it may also be the grey area in between the direct informant's example 2 and the indirect informants example 1.
Example 2 is a great narrative and emotional supporter, but also a great example of informant type 3, the illusion, because of the way it is used, as explained by creator of the game Daniel Fedor. [105]

[102] Kromand, D. 2008, October 22—22 *Sound and the diegesis in survival-horror games*. Paper presented at Audio Mostly 2008, Piteå, Sweden.
[103] Figure 10.
[104] Minto, B. (2014) Email Correspondence, EA Games, DICE. Audio Director.
[105] Fedor, D. (2015) Mail Correspondence.

Any sound is only informant if the player realises it as such, therefore direct informant sounds will most likely be made clear to the player before gameplay actually starts, but there are examples of the opposite; such as The Last of Us. [106]



[107]

A non-diegetic drone is audible when crouching and being stealthy around obstacles in the level and being within an NPC's vision.
The drone becomes slightly louder, and the low-pass filter cutoff is heightened the closer the NPC is to spot you. This feature has no documentation in the game whatsoever, the player is never informed about this when starting to play the game, but it quickly becomes one of the most useful sounds in the game when navigating an area full of obstacles and enemies and the player can now focus on the obstacles and use the sound as an informant for when to actually move, stop moving or switch cover. There is no visual representation of this either, this is an indirect informant, that is extremely audible and intentional, a very clever way to use sound.

In Hitman : Absolution[108], the same feature appears, but followed by a visual, a pointer in the direction of the NPC's vision and early in the game a helper is displayed to explain the pointers use. Therefore this is a direct informant, the developer openly explaining it's use before starting the game.

An example of the exploited and unintended by the sound and game designer is a game called: Don't Starve[109]. Sound designer Matthew Marteinsson discussed the subject with me and explained all sounds in game should be either informing the player about game events or build immersion, else it has nothing to do there. For the first part of that, a sound was created for the game Don't Starve, and when it is night in the game, the player has built a fire and has walked away from the fire; a hand may come crawling towards your fire and this triggers a number of notes to be

[106] The Last of Us. (2013) Naughty Dog. Sony Computer Entertainment America. http://www.thelastofus.playstation.com/index.html
[107] Figure 11.
[108] Hitman : Absolution. (2012) IO Interactive. Square Enix. http://absolution.hitman.com/
[109] Don't Starve. (2014). Klei Entertainment. https://www.kleientertainment.com/games/dont-starve

played back out of tune as the hand comes closer. This turned out to be really great at doing both, informing the player and building a creepy setting for the world.
A sound that informs the player, directly linked to a game event, but perhaps not meant as a direct informant sound, but because it being audible before the hand is visible the player can utilize it to his or her advantage of when to be ready for the creeping hand event.[110]

6.5 Conclusion of the model

With this model, it is now possible to map where in the diegesis any sound belongs, it may change from being non-diegetic to diegetic, but with the model having an extra layer of choices, instead of the purely horizontal line between diegetic and non-diegetic, it becomes clear whether a sound is used as part of the game design directly or indirectly as an informant, by having the vertical line as well.

From the examples I have pointed out, as well as the answers I have gotten from the sound designers of the examples, it is clear that sounds should either be informing or help immersion, which goes well with Whalens note of that sounds should be enriching the world and support the players progress, just as Matthew Marteinsson mentioned.

The model can be used as an analytical tool to map where a sound belongs or to map what type of effect a game or sound designer, or both, is looking for when developing their game.

7.0 Informant examples and games with audio informants

One of the key points in videogames is the interaction between player and computer, as explained earlier we have a constant ongoing flow of communication between the two going on; which can be done in many ways.

I will now in depth explain some audio informant features of some videogames and also explain how some simple graphical features of some games could have been audio informants by using the same information from the computer, instead of the graphical elements that they are in the games.

This is not an argument of what would have been better, it is a simple example of how it could have worked or already do work in the game.
These examples can be closely linked to the examples given in the earcons and leitmotifs chapter, but those examples are given as examples to specifically the earcon and leitmotif discussion, over the iconic sounds and music in a game, therefore they are separate.

[110] Marteinsson, M. (2015) Email Correspondence.

7.01 Fallout 3 and 4

In this post-apocalyptical series of open world games, many in-game skills are required to complete the game.
One of them is persuasion and in Fallout 3 it works in a way quite similar to a process in one of my own audio features in EVE Online; in Fallout 3 it works like this:

The higher your Charisma Skill and with a persuasion perk, the higher your persuasion value, this value counters the same persuasion value of the subject and the target you are trying to persuade and in this way, a percentage of success is calculated.

In Fallout 3, that value is presented directly onto the screen, as information to the player and the necessary decision needs to be taken by the player next.

[111]

[111] Fallout 3. (2008) Bethesda Game Studios. Published by Bethesda Softworks. http://guides.gamepressure.com/fallout3thepitt/guide.asp?ID=6888

Fallout 4 works in a different way, here the direct information of the percentage of success has been taken out and replaced by color-values.

[112]

The green options being the standard conversation choices which are safe, but once a persuasion objective is present, a color will represent your chance of success.

The player is not informed of the exact percentage values of these colors, only that they represent the risk involved and they use the typical colors of Yellow, Orange and Red, depending on the risk involved.

This gives the player enough information, but not as much as the direct information of the percentage value, to make a decision of whether this is worth it or not. It may be considered a simple bet, as if the chance of success is higher than the bet that needs to be placed.
In this specific case, you may on many occasions, only have one shot at either choice, so there is no retry, making it lucrative for the player to increase their charisma skill and persuasion perks to obtain a higher chance of success.

Using sound instead of colors or directly informant percentage numbers, these values could have manipulated any sound, either a single shot sound or a looped background noise, to indicate the risk involved before clicking the specific choice.
In a later example of my own games in EVE Online, I will show, in depth, how this can be done.

[112] Fallout 4, (2015) Bethesda Game Studios. Published by Bethesda Softworks. http://guides.gamepressure.com/fallout4/guide.asp?ID=32486

7.02 Myst, several version[113]

In the Myst series, the player might find him/herself in a position where using sound is extremely useful; An underground subway system is present in the game and in the Myst series, you are very much alone in your adventures. One solution to finding the correct path through this underground subway system could be to draw an incredibly large map of each of the possibilities present when having to choose from, up to, eight different options at each station; representing North, South, East and West, as well as all combinations in between, such as North-West, South-East, etc.

Earlier in the game, the player came by a compass, which would have a specific sound for each of the main directions on the compass. When inside the subway later, at every stop a sound or a combination of two sounds would play each time, indicating which direction the player would now have to choose for the subway to go.

This is a very rough way to inform the player of which direction to choose. This was very common for games at the time, that no hints were given earlier regarding what this might be used for, which made it very challenging to complete. It works almost similar to a simple motion picture suspense method, by using a setup and a payoff, the setup being the compass and the, at the time, unknown reason for the sounds being played at the individual directions and the payoff when discovering that these sounds are pointers of the direction of which you shall travel to reach your goal later in the game.

Games like Myst came from an era in video games where tutorials and pre-game information was often not presented to the player, making the lack of explanation to these sounds and their use in the directional puzzle an open question as to whether they are this way out of an aesthetic and puzzle difficulty choice or because it was simply not common at the time to implement such explanations. Kind of like the about silent movies not actually being silent movies before the invention of sound for film.

7.03 League of Legends[114]

League of Legends is a MOBA game; Multiplayer Online Battle Arena, simply put an arena where players can play a match of a specific game, over and over again, as a sport; which is also why MOBA games are particularly useful as E-sports games, which is becoming more and more dominant.

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[113] Myst. (1993) Cyan.
The series would later include Riven in 1997 and Myst III in 2001. Myst IV: Revelation was later developed and published entirely by Ubisoft. The final Myst V game was developed again by Cyan, this time as Cyan Worlds, and was released in 2005. : http://www.mobygames.com/game/macintosh/myst

[114] League of Legends. (2009) Riot Games.
By 2012 the most played video game in terms of hours played:
http://www.forbes.com/sites/johngaudiosi/2012/07/11/riot-games-league-of-legends-officially-becomes-most-played-pc-game-in-the-world/ . http://www.leagueoflegends.com/


[115]

All characters in League of Legends have specific sounds[116], some even have special outfits that players can purchase, which will then change the appearance of not only the character, but also the effects of various spells and attacks that this character might have.
This, in some cases, also changes the sound of spells or attacks and this might be particularly useful in some cases.

One of the most dominant audio informants in League of Legends is the towers, these are located at specific places in the arena, a brief description of these could be that they are the objectives for either team to defeat in the beginning of the game, before moving on to finally slay the opponent at their base.

[115] The arena of League of Legends, either team, Blue and Red, located at either side of the map, to take over the other team's base. http://www.mmoknight.com/article/how-to-level-up-quickly-in-league-of-legends/
[116] Swanson, A. (2015) Email correspondence.

[117]

These towers are defensive structures, meaning that they will attack any attacking playing coming near them; When they do this, they emit a very unique sound which is audible on the entire map.

In League of Legends it is possible to look at other areas of the map, rather than at your actual character, making this sound of the tower extremely useful, because if you hear it, you are being shot at and you have to get out of that situation as towers generally do enough damage to kill the character.

These towers have different sounds depending on where the tower is placed on the map, so it is possible for the player to know how much damage the towers attack is actually doing, if the player knows the amount of damage dealt by the individual towers beforehand.

Other sounds in League of Legends include, but not limited to, characters and their actions, which are usually only audible if they are within your visual range, but they can perform these actions, on the edge of your visual range and you are still able to hear them, meaning that in some cases you might not be able to see the enemy, but you can hear if they performed specific actions, thus making critical listening a useful tactical tool.

[117] A League of Legends tower, firing a beam at an attacking player. http://leagueoflegends.wikia.com/wiki/Turret

7.1 Conclusion of the games

Video games like these all contain informant diegesis to guide the players around, they may be subtle or intended to have their effect on the player subconsciously, but that is irrelevant next to the fact that they are informant and on purposely used and implemented to help players navigate the game or gain vital knowledge of situations before they approach them.

In these examples, are very different uses of informant diegetic audio in games, but they all have in common; that they take part of the constant conversation between game and player, and not just as icing on the visual cake as Andrew Barnabas[118] puts it, or not just as a layer of luxury just supporting narrative. The technical chapter of this thesis will explain in detail how these values can be setup to connect with each other and how they can be used to achieve this, but this was already made clear earlier, that the ability to link sounds and use them as guidance tools in games was possible and very often used.

8.0 Technical setups for informant diegesis

The technical side of things is just as important as the aesthetic, as setting up sound in a videogame has practically become the very core of the creativity. Earlier, as explained in Mikkel Eskesen's thesis on authoring tools and me also mentioning; the role of the sound designer has changed over the years, from being a person who just created sounds or had a small role in the creative process and implementation was done by others, such as programmers or dedicated sound implementers, the sound designer is now part of a much more diverse team setup.

The sound designer must not only be able to create sounds, but also to implement them using the system provided or decided by the company or the designer him or herself.
In my case here at IO Interactive, I use Cubase 8 for sequencing, which is my own choice. I use Wavelab 8,5 for editing, which is also my own choice, but the audio department and the company as a whole has decided that we run the Glacier 2 engine, which is created in-house, and the Audiokinetic Wwise software as an audio middleware.

This means that I must be able to not only create sounds, I must also implement them and set up logical systems that will interact with the information provided by the engine and create interactive setup's the can function as supporter of anything we decide, no matter if it is supporting the narrative, strictly of aesthetic reasons or if they are both and informant about the player's current state. In this chapter I will explain thoroughly how this works.

[118] Barnabas, A. (2016) Phone conversation.

8.1 The constant conversation - in action

So how does informant audio actually work, from a developer perspective?
As I have previously shown, then sound in games is a versatile setup with many different approaches to each little problem, and as Karen Collins notes in her book on Game Sound; the sound in a game is a constructed and assembled setup, just like in film, but in games you also have a layer of interactivity to take into consideration.[119] And again, like Schreiber in our discussion *"The when, is player controlled".* [120]

Collins note is that of immersion, but it is exactly the same when discussing how sound behaves in games on it's own.

How is this technically done? and how can it be simply explained, that is what I will do now.

In this first part of the chapter, I will dig into how a fictional constant conversation between player and game could happen. The game performing its calculations, the player performing his or hers actions, the counter calculations and the counter actions, resulting in a constant conversation. I will in detail show how any number from the game engine in numerous ways can be used to alter any sound object available to the sound designer and use it as he or she sees fit.

The constant conversation was explained earlier, and is the result of a combination of all the communication models, as the game will gather information in all ways possible about the player and the players actions, before answering back with graphics and sound and here we will focus on how sounds can be changed through this information.
The point here is to show and explain how all variables in the games code can be used to trigger sounds or manipulate current sounds in the game.

As Matthew Marteinsson mentioned in his email conversation with me, then sounds in a game must have either or both part of information or support the immersion / aesthetic of the game's soundscape and along with Ben Minto's dividing into groups, I'll use his groups 1 and 2, the intended and the hack, to explain how sounds can be intended to carry information or may hold information that is not known to the player, but could eventually be used as an advantage, explaining the difference between direct and indirect informant diegetic sound.

[119] Collins, K. (2008) Game Sound. Chapter 7. Immersion and the Construction of the "real". (pp. 133-137). MIT Press.
[120] Schreiber, I. (2013) Facebook conversation.

8.2 Game and Sound Engines

For a videogame production to work, one can either create sets of tools by oneself or use already created standard solutions that can be tweaked to your desire, most do the latter.
As mentioned, here at IO Interactive we use an in-house engine, Glacier 2, meaning that no one else can use this engine unless they are part of the same company or perhaps if they buy it from IO Interactive.[121]
A different way of working with a game engine could be to use, as mentioned before, Unreal, CryEngine or Unity as the primary engine for the game, these engines are all practically free to use, downloadable by anyone and can be tweaked still and support is provided by their creators. Though if you want to really tweak it and have source code access and abilities for creating a much bigger game, then they are of course, no longer “free”.

This could be called an off-the-shelf game engine, and is a much cheaper and less time consuming solution than creating your own engine, but you also lose some control in terms what you can control in the engine's core code.

Several engines have their own internal sound engine, maybe with their own ability to script it’s behavior; Unity 3D, Unreal Engine and CryEngine is fine examples of this, yet a lot of people combine the two engines with middleware anyway, and why is that? Simply because of scripting everything from scratch takes more time than using basic tools already set up for you.
Some bigger game developers have their own tools, D.I.C.E. in Stockholm, Sweden is a great example. They create cutting edge shooter games and have their own sound system inside their in-house engine, called Frostbite.[122]
I will go into what these engines actually are in this coming part of the chapter.

8.21 What is an engine?

All game development engines have the ability to add graphics, sound, animation and so forth into the final product. (Not all, but certainly most of them, and if the game engine can’t do either of these things, then it’s a very special case that I will not touch upon.)

There are many engines out there, Unity 3D, Unreal Engine, CryEngine, and many more. A lot of engines are used in-house, meaning that it is not possible for people outside of the specific companies to get ahold of them and try them out, therefore I will focus on the engines that I am familiar with the most and primarily the engine that I am currently working in, the Glacier 2 Engine from IO interactive. Even though it is not possible for most readers to try this at home.

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[121] Glacier 2 Engine. IO Interactive, Denmark. http://eu.square-enix.com/en/blog/glacier-2-power-behind-hitman
[122] Frostbite Engine. D.I.C.E. Stockholm, Sweden. http://www.frostbite.com/

The whole point of an engine, is to combine a series of tools into one, which can then perform all of them at once, resulting in the final product. Code for playing back sound, code for communication with graphics processors on where to draw to and from, code to calculate the artificial intelligence of the game and it's behavior and on top of that, hopefully, a nice looking and intuitive GUI (Guided User Interface) to work with, so that creating your masterpiece of videogame art becomes as easy as possible. (Games usually takes years to develop, so easy is a hard word to use)[123]

An engine is actually a combination of software, small tools and programs that can do very small things, and in combination they do great things.
It is like creating a framework, under which everybody know that they must work with these specific tools, in the end the engine knows what everybody has been using and is able to render a much better performing game than if everybody just did everything on their own and then had to put it all together manually.

8.22 How does it work?
In the old days of computers and consoles, the sound engine could only play one sound, or maybe several sounds, but a polyphony of only 2,3 or maybe even 4 voices is not very much compared to today's computers and sound standards. As mentioned earlier in The 8-Bit Guy's youtube channel and explanation of game audio for older consoles, then with the ability to playback samples and with more RAM and Computing power, came the ability to make more realistic sound. Not necessarily better, but like with silent movies, it wasn't until the invention of "perfect" sound as today, that we started making sounds like the old days, strictly for aesthetic reasons.

Sound in games can be made either through code directly or by playing back samples, the two can also be combined to create advanced variations of sounds, this is called granular synthesis. Granular synthesis is often regarded as a way of creating musical sounds and can be made of grains that are incredibly short / small, but for the simplicity of the examples here I will stick to quite big grains and their use. Granular synthesis used for music as an instrument and as an artform in itself, is described well by Curtis Roads in his book Microsound.[124]

Sound engines can help the sound designer putting these grains together, this making it possible to create a great arbitrary soundscape. For simplicity, I will stick to explaining the sound engine Wwise, by AudioKinetic and how this works in combination with the Glacier 2 engine.

Putting together samples, even if it is just two samples of heel and toe on a footstep, makes a granular system. Granular synthesis is not a term I would use for this, I

[123] http://www.economist.com/blogs/economist-explains/2014/09/economist-explains-15
[124] Roads, C. (2001) Microsound. MIT Press.

believe that this is rather a Granular Sampling system, whereas the “synthesis” part is more to be the correct term if there was hundreds or even thousands of grains, to trick the ear into thinking that this is one constant sound.

[125]

In the above visual example, one footstep detected can play multiple sounds in sequence, but for the listener it will sound as one footstep. This is the very basic part of a granular setup. INSIDE has a quite effective granular setup like this for the breathing of the main character as mentioned earlier, but even more so because internally in the game engine there would be another Constant Conversation between the animation system and the breathing sound system, as the breathing sounds would be stitched together, as just explained, as the granular part of this system. The timing of these sounds controls the breathing animation meaning that there really is a constant conversation between the sound and the animation, to support the constant conversation between the game and in the player in the form of the graphical and audio cues given as replies to the player.

8.23 How can it be triggered?

Sounds can be triggered in many ways, a player's actions, I.E. a button press could trigger a sample directly or a system in the code could figure out which sample should be played when the button is pressed.

If the system is set up for the mere purpose of just playing a sound when you push a button, it becomes more of a sample triggering system than an actual game, since we already established that a game must have interactivity.
So for a button to be pressed and a sound to be played, the game must know which sound to play back in the given situation.

Since the general subject of this thesis is the importance and use of informants in sound, I will primarily focus on those sounds.

In an email correspondence with Will Morton, audio designer at Rockstar Games North and now at Solid Audioworks, having working on big titles such as GTA V[126], older GTA titles, Red Dead Redemption[127] and more, Will mentions that they were using the Rockstar engine RAGE, which gave them access to an almost infinite number of game metrics, which clearly tells that anything can be used to change everything, from sounds created through synthesis alone to samples being played back, both single triggers and loops.

[125] Figure 12.
[126] Grand Theft Auto V. (2013) Rockstar Games. http://www.rockstargames.com/V/
[127] Red Dead Redemption. (2010) Rockstar Games. http://www.rockstargames.com/reddeadredemption/

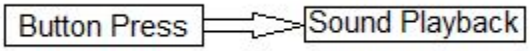
Will comments that they tried hard to give every area of the game it's own personal audio soundscape, so that players, even subconsciously would have a better chance of being able to navigate the map, it will allow for the designers to make areas sound safer or more dangerous depending on the story or what was about to happen.

8.3 Sound engine playback of informant diegetic sounds

Sound engines, how do they communicate with the game engine and how are sounds triggered and connected through variables, that is what I will be explaining in this part of the chapter.

From single events, that plays a single sound to complex setups of various values and switches and states combined to triggers different subsets of the same sound or cause a sound to be dramatically different in specific situations or even be inaudible if that is the desired effect.

8.31 Single sample feedback



[128]

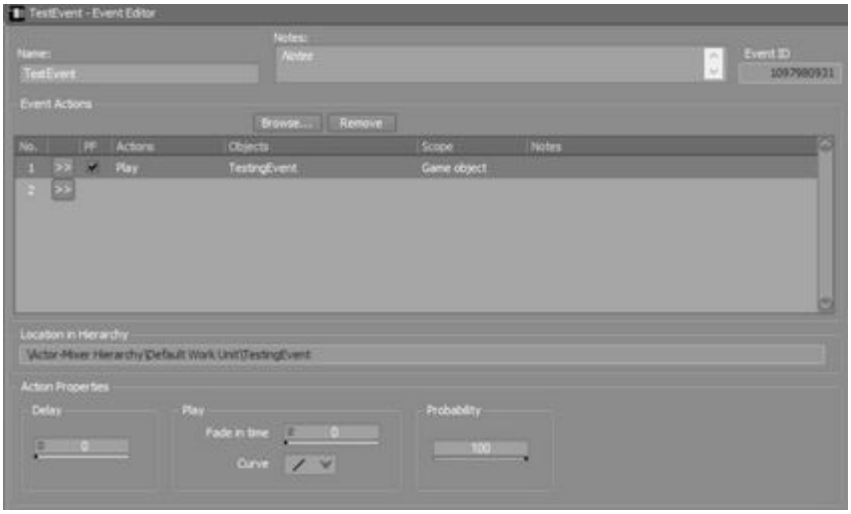
A single sample feedback, is when the player performs an action and a sound is played. This could be anything from clicking a button before the game has even started or far into the game when the player decides to press the attack button and swing his or hers sword.

In many games, there is a sample being played back when the character picks up a new item, this could be one of them.

In Wwise, this happens by having any command from the game trigger an event, inside the event a wide range of triggers and parameters can be set.

[128] Figure 13.

It will appear like this:

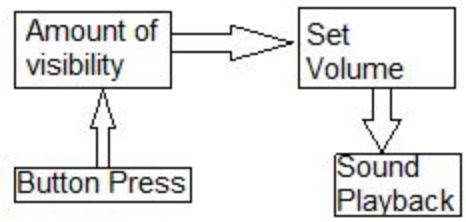


[129]

Whenever a specific button is pressed, we set it in code to trigger this event and if the event is setup like this, then the sound “TestingEvent” would play.

A simple example of this could be from the game L.A. Noire from Rockstar and Team Bondi [130]when picking up evidence at a crime scene in the game and a small chord of piano notes is heard. But because of this sounds ability to change and provide feedback I will explain this example later.

8.32 Parameter variables feedback



[131]

A parameter variable feedback, is when the player performs an action and the sound being played back is manipulated by a value. In the given example, it is the simplest of manipulations and just setting the volume of the sound.

The player may perform an action and the sound played back is dependent on other values to be set, such as the earlier mentioned example from *The Last of Us*. Where it was audible when the player was within the sight of an NPC. This amount of visibility sets the parameter for volume, and other parameters as well, and the sound is heard dependent on these parameters.

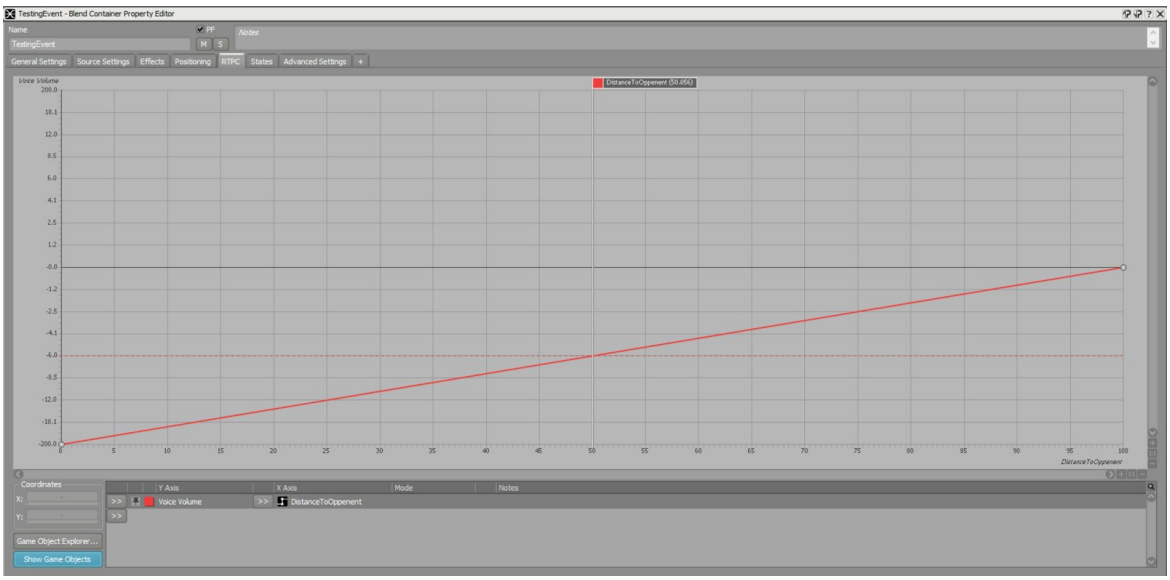
[129] Figure 14.
[130] L.A. Noire. (2011) Team Bondi. Rockstar Pub. http://www.rockstargames.com/lanoire/
[131] Figure 15.

So if visibility is 0, then the volume is also 0 (or -200dB), thus making it inaudible. This can also be done by having an event as mentioned in the example before and trigger a one time sound to be played back, but still have it come at certain volume depending on any value, but in this case it is Amount of Visibility.

In Wwise you can set up the same sound as in the previous example, TestingEvent and in the controls of the specific sound we can set a so called RTPC, which stands for Real-Time Parameter Control.

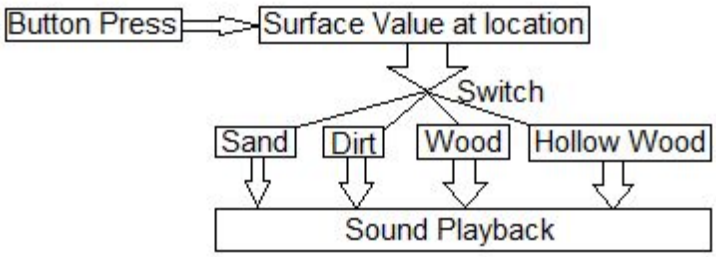
This allows us to control any value within the sound, with any value from the game in the form of an RTPC. [132]

A simple RTPC setup, with a value between 0 and 100 and a curve deciding at what volume the sound should be played back.
To stick to the example given, then the value between 0 and 100 is our amount of visibility, so 50, is 50% within the detection range of the NPC.
The value could be interpreted as the sound designer would want, there is no limit, but in this example I will stick to the use of the straight curve and simple values between 0 and 100.



[132] Figure 16.

8.33 Switchable feedback



[133]

Switchable feedback, is feedback dependent on a value to be set, but instead of adjusting a parameter on the sound played back, it decides which sound should be played.
A quite useful setup, as a game can check for each footstep what material is the character currently standing on and then switch between those values. The sound designer can then set a switch to distribute this information to the correct sound.
This makes it possible, from a design perspective, to much easier deal with such a situation, since you only need one trigger and the code will handle the rest and switch to the correct sound.

In Wwise it is important to understand the difference between a switch, like this one, and a state. It is possible to use states in the same way as a switch like this, but their main difference is that a state is set globally in your game and will affect anything that the designer has set it to have an effect on.
While a switch is game object orientated, meaning that it has to be set when an event appears or needs to be set when the game object is spawned.

In the above mentioned case, which would most likely be footsteps, the audio emitter for the footstep is spawned when our character takes a step, therefore at each spawn of the footstep emitter, we need to set these switches before hand.
This may seem like an odd process, to set these every time, but this is done automatically in code and therefore the sound designer can focus on making sure that the actual sounds function as intended and not bother with how the code actually works.

[133] Figure 17.

In the Wwise hierarchy it would appear like this:

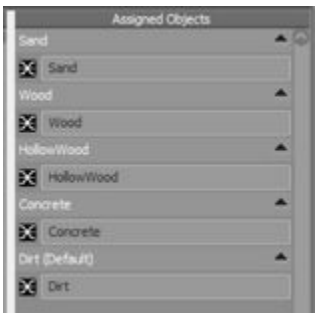
[134]

An overall Switch Container would have to be generated and underneath in the hierarchy the designer would have to locate all the sounds and logic that needs to be triggered depending on the results of the switch.
In the Switch control, we explain which switch we want it to use and set a default value in case a switch is not set correctly when the sound is triggered:

[135] and the switch itself:

[136]

And finally we also have to indicate which sounds are played depending on which switch value:



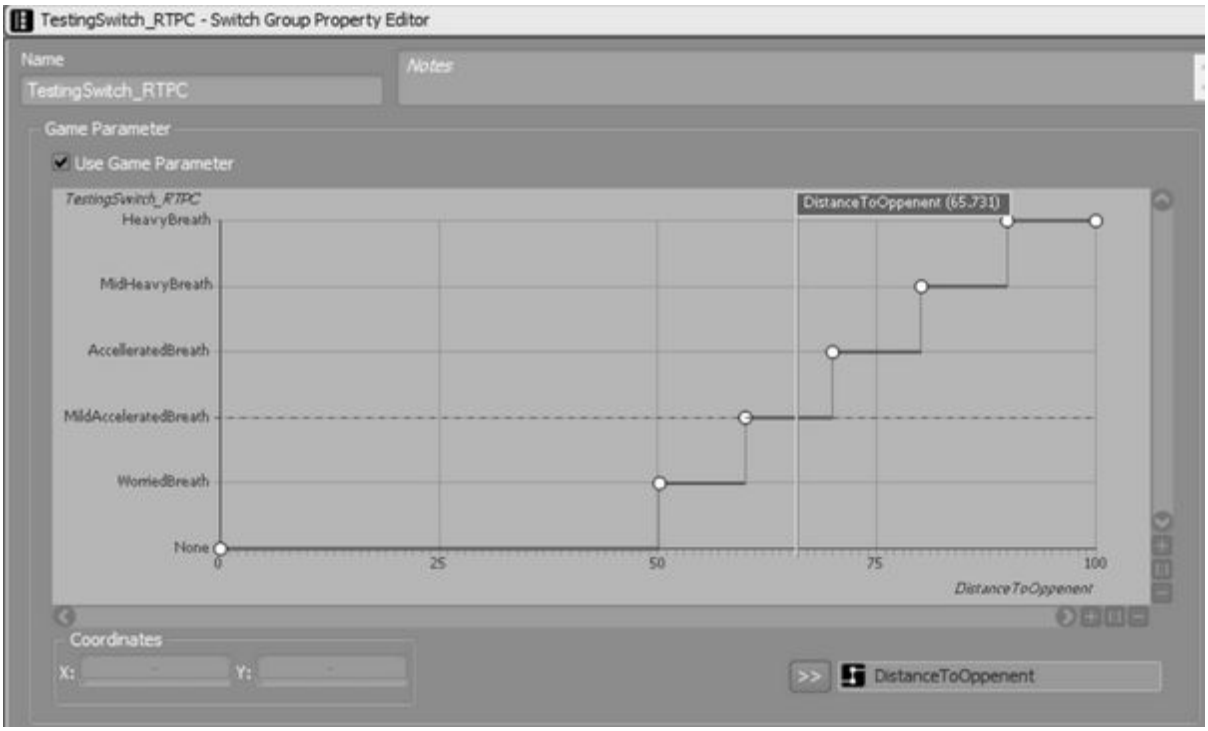
[137]

Now we just have to trigger a sound, just as the TestingEvent showed in the first example, by a simple event that triggers the Switch container. The Switch values are already set in code, therefore the switch container already knows what to play back, so the only thing that the designer has to focus on, is to make sure that the event is triggered.

[134] Figure 18.
[135] Figure 19.
[136] Figure 20.
[137] Figure 21.

A switch can also be controlled by the RTPC parameters, as mentioned before in the Parameter Variables Feedback example, this would be done when there is no switch to be set in code, but if the engine only provides a variable float or integer value.

Let's use the same example as before and determine the amount of visibility from the NPC, the exact same values as in the previous example:



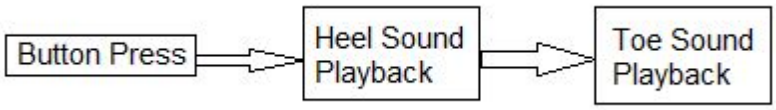
138

Instead of having the switch determine which material is audible, we can use this value to set the breath of our character, meaning that we could easily create an informant here, by having the characters breath become more and more hysterical the more in vision of our enemy we are.

In this case the "DistanceToOpponent" variable set by the game and sets our RTPC value at 65,731, I have set that to result in Mild Accelerated Breath, meaning that every time our breath is triggered, it will check for this value first and then playback the correct sample.

[138] Figure 22.

8.34 Granular feedback



[139]

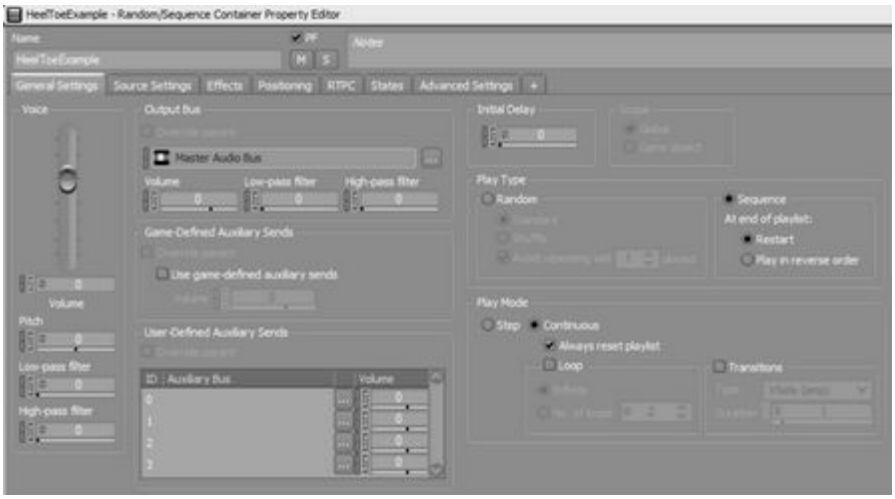
Granular feedback is different from the previous three examples, as it also a way of just creating randomization in your sound playback.

But in a more global scale, this is quite important for the whole feedback system, which will be explained in the combination feedback example.
This is a system which the player can trigger by an action, which will then combine several sounds to become, seemingly, one sound.

The above example with heel and toe, is an easy way of randomizing and thus having more options instead of just randomization between full assets.
So instead of having five different footsteps which can be randomized between, then we can now have five heel and five toe, providing us with with 25 variations instead, using the same amount of space.

Each “grain” in this system can controlled just as any of the other types of feedback, so our heel can be controlled in volume and our toe can be controlled by a switch, and that will be explained in the combination below.

In the simple example above, pressing a button and have the audio engine playback a Heel and then a toe sound would be done like this in Wwise:



[140]

This is a sequence setup, and it allows us to trigger a specific order of containers.
In this case I have set it to play and every time it is triggered, it restarts, meaning that we know the order of the playback every time it is triggered.

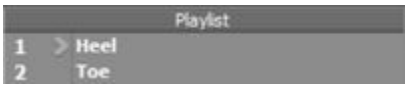
[139] Figure 23.
[140] Figure 24.

With the play mode settings at the bottom of the settings it is possible to set the sequence to continuously play until manually stopped by activating the Loop option, also special settings for transitions between the sequence part can be set. This would usually be set to a slight crossfade, but in this case I won't use that.

The hierarchy is very straight forward:

[141]

and after that you set a playlist like this



[142]

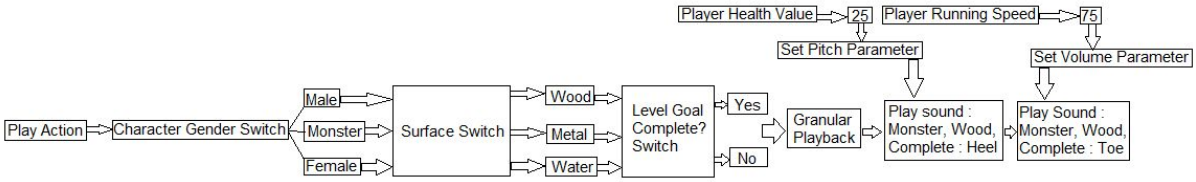
So now we have a functioning sequence, which plays whatever we set up in the heel and toe containers. Setting those two to randomize between various heel and toe samples, means that you double your amount of randomization with the same amount of memory and disc space. Combining this with some of the previous examples, allows for a quite detailed setup and using RTPC's and switches individually when firing the heel and toe, means that the possibilities are practically endless, it allows our heel to be hard and our toe to be soft, or vice versa. Individual volumes can be set depending on which switch you use and so on, the amount of ability to create informants is endless. Jakob Schmid and Martin Andersen explained the use of combination values in their game INSIDE, explaining that the main character, a boy, had several states he could be in, particularly the action state of the boy was important as it would indicate if the boy was performing an action currently or what action he just did or the last action he did.[143] [144]

The boy also carries an array of values with him, which are conditions named by the developers and in this case it is calculated how exhausted the boy is. Let's call it his exhaustion value. For the game INSIDE and the boy character there is a breath sequencer, which use a combination of what state he is in and his exhaustion value to perfect the sound of his breathing. It is like a machine that constantly plays a typical breathing in and out sound after each other, but taking the values and states into account, the character could be out of breath and therefore not needed to have an exhale sound next. He could also be performing an action which limits his breath or one that should empathize the sound of his breath.

[141] Figure 25.
[142] Figure 26.
[143] Schmid, J. (2016) Transcribed discussion.
[144] Andersen, M. S. (2016) Transcribed discussion.

8.35 Combination feedback

To create a more complex example of all these, just as with the communication models, all these can be combined and used in practically unlimited combinations. Here is an example:



145

An action in our game triggers a footstep, first we need to establish the gender of our character, in this case “monster”, what material is this monster stepping on, in this case “wood”, and has the player completed a specific goal on this very level, in this case “yes”.

From here we can determine which sounds to play, the Monster sounds for wood and we have a special sound playing if the goal is completed, which is the informant in this case, as in this specific case, we assume that the player needs to know if the goal has been completed before he or she can proceed.
The sounds played back, the monster version of wood, and the complete sound, are altered because of values in the game.
The monster is fatigued because of low health, so we have set a pitch parameter that would lower our pitch, to make the steps sound heavier.
And because our monster is running, the action is triggered more often, therefore we lower the volume slightly because of multi triggering, to make mixing easier.

This may seem like a very complex setup, but it is actually quite common in a lot of videogames, to have switches determine what to be played back and quite large hierarchies of sounds to constantly fit the situation. The boy breathing example from earlier, from the game INSIDE and Jakob Schmid explanation of the setup if one of these games. [146]

This allows sound designers to have a lot of variation going on, so that the soundscape does not become repetitive, and the ability to alter the soundscape depending on basically everything in the game. The boy in INSIDE has many more states and values than just the previously mentioned exhaustion value and action states, he also has an intensity value controlled by several other factors and an emotion value. The emotion value and an emotion feedback sound coming from the boy gives a clear indication of several things in the game, such as that the boy may provide a normal, scared or relieved emotion feedback sound. The two latter sounds

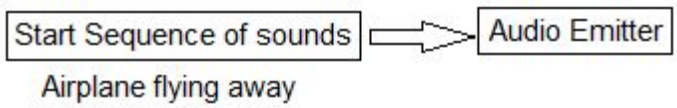
[145] Figure 27.
[146] Schmid, J. (2016) Transcribed discussion.

are direct informant diegetic of the current situation in the game and they are particularly valuable to the player since the character may provide the scared emotion sound, before the player has experienced the scared part, giving valuable information about the coming dangerous situation, or the end of this situation if the relieved emotion sound is heard. Exactly like the victory gong and end of combat music stinger examples mentioned earlier.

As Steve Whetman said in our discussion of the subject, then in film the decision of which sound to play and the response to any sound or event has already been made, the difference in from that to video games is that the player has the option to alter the scene or make a different decision. Just as Schreiber also said.

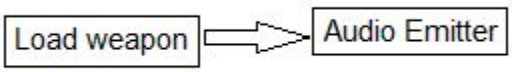
The goal mentioned in the previous example, might not have been a goal that the player would know about. The goal, the requirement to progress, isn't explained to the player through narrative in this example, the player would manually have to figure out how to progress, but if the player knew that when the "goal complete sound" was audible for every footstep, then it would be a direct informant, if this information is not provided to the player either, the players would have to figure it out for themselves making it an indirect informant and could also be considered "a hack", if the sound was added to the game by the developer without the intention of making the player know about the completed goal.

Another example:



[147]

Sound is playing, because this plane we are about to shoot down is flying and it is the goal of this very level.

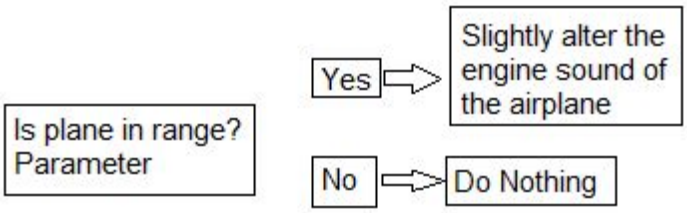


[148]

We load our weapon and it plays a sound

How do we know when to shoot? We can see that the plane is approximately straight in front of us or?

[147] Figure 28.
[148] Figure 29.



[149]

In this specific example, we have not informed the player about when to fire, so the player will have to rely on vision, but if the player found out that the engine sound would be altered when the plane is in range of being shot, that would make the engine sound the indirect informant.

8.4 Glacier 2 Engine and Wwise

Glacier 2 is the game engine that is used at IO Interactive, currently being used to create the upcoming HITMAN game.[150]
Glacier 2 allows for very complex setups through a visual scripting tool called Graph, in which both audio designers and any other type of designer works to create the game.

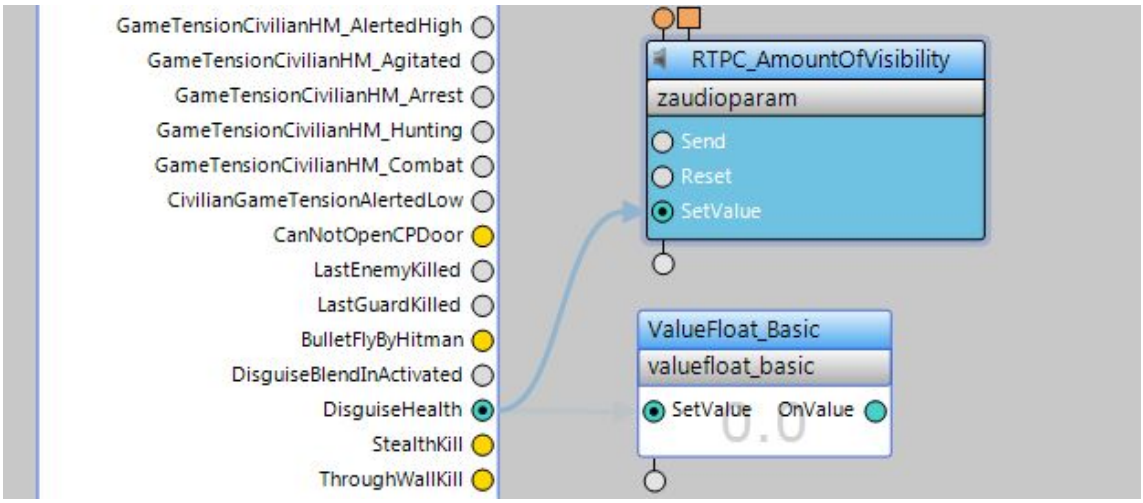
It allows for setting up any parameter to control any other parameter and works just like most other visual scripting tools, such as the blueprint system in Unreal 4[151], max/MSP[152] and Pure Data.[153]

Being able to control any variable is extremely useful, making it possible to shape any sound and being able to use it to shape any sound is extremely useful.
As explained earlier, Wwise works with event triggers, states, switches and RTPC's, for a more specific explanation of how these systems work, another Masther Thesis from Aarhus University is a of great interest, by Mikkel Eskesen, Graduate of 2007, explains both Wwise and other systems alike, very well.[154]

Glacier 2's Graph View for scripting, allows a number of so-called entities to be placed and each of these is coded to do what we ask of them, these can also be combined into Templates, which is practically the same as what on the Unity 3D engine would be called a Prefab.

[149] Figure 30.
[150] HITMAN - Planned release March 11, 2015. IO Interactive, Square Enix.
[151] Unreal 4 Blueprint System - Visual Scripting. https://docs.unrealengine.com/latest/INT/Engine/Blueprints/index.html
[152] max/MSP. Cycling '74. https://cycling74.com/max7/
[153] Pure Data, also known as PD. https://puredata.info/
[154] Eskesen, Mikkel. (2007) Implementations Editorer. Ms.It.Audio Design Thesis.

In the previously mentioned example of how amount of visibility works, here is how it could be setup in the Glacier 2 Graph View:

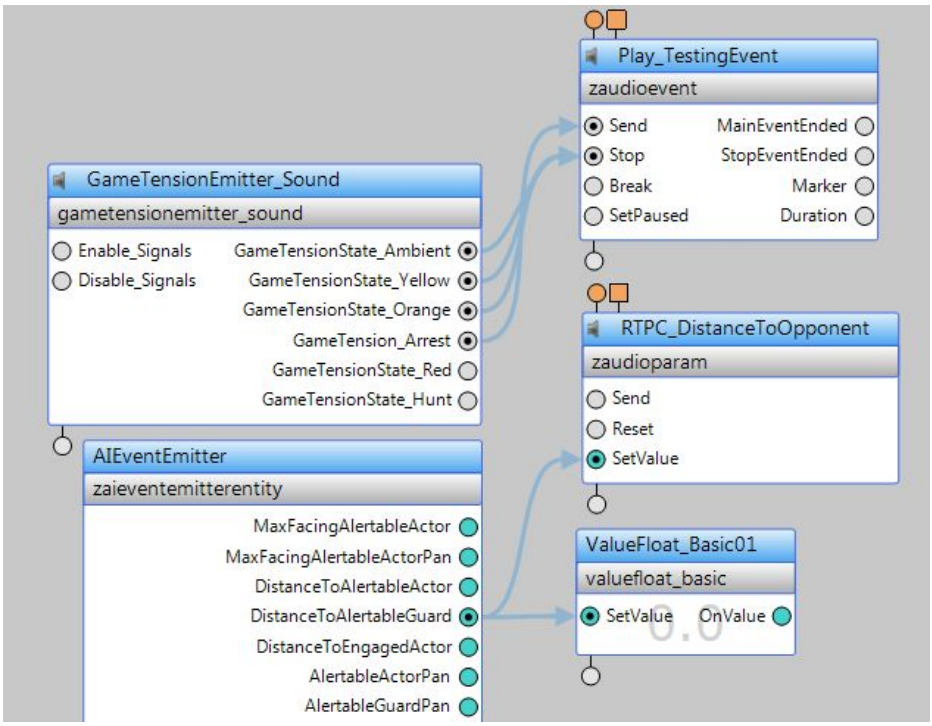


[155]

A quite simple signal made through algorithms in the game code calculates how much in vision of an NPC you are, this is called “DisguiseHealth”, meaning the health of your disguise aka. the amount of visibility an NPC has on our character.
The ValueFloat_Basic, is just a way of debugging the number output, as the blue dot icon represents a floating point value output, and in this case it puts out a number between 0 and 1, 1 meaning that we are in full vision and is spotted by the NPC who will then engage in either combat or begin searching for us. It doesn’t have to be a sound fading in or out, it could also just be single sample feedback when the value hits 1 and the player would know that they had been spotted, add unique samples to each type of enemy and the player would also know what spotted them, just like in old-school game Wolfenstein 3D[156]. [157]

Sending this value to our RTPC_AmountOfVisibilty, allows us to create such an RTPC in our Wwise setup, as mentioned before and use that value to control what we may desire. Which as seen in earlier examples, could be anything from volume to various filters or triggering of the sound or used as a controller to control which sound is audible with other events play later on.

[155] Figure 31.
[156] Wolfenstein 3D. (1992) Romero, J. Carmack, J. id Software. http://3d.wolfenstein.com/
[157] Newsom, S. B. (2016) Skype discussion.



[158]

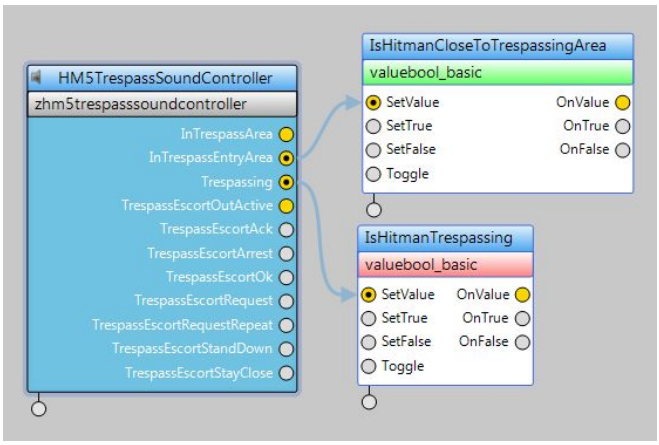
Another example is here, where I have used the same names as in the previous examples, for ease of understanding.
The Distance to an alertable guard is measured with a float value, and through another entity called GameTensionEmitter_Sound we can control that if the game tension reaches ARREST level, then it shall play our TestingEvent, which we set up in an earlier example.

So let's say that we know that we are 50 meters away from an alertable guard, but we somehow manage to trigger the tension to go into ARREST again, then we can through our switch system which is also explained earlier, setup that it shall now play a specific sound which represents ARREST Mode, but outside of the combat zone, which we could have agreed to set to 25 meters.

If there is no visual alert for entering ARREST mode, then this sound could be the only informant that the player receives, which could then be used as a hint to back off, take it easy or play more in cover, a more stealthy play style.

Another way of dealing with this type of communication is internally in the Graph View, by setting up boolean values. Which is binary values that can only be set to either True or False and then checked at any given time in the game and use this value.

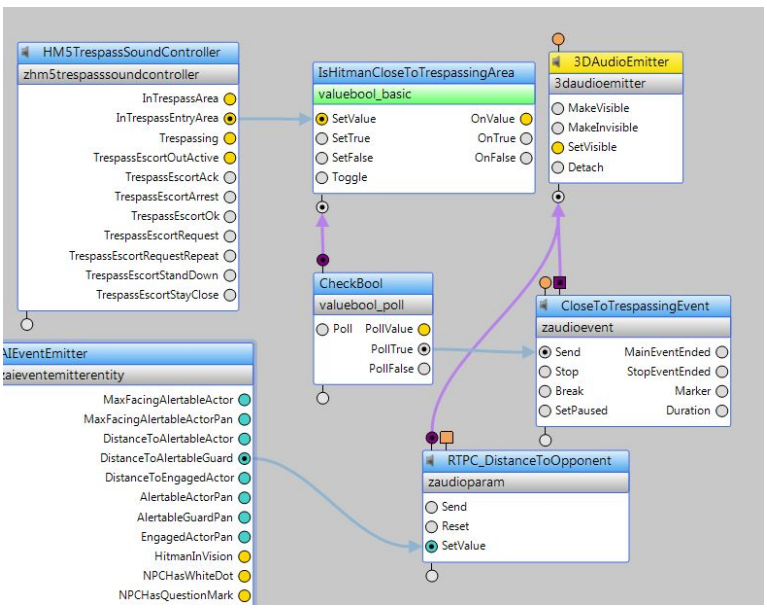
[158] Figure 32.



[159]

In This example I have marked “InTresspassEntryArea” as true and Trespassing as false, meaning that we are close to a place where trespassing will begin, we can then at any point in the game check if this value is true or not and use this as we may see fit.

We could create an informant diegetic sound out of this, by checking if InTressPassEntryArea is true and if we are more than 50 meters away from an alertable guard, by doing this:

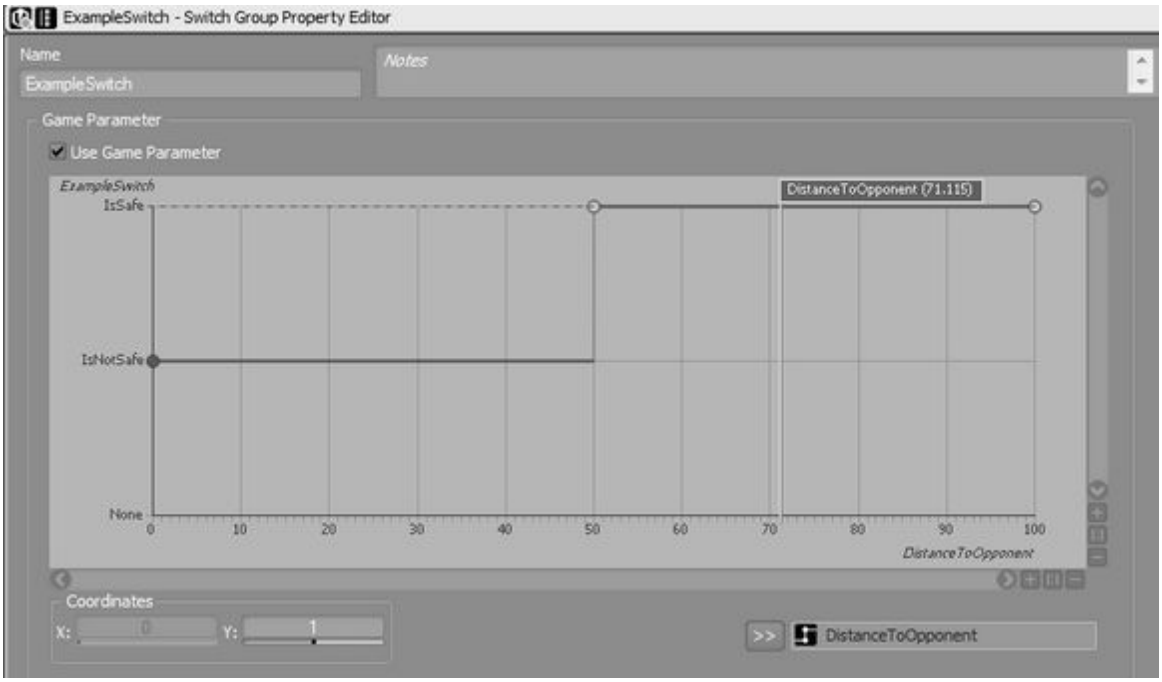


[160]

This gives us the ability to control that a sound is only played when the correct numbers are set, meaning that we could set it so, that a small sound is audible if our character is close to a trespassing entry zone and the distance to a guard is great than 50 Meters, by setting a switch in Wwise that controls which sound to play and set it to playing nothing if the RTPC value is below 50 and to play a small sound if the value is above 50.

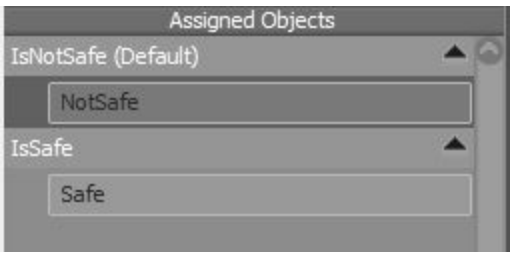
[159] Figure 33.
[160] Figure 34.

This could be any sound and it could be used to inform the player of that entering now is SAFE or the opposite, that entering now is NOT SAFE.



[161]

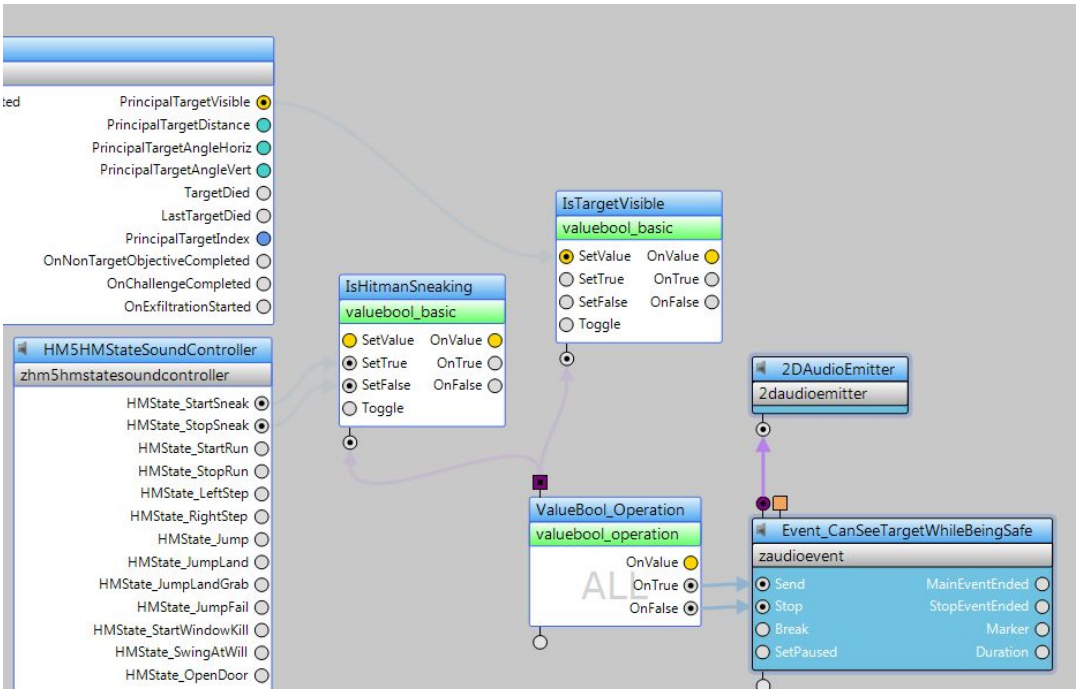
[162]



[163]

[161] Figure 35.
[162] Figure 36.
[163] Figure 37.

A more useful example is this one:



[164]

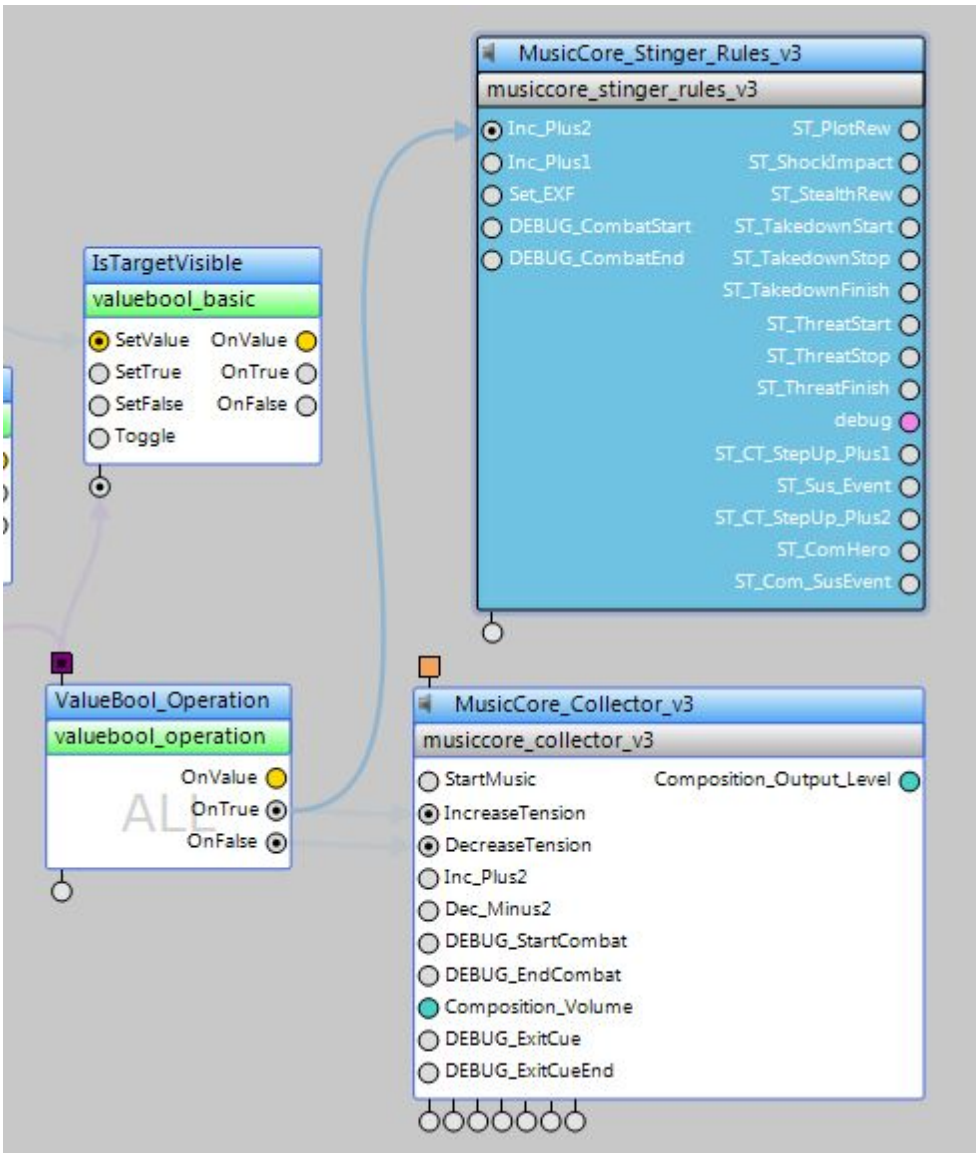
In this setup, we control if we are sneaking and sets a boolean to being TRUE, as well as checking if our primary target is visible to us, if they are both TRUE, then our ValueBool_Operation entity will send a signal to our audio event.

In This specific example, it doesn't have to be a specific sound that is controlled, but could be our music system which is then set to alter something very simple or complex for that matter.
A similar example is present in the game INSIDE as explained by Jakob Schmid in our discussion, that any material has a value which indicates which step to take, but any part of the material map or a generated effect can cause a specific area to be wet, this will trigger a boolean value that will decay over time, so if this value is true the sound of wet footsteps, because of the characters shoes being wet, will continue to be audible even after the water is no longer present in the scene. This is a different way of using boolean values, and this one could have been named IsPlayerWet?

It could trigger a small stinger, which could then indicate through the music, that our target is within our vision, if there was no visual cue to represent him or her, thus making this a very useful informant diegetic sound or making that part of the music an informant diegetic, the leitmotif of the situation where it is possible to achieve our goal, which in this case is to kill the target without being discovered, or a specific leitmotif to this situation with this specific target as it may be different to other targets

[164] Figure 38.

or a very easily recognizable add-on to the composition which becomes iconic to the player of the situation at hand, just before you make the kill.



[165]

8.5 Musical controllers for creating informant music

Music for motion picture and for most modern games is very different, though many modern videogames do use Hollywood composers to create their scores, many of the same composers have adapted to making videogame scores.

In many cases the music is divided into loops, which can play forever and ever, and the trick here is to make sure that it can do that without becoming boring. Using adaptive music by using variables from the game, controlled by any information gathered by the game about the current situation or the players behavior in the game, we can control exactly what is heard at any given point.

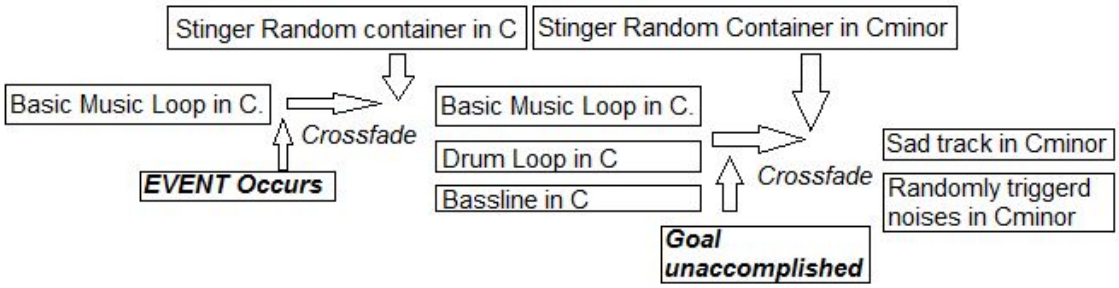
[165] Figure 39.

In motion picture, the score is created to the exact frame[166], though the music may be created to support narrative or be subconsciously scary or contain a leitmotif of a coming character or situation so that the audience can be “prepared” for what is coming, but the director and the sound designer chooses when this happens, whereas in games, the player may leave the controller of the game untouched for minutes or hours and come back to continue play and in this situation the game will be prepared the loop the current music and switch to what comes next the frame it is told to when the player changes a certain parameter, such as entering a new area.

This creates a situation where the composer has to think of all the transitions to and from any part of the musical score to any other part of the musical score and a system has to be created to make sure that the transition between these is seamless.

This could be done by so-called stingers, as mentioned before when being sneaky and the target was visible, this could trigger that the tension level of the music should rise, meaning that we go from a basic track in the music, to a more pumping track, i.e. adding a beat and the bassline goes deeper.

To avoid the transition to be like a skip from track to track, a system could look like this:



[167]

Already here the random stingers, being random, will change how the transition is, so the transition may never be the same and even the track before and after the stinger as part of the transitions to and from loops may not and never be the same, meaning that a unique or in most cases situational unique piece of music is created.

In the above case, we go from being in the core part of the game to a more exciting part of the game and being unsuccessful, thus transcending the music into a less than happy piece.

[166] Stevens, R. http://www.asoundeffect.com/procedural-game-sound-design/ (January 18th, 2016)
[167] Figure 40.

It doesn't have to be in the same key, minor, major or anything, a properly produced stinger and loop could change from any key to any other key without the player noticing the transition.

In many games, the stinger that is played when combat ends, is often the players only indicator that there are no more enemies around, the earlier mentioned victory gong.

A great example of this is in the Uncharted series, both 1,2 and 3 in the series, where combat on the higher difficulty levels can be quite difficult to deal with and often results in that all enemies are dealt with except one which then ends your adventure and you have to start over before the battle.
Therefore listening to the music and the combat ending stinger, is a great informant - non-diegetic about the players combat state and whether or not it is safe to move on out of cover without being shot at again.

In the HITMAN series that I am currently working on we also have a system similar to this, but since it is a stealth game there isn't as much focus on the combat music as the small details in variations of the music. In HITMAN there are five levels of intensity when walking around the level, including specific music for combat and exfiltration of the level, combat only has three levels of intensity.

The intensity can be controlled by any parameter in the game and as in the above example it is quite clear how easy it is to connect any output to the intensity increase input and control it from there.

There is also a sixth level, a so-called add on layer level, which consists of mostly stingers and pieces that can add to the specific scene.
These stingers are mapped to be in sync with the beat of the current composition and can be both played constantly or randomly around the track.
An example will be a military snare drum in the Marrakesh level of the new HITMAN game, which is directly connected to the boolean value of "IsHitmanInMilitaryArea"; true or false. If HITMAN is in the military area, the level specific composition will continue to play at it's current level of intensity, but the add on track will also play, giving the player an indication of the current part of the level. This kind of add on music layer is in all parts of the game and in all parts of the compositions.

Another part of the music which uses the same system is small stingers that play when specific conditions are met, such as when being close to the current target, moving past a character that the player doesn't know is dangerous or part of the current opportunity puzzle. These stingers will fade in, in sync with the beat, so they appear as part of the composition specific composition and not just as an add on.

When the player has achieved the goal, killing the final target, an exfiltration track will play, this exfiltration track is the same for all levels to give a sense of having reached the goal, no matter the level, but the track will contain multiple variations and also have an "DistanceToExit" RTPC value which will be used to fade in and out new parts of the score. So if playing on the hardest level of the game, which takes away the UI and all graphical help, this fade in part of the music is the only key to finding where the exit is. This is the leitmotif of having completed the level successfully.[168] [169]

8.6 Explaining other games

I will go through some games and explain how some of their informant diegesis works technically, without knowing how it works in their engine, but explain how it could be setup and how the information most likely would be distributed.

8.61 L.A. Noire. Piano notes as feedback

After some long discussions with Will Morton[170], a leading sound designer of L.A. Noire a lot of questions were answered regarding several games and this was one of them.

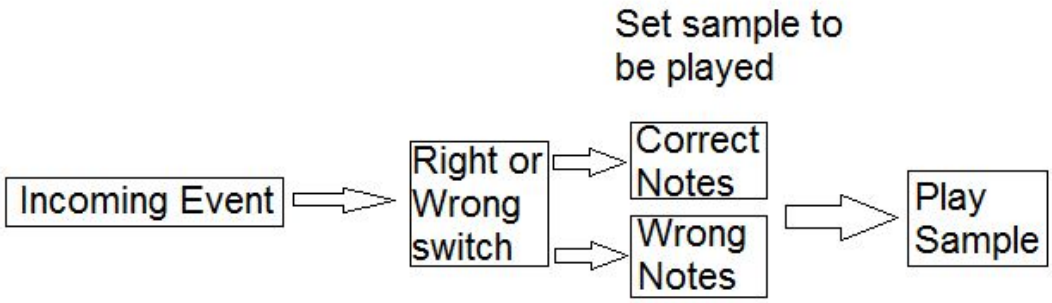
In this game, the player gets to search crime scenes, which has several pieces of evidence scattered out all over the scene and whenever standing a location of a piece of evidence a small two note piano chord would be audible..
Whenever the player interacted with the evidence, if the evidence turned out to be important to the case, another three note piano chord would be audible upon inspection of the object, giving a clear indication of that this was needed to progress in the game.

In other parts of the game, the same audio feedback is provided when the player is interrogating suspects, when making the right choice in a classical multiple choice selection, a series of piano notes will represent the correct and the wrong answer. The player cannot go back after having made his or her choice, but the feedback still provides an idea of which way the suspect or evidence is going, meaning that the next choice may be easier, since you know what was right or wrong with the last answer you made.

[168] Nielsen, N. B. (2016) Skype Discussion.
[169] Jensen, J. B. (2016) Email discussion.
[170] Morton, Will. (2015) Email Correspondence.

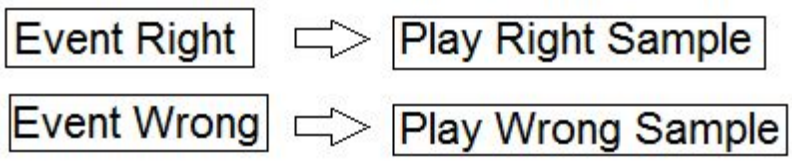
Will Morton, in our email correspondence, mentioned that this was the way it was meant to be used, there there wasn't anything more than that going under the hood, but this is by far enough to make it valid as an informant.

The reason for mentioning this game earlier in the single sample feedback part of this chapter, is that an incoming event triggers a sound, is a single sample feedback provided to the player, but in this specific case it also uses a switch.
During an interrogation of a suspect, you have a multiple choice to make to progress and if you answer correctly a positive series of notes is played, but if you answer wrong then a more negative, dissonant, series of notes will be played, and that would be a simple switch or dual incoming events. It could be done in these ways:



[171]

or it could also be done by having separate events:



[172]

There is audible no difference between the two, but having the game code automatically create a switch that determines if the answer is right or wrong and let the designer focus on the actual sounds / notes makes it easier than having to manually set in the code which of the two events to play.

of course, there probably is a graphical interface making this far easier than by doing it directly in code, but for structural reasons in a program; like Wwise, the switch method would be far easier to debug.

[171] Figure 41.
[172] Figure 42.

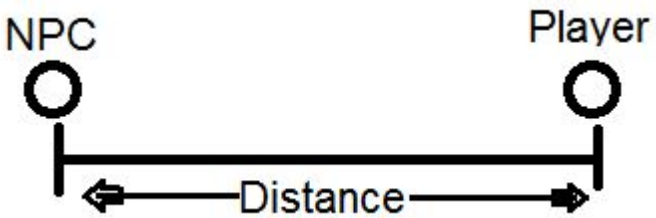
8.62 The last of us, Amount of NPC visibility

The last of us has a very unique way of presenting a non-diegetic informant, which is a sound, a noise, connected directly to the value of the amount of visibility an NPC has on the player's character.

The player can use this sound to guide him or her through a level, often the sound only becomes slightly audible before the character is spotted, but if the player is already sneaking and is trying to hide from the NPC's in the game, the sound can be extremely useful.

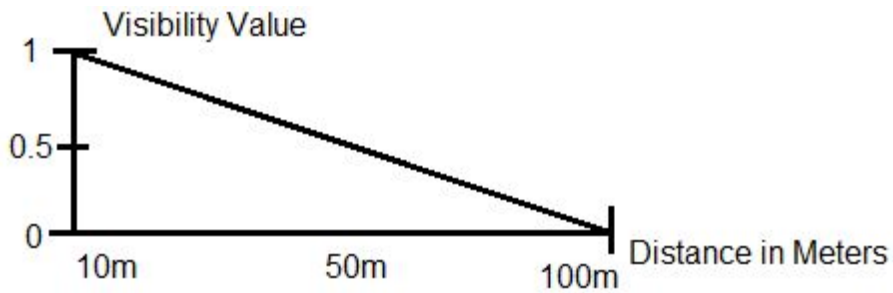
Whenever inside the vision of an NPC, a number will most likely be given from and to an algorithm which is determined by programmers and game designers, because not all NPC's may have the same amount of vision or sensitivity to vision.

This means that some NPC's can see you and will engage in combat if you are within 50 meters of them, others may need 100 meters and some may be able to see in a wider angle than others.



[173]

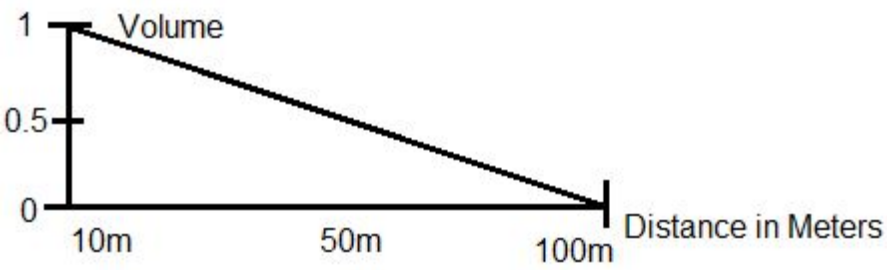
The distance can be measured in any value in the game engine, but will most likely provide a value between 0.0 and 1.0. If the value hits 1.0 then the player is spotted and combat will commence.



[174]

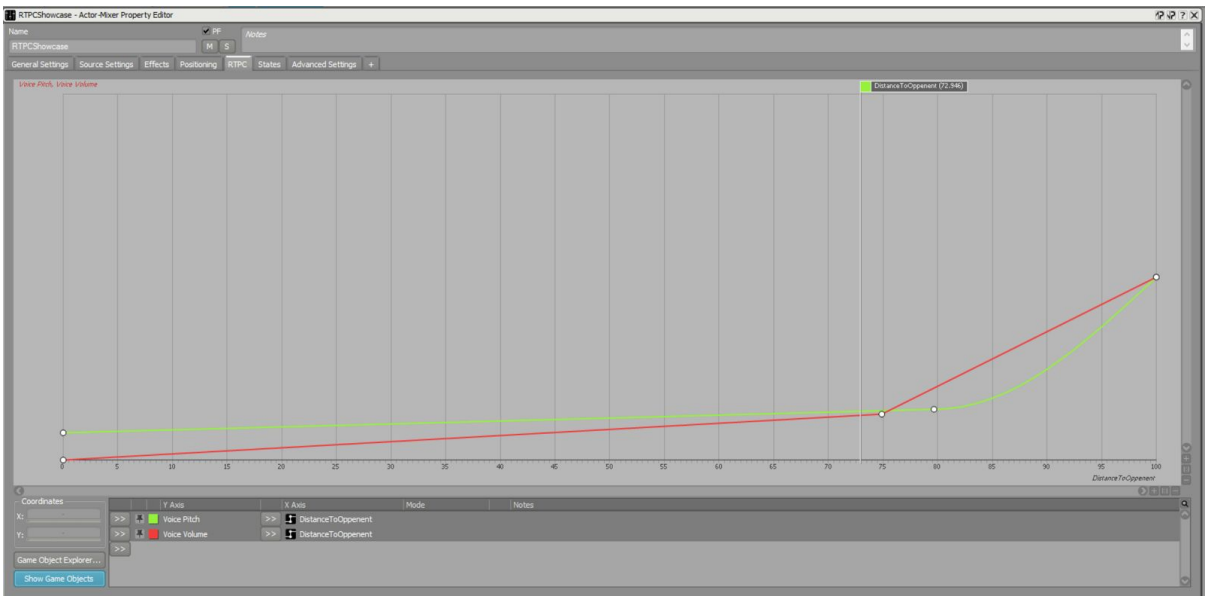
[173] Figure 43.
[174] Figure 44.

This exact same graph, could be explained differently by interpreting the visibility value



[175]

By doing so, we make it possible for any sound to have a specific volume given on the distance from the NPC to the character. In Wwise it could be setup like this:



[176]

In this Wwise example, I have changed the value from 0-1 to 0-100 and inverted the curve for easier reading.
This means that if you are a visibility value of 72,946 from the NPC (or 27.054 Meters), the volume and pitch would be as set by the red and green curve, making the volume just below 12dBFS and the pitch around -3500 cents.

This would make it an extremely deep and subtle sound at this moment, but the key is to know that these values can be linked.

An interesting note about this specific noise in The Last of Us, is that it is not followed by any visual cue, meaning that it is only the sound that carries the information. Besides from making it an informant, this is also in the grey area between direct and indirect, since this sound is never mentioned to the player as being an informant, the player has to discover it by him or herself.

[175] Figure 45.
[176] Figure 46.

8.63 Manhunt[177]

The sound design in that game was also done by Will Morton (with other sound designers attached to the project as well) at Rockstar North, and Will explains in our correspondence how this was a really good game to use in the explanation of guiding players.

Everything in Manhunt is designed to support the narrative, the atmosphere and to guide the player, giving a clear indication of where the enemies are located so that it is possible for the player to know where to go without relying on visual orientation alone.

8.7 Conclusion of the technicalities

Here I have shown a number of examples and a wide range of ways to deal with various issues when sound designing a game. It is clear that the abilities for actual design are practically endless and the combinations possible between the information delivered by the game and the sound engine is immense.

Combining any value from the game engine to a sound and have them manipulate each other are some of the basics of synthesis, yet in the cases here we do use samples, but the way they blend into each other and can be used individually as grains to create a larger scale of randomness prove that sound design for games is far from linear, even if the visuals of the game is.

I have shown a number of examples in both Wwise and in Glacier 2, showing just a small amount of the possibilities there is in these engines. The fact that it is possible to manipulate a sound from a value based on the amount of vision that any enemy may have on your character, prove that sounds in games, if made for it can be of great importance and help guide the player directly towards or away from the goal if that is the intended.
The ability to alter the music in a game on the game depending on player actions and game code is the very foundation of interaction, and even though that many modern games are becoming more and more linear and story driven, this is still the very key difference between motion picture and video games, the nonlinearity of the sounds and the musical score.

As shown, it is possible to utilize the constant conversation going on between player and game, simply because the player sends endless amount of information to the game and the game itself can be tweaked to pass on just the right information to the audio engine, providing the perfect response to any player action feeding the constant conversation with sounds that are informant diegetic.

[177] Manhunt. (2003). Rockstar Games. http://www.rockstargames.com/manhunt/

9.0 Informant Diegesis Features in my own games

I have worked on quite a few games now, but a lot of the older games I worked on only had sounds that had to follow the image. They may have been interactive so that the player could choose what to do and sounds would accompany the actions, but they would be strictly non-informant diegetic.

They may have been aesthetically interesting or heavy supporters of narrative, but you could play the games without sound and the only difference would be the atmosphere that the player would experience.

For two years I was employed at CCP Games in Reykjavik, Iceland. And got to work on some very unique and fantastic IP's, this will be explained in the first subchapter of this chapter specifically about EVE Online.

9.1 EVE Online[178]

I was working at CCP Games for two years (from August 2012 to 2014) and I got to work on some incredible unique titles, such as EVE Online. CCP Games is located in Reykjavik, Iceland.

During this time I had almost creative freedom to create the sounds for- and implement them into the game, which lead to some really interesting behind the scenes / under the hood audio development.
The engine used with EVE Online was incredibly primitive compared to others I have worked with, but that can be a good thing when it comes to limitations, and because of the primitive audio engine and primitive implementation possibilities, almost everything could be done at a much deeper level than having tools to make production faster or easier.

Several ideas did not make it into the game, but that doesn't mean that they cannot be presented here as prototypes and examples of informant audio.

EVE Online is an online multiplayer game, with several hundred thousands of players, by the time I left the company in August 2014. EVE Online is different from many other online multiplayer games by having only one server or one game universe, so to speak.
This meaning that everybody connected to the game server, would play in the same world, everybody could meet each other, fight with one another or work together with one another.

[178] EVE Online. (2003). CCP Games, Iceland. http://www.eveonline.com/

This is very different from most other games of this kind, where servers are located all over the world and players on one server would never get to meet players on the others.
Therefore EVE Online relies heavily on players versus players, where many other online games only have some fighting between players and are mainly about fighting together against the NPC's (Non Player Characters). This makes EVE Online unique and is a great study for many fields of interest outside of videogames, such as market research, as EVE Online offers it's very own player only driven market of items traded within the game, so such item values can be studied by economic researchers to find reasons to fluctuating prices.

Even on the technical side of things, the server running EVE Online, is studied by many companies and researchers all over the world for its powers and it's way of running such a unique game.

9.11 Problems with EVE online

One of the problems with EVE online was that the game had previously not focused very much on audio development; the game had a great soundtrack and though the sounds and audio aesthetics of the game were of excellent quality, the game itself was not developed around having a soundscape to immerse the player in.

Some statistics that we had gotten in revealed that it was roughly only 60% of players playing with sound on and we made a focus group focusing hard on how we could make it lucrative for players to turn on the sound.
We had a lot of things in focus and some of them was actually non-audio related, but more of a PR nature by communicating our ideas to the EVE Online community and showing off our new sounds before release, but one of the core ideas that spawned during these meetings was that we had to make sound a tactical advantage.

Not a great advantage, but still an advantage; and we started planning how this could be done by using informant diegetic audio and we started with the small things. We wanted to create new turret firing sounds, which was my first assignment when I started working there, and to begin with it was expected that each type of turret would have a specific sound, but the system actually allowed for a much deeper integration, which was that a ship of type A with turret type A, should not necessarily sound like ship type B with turret type A and so forth.

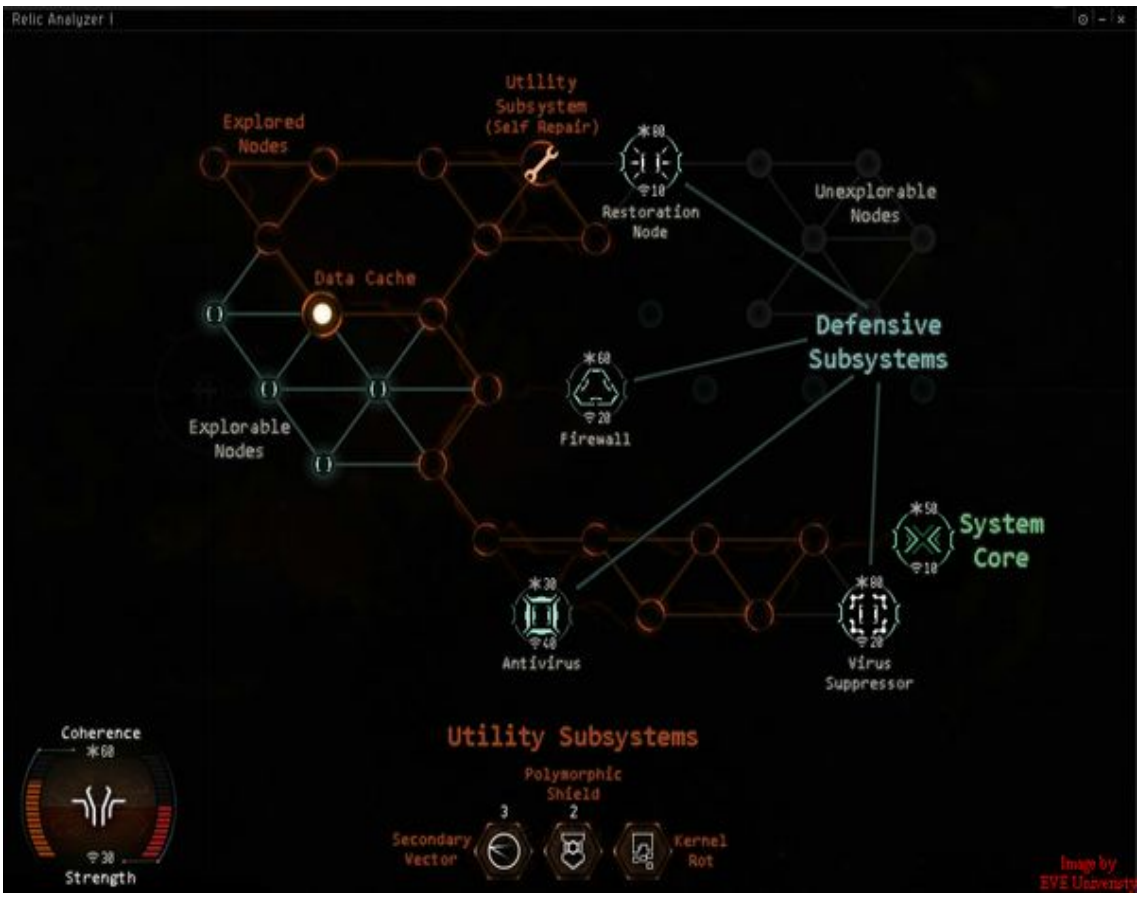
Some of the turrets need to be loaded with specific ammunition which has different game designed bonuses attached to them, and these are important to other players. The player who fits a turret with ammunition type A, knows that this type of turret with this type of ammunition will do mainly damage type 1.

If player two is able to hear this, by listening to the gun sounds and then tank his ship to resist that specific type of damage, then we have an informant diegetic turret fire sound.

Another thing was the impact when a player was his, the type of shield and armor a ship was carrying could also be useful, which would be reverse from the situation with the firing sounds which was an advantage to player two, the defensive player, this would be useful to the player firing the turret. Being able to hear what type of defense the other ship is carrying would also be of an advantage tactically. There was a lot of material that could be adapted to informant diegetics, we just needed to get it in, which is the hard part and therefore a lot of this never made it in.

9.12 Problem Solving audio with EVE Online

In the EVE Online expansion, Retribution, in December 2012 a hacking mechanic was introduced to the players when exploring certain parts of the EVE Online universe. This small mini-game was for players to solve a small puzzle before getting the valuables inside this specific part of the game, which is called Ghost Sites.



179

[179] Image from EVE Online Ghost Sites, representing all the different types of systems that can be clicked and the different nodes. https://wiki.eveonline.com/en/wiki/NPTS_-_Data,_Relic,_and_Ghost_Sites

The point was to click through a number of nodes to find the core of the system and then "hack it" – on your way there would be nodes that would be more or less attractive to hit. The player would have trained specific skills in the game to make this hacking part of the game easier, but a rule of thumb made by the game designers was that even with the lowest of low skill points in hacking, a player should be able to hack these systems, usually by luck, if the generated puzzle would be created to be easy to fix.

We wanted a very sci-fi modern soundscape for this type of gameplay and as a sound designer I wanted as much of the sound as possible to rely on data hidden from the player.
I asked the programmers of the game to provide me with some sort of predictive data of what the unclicked nodes would hide underneath.

Of course such data sent straight to the player's client is a liability to data security, so only certain parts of the data could be used and only used after they had been sent from the server to the player client, to avoid players exploiting the data and the ability to see the raw data.

The server would then provide us with a number between 0-100 indicating the calculated risk of the unclicked node, that divided by the amount of unclicked nodes that the player was able to explore would then give us the specific "risk" indication.

I used this number to control a blend container in Wwise with an RTPC value as explained earlier in the Wwise examples, meaning that it would control the amount of blend between sounds.

I created three layers of sounds and divided them into random groups of low, medium and high risk and whenever the player would hover one of the unclicked nodes, this noise would be audible in the background. The noises were sounding like static coming from electronic circuitry, but because of their grouping into low, medium and high risk, the player could hover the available nodes and get a tiny hint of which one of these would be the least risky to click.

This would mean that players with low skill could still complete a mini-game of hacking even if it was meant for characters with higher skill level or if a player had made a number of bad choices previously and was lacking the option to fail again without loosing the loot from a successful hack, could then use this noise to try and beat the game even if the odds were against him or her.

Another similar informant diegetic system implemented into EVE online is the anomalies in space.

Whenever entering a new star system, the player's spaceship will automatically scan the system and provide the player with information about this system; such as information about anomalies in the system. Some of these could be flown to right away, others needs to be scanned down, which requires a certain amount of skillpoints in scanning.

These sites could be very different, some of them could be the so-called Ghost Sites mentioned before in the hacking example. The ones that could be flown to directly was marked in green, the others in red.
The player could hover the HUD icon representing the specific anomaly and a static radio signal would be audible, much like the hovering of the unclicked nodes in the hacking example.
The sites would also be divided into groups of danger, leading to different radio static noises to be audible when hovering them, meaning that it was possible for the player to hear if a site was packed with enemies or if there were fewer enemies located at the site before approaching. This could be a clear indication of whether it would be a definite suicide to go to the specific site or if the site and mission present was worth it for the player.

9.2 EVE Valkyrie[180]

In EVE Valkyrie, a title coming out in March 2016,[181] as a release title for the VR headset Oculus Rift, I was working on the first iteration of the game in 2013 and 14. One of the core elements in EVE Valkyrie is that it is a Virtual Reality game (VR), meaning that the game will be played in true first person, this is different from other first person games, where you play a different character than yourself but see everything in the game first person from this character.

Because of VR it is now possible to create first person games where everything you see is actually your vision, it is no longer a flat screen representing someone else that you are controlling and with that we decided that everything should sound like it was coming from the player's head or at least from the players cockpit and surroundings.

One of the things we did here was take the use of head tracking and controller tracking, meaning that we at any time would know in which direction the player is looking, how the player is holding his controller and that combined with HRTF[182] and

[180] EVE Valkyrie. (2016). CCP Games, Newcastle, England. https://www.evevalkyrie.com/
[181] EVE Valkyrie announcement trailer. CCP Games. Sound Design by Bjørn Jacobsen https://www.youtube.com/watch?v=KmNQEiJUthc
[182] Head Related Transfer Function. Binaural audio, able to use psychoacoustic theories and create a soundscape from stereo playback, that will represent the entire audible space of the player, including true positioning. http://www.umiacs.umd.edu/~ramani/cmsc828d_audio/HRTF_INTRO.pdf . http://www.mattmontag.com/auralization/hrtf.php

the basics of binaural audio, it became possible to create an, as close as possible, realistic soundscape.

When playing a game like this, and the fact that you are most likely present in a war zone inside the game, knowing where your enemy is becomes essential.
We created sounds that would follow the entire universe surrounding the player, meaning that it became possible to hear exactly where your ship was hit, if you were shot, meaning that every sound in the game became an earcon, nonverbal information to the player, constantly flowing and providing the player with positional data other than that of the visual cues and whatever information the HUD and may provide.

In the original audio design brief, the plan was to make it possible to hear what type of damage you were taking in, which engine was it, what was the condition of the ship, meaning that the player would constantly know if his or hers situation. Everything becomes informant diegetic sound really.

9.3 Hitman
Since November 2014 to present day (as of February 2016), I have been employed by IO Interactive working on the new HITMAN game coming out in the HITMAN franchise. A very big and exciting project.

As seen previously in the Glacier 2 engine examples, HITMAN is a game that offers great diversity when it comes to sound design, and the possibilities of tweaking any sound with any variable from the game's engine is practically limitless.
One of the features in HITMAN to notice is the endless changes in the musical score, the composition is built from several layers and several stingers to be triggered for transitional purposes. Hitman has several states the game can be in and the player might not know that the state of alert is slightly higher than normal at a given point in the game, but if the player would listen to the music, he or she could perhaps know.

[183]

In Hitman there are several ways to use the sound to an advantage, also the special ability to slightly be able to increase the focus of the character, giving him the ability to see slightly around corners and hear things further away is a great way of using sound as the primary informant. In previous hitman games, the only informant about NPC enemies around corners was entirely made of sound and their audible footsteps.[184]

Another simple informant diegetic sound implemented into the game, is at a point where Hitman has to shoot down a plane, that is escaping from a specific level. You can shoot it down with a cannon from a castle, but there is no visual cue as to when the plane is within the shooting range or within the correct aim of the cannon. A value is set in code when the plane is in the correct position, so that if the player presses the fire button when the plane is so, then the correct series of events, explosions and sound will play.

The feature added, which is a direct informant in terms of what it actually informs, but indirect because the player is unaware of it's existence, unless they have noticed themselves or read this thesis. The sound of some bypassing birds is heard, just as when the plane flies into the correct angle and aim. Creating a unique way of indicating that now is the time to fire the cannon.

[183] Image of Hitman's Agent 47 in his element, hiding at a fashion show waiting to kill his target. Image used with permission of IO interactive.
[184] List, S. H. (2016) Facebook discussion.

As explained earlier in the chapter on informant music and controllers the music is a great part of what makes the soundscape of HITMAN great, but also very informant about the players situation, both direct and indirect.
"I have never heard of anything like this and never seen a system that does what so. Add ons and small changes are common, but not in this level of complexity". [185]

Niels, along with our sound design team came up with a term we called "Suspense Event Stingers", which are mentioned earlier in the music controller chapter as well, these stingers are made so that in case the music needs to increase its it's intensity level, but only for a brief moment, instead of switching to a new level of intensity, one of these stingers can be played instead.
These can be triggered in all sorts of situations manually, but also automatically if specific conditions are met. This is confirmed by Jonas Breum Jensen as well.[186]

There are also "Stealth Reward Stingers" which add to the current musical score, instead of altering the intensity level, it plays a stinger when the player has done specific things and met certain conditions, I.E. when the player has moved past a guard without being noticed successfully.

9.4 Conclusion of my own games
In conclusion to these examples of games and mechanics that I have made myself, I believe that it is made clear that it is possible through very subtle changes in the game sound to alter the state of things.

Through these setups I was able to provide, not only feedback, but also small hints in the game which to some game players might be like a small easter egg. Easter eggs, but also just hidden features like that can fuel a sort of metagame within many players making the hunt for this type of feature the game itself over the actual content of the game.

It is clear that by implementing some of the mechanics I did in EVE Online, it became possible for players to gain a slightly tactical advantage when approaching specific situation. Knowledge that was extremely useful and valuable in a game like EVE Online.

And as a bonus, it is quite fun to develop features like these rather than just providing sound as "icing on the cake".

[185] Nielsen, N. B. (2016) Skype Discussion.
[186] Jensen, J. B. (2016) Email discussion.

10.0 Real World Audio Informants

In the real world, there are several informants. Humans are built through evolution to be able to alert and be alerted through our own speech and screams and our hearing.
There is a very specific reason as to why the pinnae of our ears and our basilar membranes increase the volume of certain frequencies, called the formant area. Specifically we these are the frequencies approximately between 2000 and 4000 Hz.

Peculiarly enough, human speech has its primary area of information located exactly between 2000 and 4000 Hz, meaning that you can remove basically all other frequencies and maintain an understandable voice, but removing or altering specifically these frequencies will result in a much different voice and most likely the inability to understand the voice.

The world around us utilises this ability and provides us with a wide range of information, just by listening, there are even video games based entirely on sound, which by using HRTF and directional sound guides the player through its levels, meaning that every sound is part of the game design and informants. The game in question is Papa Sangre, a brilliant game and I had the honor of discussing it over email at some point with one of its creators, Paul Bennun.[187]
But there are many more informants all around us, either generated to help us or informants that we can create or generate ourselves to guide us through the day.

Just like your car telling you that you forgot your seatbelt by beeping, or fuel is running low or in modern cars if the road temperature is below a certain threshold and more.

10.1 Crossing the street

When crossing the street, some street lights have an aural warning system, which function is extremely simple. It plays a low frequency click when the light is red and a higher frequency click when the light is green.
This is meant for blind people to orientate themselves about whether it is safe to pass the street or not, but this is easily as useful for modern people waiting to cross the street with their heads pointing towards their smartphones rather than on the street or crossing they are supposed to be aware of.

A simple click, informs of a color, which is the indication of clearance to pass or not to pass.

[187] Papa Sangre. (2010) Somethin' Else. Paul Bennun. http://www.papasangre.com/ http://www.somethinelse.com/

10.2 Pilots and Airplanes

It is well known that pilots in airplanes rely heavily on radio communication, which is verbal communication between the cockpit of the airplane and the flight control tower or other airplanes, but another way of dealing with information in a cockpit is through sound warnings.[188]

My friend Martin Fisker, pilot at Norwegian Airlines, and I had a long chat about the subject and he helped me understand quite a few things about what pilots needs to listen for when flying. The first example that he mentioned was that pilots are trained into hearing the engine running and if something is wrong, then judging by the type of sound it emits, tells them what is the problem.
This is much faster than any system having to do a full calculation of the whole system to figure out what might be the issue at hand.[189]

Martin also pointed out that they are constantly upgrading the cockpit systems and warnings, so new ones are added from time to time and he mentions after a Turkish Airlines crash in Amsterdam a new aural warning of “Low Speed” was added to their list of aural warnings.

There is a hierarchy of aural warnings, in the Boeing 737, as Martin flies, and the hierarchy means that the more important aural warning either mutes the less important one or is played more often. These warnings can be simple beeps, but in most cases they are verbal, meaning that their meaning is very clear.

A system called TCAS (Traffic Alert and Collision Avoidance System) can inform the pilots with the words “traffic, traffic” meaning that they are on a potential collision course with another aircraft. The system will also inform whether the pilots must perform a climb or a descend of the aircraft in order to avoid the other aircraft.
This alert can be overruled if the aircraft is in immediate collision danger with another object, like a mountain, then the EGPWS (Enhanced Ground Proximity Warning System) would take over with a warning that could be “Pull Up Terrain”.

The logic here is that the immediate danger is a greater threat and must therefore be treated first and that it is far more dangerous to crash into a mountain wall over having to orientate yourself about another aircraft in the sky.

Some warnings are different, as the stall warning is not a sound emitter, but a little rotor engine that will cause vibration to occur in the physical steering, called a yoker.

[188] Boeing 373 warnings https://www.youtube.com/watch?v=W5Z-d1Zx02o
[189] Fisker, M. (2015) Email Correspondence.

It creates a rattle sound and because the physical vibration together with this, the pilot knows that the aircraft is about to stall.[190]
In a lot of films about flying and aviation in general, a lot of warnings are seemingly only beeps and noises, these do occur as well in a real airplane, though I must admit that I by far would prefer verbal warnings and their meaning cannot be misunderstood as well. But that might be why I am not a pilot myself and have friends like Martin to fly me around.

All aural warnings in an aircraft are intended not to sound alike, which is why the verbal system is very good, but certain beeps cannot be mistaken from one another. An example is that the sound of having a wrong start configuration before take off uses the same warning as the cabin pressure warning if the aircraft is above 10.000 ft. These two warnings may have the same sound, but they cannot be mistaken because of the situation they might occur in.

As mentioned earlier, the pilot can listen to engine problems and will know exactly what type of problem is occurring.[191] In the reference video example you can clearly hear how small explosion like sounds are audible in the entire plane, this is a direct indication of that a so-called “engine surge” or stall, if at high altitude, has occurred. Most aural warnings in the cockpit which are generated by the flight computer, comes out of small speakers all over the cockpit as well as in the headphones of the pilots, meaning that there is no way that the pilot cannot hear these warnings.

10.3 Hollow walls

If you need to know if a wall is hollow or what type of material it is made of, tap it and use the sound feedback as the information that you need.
This goes very well hand in hand with the footstep example from earlier about when to dig for the treasure, but in this case it could be about where to drill your hole or where not to drill your hole, depending on what you need to put there.

10.4 Papa Sangre. A real world directional audio game example.

Papa Sangre was developed by a company called *Somethin’ Else*, they are actually not a typical videogame developer, but more of a media company who develops whatever they feel like, commercials and music for BBC and much more. The game relies entirely on HRTF, as explained earlier this is the Head Related Transfer Function, the very basic foundation of binaural audio, which in theory gives anyone the ability to listen to a stereo pair of headphones and through that and careful filtering it should theoretically be possible to make any listener to hear perfect positioning.

[190] Stall warning in a Boeing 373, steering control vibration. https://www.youtube.com/watch?v=NtQqb7rstrQ
[191] Engine surge during takeoff. https://www.youtube.com/watch?v=4EJl1--q2YQ

A quick explanation of this, is that when a sound is coming from your right, it is not the same as just panning the sound to the right. You may have tried to pan a sound in your headphones and noticed that it then sounds like it is from the right side of your head or that it is coming from the right headphone only, but if this was a physical sound coming from your right, it would not only be louder on your right side, it would also be audible on your left side with a slight delay. Speed of sound is approximately 342 m/s or 13464,5 inch/s, and the ears on a regular human is approximately 17 cm apart or 6,7 inches. a quick calculation gives us that it then takes sound 0,00004976 seconds to move from one ear to the next, just enough to achieve binaural effect and become a just-noticeable internaural delay, since the calculation is not entirely precise because of the line that sound travels is not in a straight line across the face.[192] This may seem like a small number, but the ear is definitely able to understand this and define that there is a slight delay, and give you a clear positioning representation of that object is coming from your right side. A barely noticeable delay between two signals will result in a psychoacoustic separation of the signals, used to judging the sounds original position.[193] *"Unlike the eye, the ear affords no direct image of the world around us. Yet, in addition to our ability to judge frequency and distance, our binaural hearing can give us an amazing amount of help in dealing with that world."* [194]

By tapping the feet on this UI on your phone, while listening is the only interaction the player has during playing a level, the player has to turn the circular bones at the top like a compass to change direction. In the headphones, a sense of space and positioning is available.

The first couple of levels provide great fun and include finding a target hidden close to water, but not in it - so don't go further if you hear your footsteps getting wet. A very big informant.

There is also a monster that you need to avoid, you can hear its breath as it is sleeping nearby, walk slowly, by tapping slowly on the UI interface and listen carefully so you don't disturb it to continue.

[192] Fastl, H. Zwicker, E. (2007. 3rd edition) Psychoacoustics - Facts and Models. (pp. 293) Springer
[193] Fastl, H. Zwicker, E. (2007. 3rd edition) Psychoacoustics - Facts and Models. (pp. 157) Springer
[194] Pierce, J. (1999, 2001 MIT Paperback Edition) Hearing in Time and Space. In Cook, P. R. (Ed.), Music, Cognition and Computerized Sound. (pp. 101). MIT Press.


[195]

This game is filled with informants, every sound has a reason to be there in terms of being informant, everything is directional, meaning that you have to be aware of your surroundings and the game is much easier to complete if you close your eyes at the same time.

10.4 Conclusion of the Real World Audio Informants

Warnings and information is all around us, no matter if they are generated by computers and used as information sources to help and guide you or if they are warnings in an aircraft, or if they are sounds that we can generate ourselves and use to check on specific material or situations.

The difference between listening to a hollow wall knocking sound and an alarm in an aircraft is that the sounds in the aircraft are generated warnings while the knocking on wood sound is more of a generated informant, but both extremely helpful and necessary to achieve the desired.

Warnings and sounds like these is no different from any informant diegetic sound in a videogame as the guide and provide information about a current situation and possibly also contain the solution to the situation if the information is verbal or if the receiver of the warning is completely aware of a specific type of signal warning.
A sound can prevent an aircraft from crashing by warning the pilot in time, a sound can cause a player of a videogame to take a different route towards the goal because of his or hers situation.

[195] Papa Sangre. The only visual available to the player, the rest is sound only. https://itunes.apple.com/us/app/papa-sangre/id407536885?mt=8

11.0 Informant diegesis in video games conclusion

Game audio is unique for its interactivity and it's use of interconnection between game and player to create a much more detailed soundscape over any other audio visual medium. Of course it can be overdone and bad practice exists in all areas of all crafts, but in conclusion to everything in this thesis I hope that we can agree upon that sound in games can and will be connected to any parameter or value provided by the game as well as the game using, not only the obvious input from the player, it's ability to use all of the communication models processes to obtain information about any given situation, and it is up to the sound designer and developers of any game to determine how needed and how in-depth this kind of intercommunication is required.

By comparing real-world audio informants and how they guide our everyday life to how videogames work, then they are not far apart and the key difference between a film and a game is that the sound of "you have forgotten your seatbelt" in a film is a simple message to the character on screen, in a game it is a message to the player about a reaction is needed, just like in the real world. Because of films lack of interactivity. Unless of course, the mechanic to actually put on the seatbelt is not present.

By having discussed the subject of this thesis with many industry professionals I have gotten a wide range of views upon the subject and we all agree that sound is used to help the player in a different way than in film, yet we do also agree that it is not an uncommon thing in film either, it is simply that in film you cannot respond to the sound and action of the frame as you can in a videogame.

The conclusion is clear, that because of videogames interactivity, the constant conversation is real and this makes the use of the term informant diegetic and the ability to label as sound as such relevant to the creation of a game or any other interactive medium for that matter.

11.1 Critique of the conclusion

The amount of grey areas in the informant diegetic model and between all the different terms of diegesis that there is today makes it very difficult to perfectly label a sound. Sure more terms means that they are more and more specific, but it also creates more of these zones in between them which can be hard to nail. Sound in film and in games may not be that different, if their level of informant and the interactivity is ignored, their production may be the same - setting them up is of course different, but the desired result to immerse the audience and the player and to shape emotion and the narrative stay that same.

12.0 Perspectives

This thesis has discussed the subject of using sound as an informant in videogames and I believe that I have touched upon many essential areas of this discussion in this thesis.

The fact that sounds are commonly used in videogames to inform players is undeniable, and as Jakob Schmid and Martin Andersen from PlayDead, Limbo and INSIDE, nailed in their discussions with me, then connecting any value and information is taken for granted during their development. Any value or property that the sound designer needs to create the perfect soundscape, not only for aesthetic and narrative reasons, but also for game mechanic and game design reasons, is made available without question, meaning that setting up a game like this is an obvious assumption for game developers.[196]

12.1 Critique of the perspectives

Though I have proven that informant diegetic audio is a thing and that it commonly used in game audio production, then it also has to be clear that many games are also created without this in mind, using sound strictly as icing on the cake to simply support the experience or in many cases sound is “just something that is needed on top”.

If the game at hand does not need this kind of in-depth communication between player and game, and that simple visual cues is the only feedback needed for the game to work, then informant diegesis and this discussion can seem as overkill.

Specific cases for this has not been researched for this thesis, causing focus to be on how informant diegetic audio is possible and examples of it’s use and not how games without it would work. If a bigger picture of when informant diegesis was not needed or when it would be wrong to use it, a longer discussion and thesis would have been required.

The lack of film sound designers, particularly from great film production is also not present in this thesis, making all statements and my own theories and arguments become one-sided because we are only representing the game audio production side of the subject. Yet I believe to have made clear that informant diegesis is extremely useful, this does not give us the film sound perspective as to how film sound designers would make use of similar tricks in their productions and I am sure that there are some.

But as an overall perspective of this thesis; I believe to have made several angles, both aesthetic and technical of the subject and therefore made it clear again that

[196] Andersen,M. S. (2016) Transcribed conversation.

when it comes to videogames there is a need for either new terms or rewriting of the old analytical terms within audiovisual theory, to match this new interactive medium, which is actually not that new any longer.

12.2 Final Notes

This concludes my thesis about Informant Diegesis in Video Games. I have covered both the theoretical, practical and technical perspectives of the subject as well as showing several examples and using several sources of videogame industry professionals and sound and music industry professionals.
All discussions with these professionals led to extremely interesting new perspectives and angles on the subject as well as they fueled several new thoughts and future ideas within me.

I would like to thank all who participated in the discussion of the subject with me.

Through all these discussions and examples, it shows that some sound designers of videogame sound use and some do not think of it when they use informant diegetic sounds in their games. Sounds do not necessarily have to be planned as such, but it will more often than not come as a natural result of playing the game, that sounds become informants by themselves because they are in constant relation to massive amounts of data from the games code.

I look forward to researching this subject further and clarifying it even further in future papers about the subject.
Thank you for reading my thesis and I hope you enjoyed it and learned something along the way.

13.0 Acknowledgements

I would like to give a big warm thank you to all of my family and friends who put up with me during my studies and constant talk of music, sound and game audio implementation for the past 20 years since I made the decision that this was my way to go.

Olivia and Signe for putting up with my horrible skills at being a family father while working full-time and writing this at the same time.

Sus, Bo, Jan, Peter and Lasse for supporting me and understanding how important this was to me and particularly Sus, Jan and Bo for putting up with my noisy skills as a teenager and my decision to become a musician and sound designer.

I succeeded and fought hard for it, and it wouldn’t have been the same without you. Thank you.

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15.0 Appendix for images and figures

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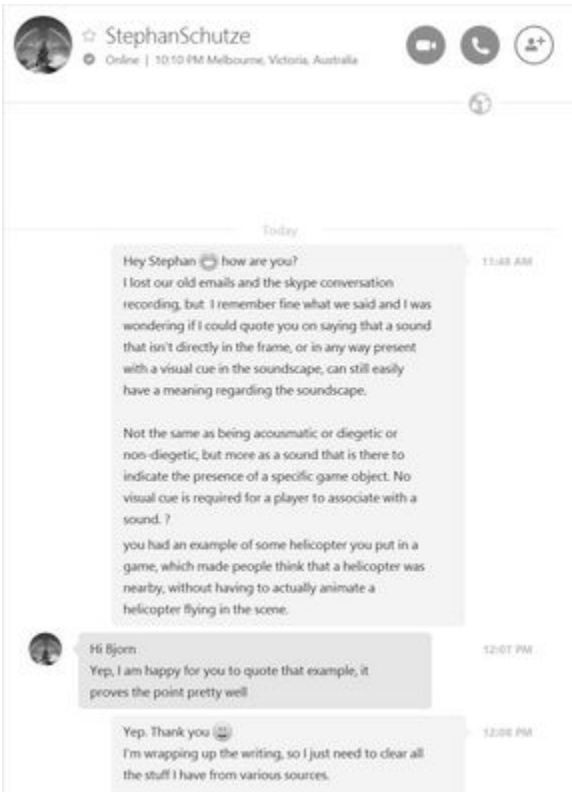
16.0 Appendix for Discussions

This appendix contains all email and transcribed conversations that took place prior to and during writing of this thesis. If a reference has no copy of the conversation or transcribe it is because the person took part in the discussion but an official transcribe or copy was not made, those specific discussions are not referred in the thesis either and they will not be quoted, but they are mentioned because they were very inspirational regarding the subject.

Stephan Schutze - Sound Designer, Audio Guru. Skype Conversation. http://www.stephanschutze.com/ http://www.soundlibrarian.com/ https://www.linkedin.com/in/stephans1  	Adam Swanson. Lead & Senior Sound Designer at Riot Games. https://www.linkedin.com/in/adamkswanson 

Ben Minto. Senior Audio Director at DICE. EA Games.
https://www.linkedin.com/in/jiblite

From: Minto, Ben
Sent: Monday, January 27, 2014 8:02 AM
To: Bjørn Jacobsen; Ben Minto
Subject: RE: Fwd: thesis

Actually you are right

"The correct word, I think, would be to have a third layer of diegesis, which doesn't take into account of the first layer, diegetic or non-diegetic. It simply names if a sound is informant or not."

disagree sort of - its a different axis as in the LAD example

I think layer is the term I got stuck on – to me that suggests some kind of inherent relationship – like layers in a cake

I also like

its only an informant when the listener realises :)

and the different cases of this;

1 – the intentional – they hear what we sonified

2 – the hack – they use the unintentional to provide information

3 – the dillusional – belief that there is information in the sound when there isn't!

Fun! /ben

Rich Carle. Audio Director at NetherRealm Studios.
https://www.linkedin.com/in/rcarle

Carle, Rich [RCarle@netherrealm.com]

Hey Bjørn,

Sorry for the delayed response – things are a little busy around here right now.

Well – I guess I'll just ramble on a bit and hopefully something I write will be helpful, but I can't say that I 100% agree with you. I still believe that the vast majority of game sounds fall into the diegetic and non-diegetic definitions (http://filmsound.org/terminology/diegetic.htm). I believe that sounds that inform the player of a particular game design issue would fend to fall in a subcategory of non-diegetic. Does your informant/non-informant sound category live under non-diegetic? Or is it meant to replace them? and if so why? And, if informant/non-informant, both live under the non-diegetic classification then I'm not sure what function a non-diegetic, non-informant sound would serve...

From your examples, I would define an "informant" sound is one that relates some gameplay information to the player. In your example of footsteps, you show how subtle that change can be. That there are cases where informant sound can actually still be diegetic. I love this idea because your simultaneously keeping the player immersed while simultaneously queuing them to a situation they can interact with. Unfortunately, in my own development experience and in my experience as a game player clues that subtle are often too difficult for the average player to discover and need further support. This support typically comes in the flavor of visual icons, or glowing particles or non-diegetic sounds. Games that use sneaking and discovery as a primary feature, however, are much more likely to be able to effectively utilize diegetic, informant audio cues to alert the player.

A film professor might argue that a film sound designer could inform their audience in a very similar way. By stretching the boundary between diegetic and non-diegetic sound to underscore a particular motif in the film. For example, if a film was exploring the dysfunctional relationship between three people any time 3 things happen in succession (three doors slam, three phone rings, three slaps on the face) the sound designer could enhance these beyond their diegetic original to subtly act on the audience. These final sounds could easily sit in between diegetic and non-diegetic. They may not be informing the audience they could now do something, but they are intentionally trying to illicit a response – just an emotional one.

I think design-centric audio in games is similar to story centric audio in films. There has been a lot of emphasis on narratives in games and for many games the narrative is the equally as important as the interactivity (The Last of Us, Uncharted, Bioshock etc.) I still believe, however, that a game lives or dies by its interactive experience and audio design that is always aware of that experience, enhancing it, supporting it – raises a game's interactive experience dramatically.

Back to work!

-R

Ben Minto - Continued.

... just like the beginning of Gravity, where they try to get people to shut the f-ck up, by making the noisy ones painfully obvious instead of drowning them out with sound.

disagree sort of - its a different axis as in the LAD example

Fun! :)

Leonard Paul. Interactive Audio Specialist. School of videogame Audio.
http://sovga.com
https://www.linkedin.com/in/videogameaudio

Info SchoolOfVideoGameAudio
To Bjørn Jacobsen
12/13/2015 5:48 PM

Hi Bjørn,

It took me a while to get back on top of things after NYC but now's a good time for me to respond to your question.

I'd start out by saying that I'm not too concerned about academic thought on this topic. I try to consider input from many different directions, which include individual players' reactions on how game audio influences them on a personal level rather than getting too theoretical about it. I also believe that it is difficult to force people to do things with audio and this isn't really my goal when I'm creating interactive audio. I try to support the player in their experience and aim to make it a more deep and meaningful experience that will hopefully be a positive memory that they can return to in the future. I feel that my work on games like *Vessel* and *Retro City Rampage* support this approach and give a lot of space for the player to explore the world.

As far as a good example of creating an environment that directly takes the player in mind, I would say that the adaptive music for the indie game *Vessel* is a good example. The game was entirely created around the music of Jon Hopkins. The developers used it as temp music when creating the game and the feel of the music is infused throughout the design. We were lucky enough to be able to license several songs of his. I took the stems and remixed them down to four tracks that would work interactively in response to how the character was doing solving the puzzles in the game. The basic structure was that the songs would change based on location and then the mix would change depending on their progress in the level. One of the nice things about the system we created was that the music would change in a musical way by waiting until a certain passage had completed or to slowly fade out a layer if the player was having difficulty with a puzzle. I wanted to create a system that really felt like someone was underscoring the game as you were playing it instead of it being a more obvious dynamic music system. All of the music in *Vessel* was brought together to create a consistent musical environment. There's some great thoughts by Koji Kondo in his GDC lecture from a few years ago that gives some great insights, especially in how the player and the music are related:
http://www.gamasutra.com/view/news/194002/GDC_Koji_Kondos_Interactive_Musical_Landscapes.php
http://www.gdcvault.com/play/754/Painting-an-Interactive-Musical (audio currently incorrect!!)

There's a good video on the details of *Vessel* here:
https://www.youtube.com/watch?v=KGydMPPvaY4

If you're quoting me for a publication, it'd be great to send me a copy for review just so I can have a look. Feel free to ask me any questions you'd like.

-Leonard

On Wed, Oct 21, 2015 at 1:24 AM, Bjørn Jacobsen <b@...dk> wrote:

Prof. Brian C. J. Moore. Professor at Cambridge University in Auditory Perception.
http://www.psychol.cam.ac.uk/directory/bcjm@cam.ac.uk
http://hearing.psychol.cam.ac.uk/Biogs/bmbiog.html

Matthew Marteinsson. Audio Designer at Klei Entertainment.
https://www.kleientertainment.com/
https://www.linkedin.com/in/mmarteinsson

Re: Thank you

Matthew Marteinsson
To: Bjørn Jacobsen

1/13/2016 8:51 PM

Oh sorry, totally forgot to respond!

Was happy to chat about stuff.

Please use the quotes from me. Happy to help out.

Matthew

On Wed, Jan 6, 2016 at 1:16 AM, Bjørn Jacobsen <b@cup.dk> wrote:

Hey Matthew

I just wanted to say thank you for your contribution to the discussion we had on sounds and informants in games.

I'm wrapping up the project and just wanted to say that it was very inspiring what you had to say.
If it's cool with you, I'd like to quote a few things and paraphrase some thoughts from the discussion.

Mainly your comment about that a sound in game sound design should either support the narrative or inform the player, if it doesn't then it shouldnt be there.

You mentioned a couple of things from don't starve, which wasn't meant as an informant but turned out to be, specifically the hand at night which was audible before it was actually visible.

Is that correct ? And cool with you that I mention this? Beer is on me of course.

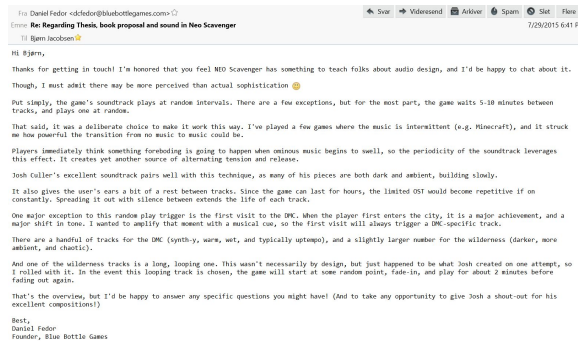
Cheers. From the the super cold Danish flatlands.

Bjørn

Bjørn Jacobsen - Audio designer - CCP games - EVE Online - EVE : Valkyrie

Contact: b@cup.dk - Phone: +45 30 137 909

Daniel Fedor. Game Designer at http://bluebottlegames.com/ .



Svar | Videresend | Arkiver | Spam | Slet | Flere

Fra: Daniel Fedor <dcfedor@bluebottlegames.com>
Emne: **Re: Regarding Thesis, book proposal and sound in Neo Scavenger** 7/29/2015 6:41 P
Til: Bjørn Jacobsen

Hi Bjørn,

Thanks for getting in touch! I'm honored that you feel NEO Scavenger has something to teach folks about audio design, and I'd be happy to chat about it.

Though, I must admit there may be more perceived than actual sophistication 🙂

Put simply, the game's soundtrack plays at random intervals. There are a few exceptions, but for the most part, the game waits 5-10 minutes between tracks, and plays one at random.

That said, it was a deliberate choice to make it work this way. I've played a few games where the music is intermittent (e.g. Minecraft), and it struck me how powerful the transition from no music to music could be.

Players immediately think something foreboding is going to happen when ominous music begins to swell, so the periodicity of the soundtrack leverages this effect. It creates yet another source of alternating tension and release.

Josh Culler's excellent soundtrack pairs well with this technique, as many of his pieces are both dark and ambient, building slowly.

It also gives the user's ears a bit of a rest between tracks. Since the game can last for hours, the limited OST would become repetitive if on constantly. Spreading it out with silence between extends the life of each track.

One major exception to this random play trigger is the first visit to the DMC. When the player first enters the city, it is a major achievement, and a major shift in tone. I wanted to amplify that moment with a musical cue, so the first visit will always trigger a DMC-specific track.

There are a handful of tracks for the DMC (synth-y, warm, wet, and typically uptempo), and a slightly larger number for the wilderness (darker, more ambient, and chaotic).

And one of the wilderness tracks is a long, looping one. This wasn't necessarily by design, but just happened to be what Josh created on one attempt, so I rolled with it. In the event this looping track is chosen, the game will start at some random point, fade-in, and play for about 2 minutes before fading out again.

That's the overview, but I'd be happy to answer any specific questions you might have! (And to take any opportunity to give Josh a shout-out for his excellent compositions!)

Best,
Daniel Fedor
Founder, Blue Bottle Games

Jakob Schmid. Audio Programmer at PlayDead.
https://www.linkedin.com/in/jakobschmid

Jakob Schmid 5:03 PM
To Bjørn Jacobsen

Hey Bjørn!

Schmid quote:

The main character in our game INSIDE is a young boy. To be able to play foley and voice sounds that react to the state of the game, we analyze the physical properties of the character and feed values from the game engine to the sound engine.

The most important value we determine is a discrete action state, that describe whether the boy is running, jumping, climbing, falling, etc. We use this action state combined with the action state from the previous frame to determine which sound to play at any given time.

We also determine a set of numerical values that describe his physical state: how exhausted he is, how wet he is, etc.

For playing voice sounds, we developed a breath sequencer that uses his action state together with the exhaustion value to determine when to play a breath sound and which sound to play. If the boy is standing still, the breath sequencer will stitch sounds together to form a continuous breathing pattern. When the boy is running, the breathing will align to his footsteps. If the boy is jumping, he will hold his breath until he hits the ground again.

When the character is standing still, the length of the randomly selected breathing sounds will vary and form a natural sounding breathing pattern. The timing of these sounds directly controls a breathing animation that animates the chest and spine of the boy.

Bjørn analysis:

Internally in the engine, we have a constant conversation between the breathing sound and the animation system.

Schmid quote:

We use control trigger boxes as well as scripts to set values that control the breath sequencer, such as breath intensity. We can also control an 'emotion' switch that determine which subset of sounds are used in the sequencer, and make the voice of the boy sound normal, afraid, or relieved. These emotions may serve as a warning to the player that the boy is danger even before the player is aware of the danger.

Bjørn analysis:

The two latter are direct informants of the current situation in the game, as these emotion sounds may be played before the physical player of the game may know of a dangerous situation.

I also mentioned your production planning phase, which makes it clear that these kinds of values and parameters are all taken for granted and any combination of these that any designer, in this case sound designer, would need should be made available to them as it makes the creative process of creating a more complex soundscape possible.

Schmid quote:

During pre-production, we didn't discuss feeding analyzed values such as physical state and material information from the game engine to the sound engine, everyone assumed without question that it had to be done. A similar setup was used in Playdead's previous game, LIMBO, and it was taken for granted that the sound designer would be provided with whatever values he needed.

Held og lykke med opgaven,

Jakob

Will Morton. Audio Director at
http://www.solidaudioworks.com/
https://www.linkedin.com/in/willmortonaudio

Re: Thesis 'n stuff

Will Morton 1/10/2016 12:34 AM
To Bjørn Jacobsen

All sounds good to me! Glad to be of help!

Good luck :)

Will

Will Morton
Audio Director
www.solidaudioworks.com

On 9 Jan 2016 10:18 p.m., "Bjørn Jacobsen" <b@cujo.dk> wrote:

Hey Will,

Hope all is good and that you had a wonderful Christmas and a happy new year. :)
I'm wrapping up the thesis and draft for my publication project and I wanted to thank you for participating.

Just a heads up, I'm quoting a few parts and paraphrasing some, it's mainly about your comments on that GTA V was made to have a unique soundscape for every area on the map, making it possible for the player, even just subconsciously, to know their location. Also providing soundscapes that would make areas sound more or less dangerous depending on their "level of danger" or what was about to happen in the game.

Specifically:

Will mentions that they were using the Rockstar engine RAGE, which gave them access to an almost infinite number of game metrics, which clearly tells that anything can be used to change everything, from sounds created through synthesis alone to samples being played back, both single triggers and loops.

Will comments that they tried hard to give every area of the game it's own personal audio soundscape, so that players, even subconsciously would have a better chance of being able to navigate the map, it will allow for the designers to make areas sound safer or more dangerous depending on the story or what was about to happen.

I might change the wording and not have them say "Will mentions" or "Will comments", but that's just for the editing later.

and the piano notes played in L.A. Noire, with nothing fancy going on, as you said, but it is still a great example.

During an interrogation of a suspect, you have a multiple choice to make to progress and if you answer correctly a positive series of notes is played, but if you answer wrong then a more negative, dissonant, series of notes will be played, and that would be a simple switch or dual incoming events. It could be done in these ways:

And I just want to ask, if that is kosher with you?

thanks Will, I really appreciate this.

-Bjørn

Bjørn Jacobsen
Audio Designer - IO Interactive - Cujo Sound

Phone Contact: (+45) 30 137 909
Mail: b@cujo.dk
CVR / VAT Registration: DK03730225

Steve Whetman. Audio Director and Designer at AudioBeast.
https://www.linkedin.com/in/steve-whetman-45353115

Re: Book project thing.

Steve Whetman 1/13/2016 11:17 AM
To: Bjorn Jacobsen

Hey,

Absolutely fine by me mate :)

Good luck!

Cheers
Steve

Steve Whetman | www.audiobeast.io | +44(0)7540 242 633

Audio Direction | Sound Design | Recording - Games | Film | Trailers

On 13 January 2016 at 08:40, Bjorn Jacobsen <b@cujo.dk> wrote:

Hey Steve

Just a heads up, I really dig those things you said about that both film and games have practically identical tell-tales, warnings and so on, but in film the reaction to them has already been chosen

and a few other things, I'd like to paraphrase some of that, if that's kosher with you?

only 14 days left of writing, it's going to be hectic-

-Bjorn

Bjørn Jacobsen
Audio Designer - IO Interactive - Cujo Sound

Phone Contact: (+45) 30 137 909
Mail: b@cujo.dk
CVR / VAT Registration: DK33730225

On January 6, 2016 at 5:18 PM Steve Whetman <steve.milanese@gmail.com> wrote:

Hey!

For sure, if your team has free sound designers then why outsource anything! Personally i love doing trailer sound design and so i've always done that myself in-house, but there's definitely a trend of studios being very busy and wanting to focus on the product, so they outsource to a specialist. Some are better than others, some are absolutely fantastic at making great trailer audio.

Both games and film use tell-tales, warnings, signifiers, informants or audio-ui to communicate and feedback for sure. In shooters there is the obvious 'last 3 bullets' that's been around for many years. Designers and game directors are often trying to get away from having visual clutter and use in-world visuals or audio instead of UI, a truck mounted mini-gun overheating visually and auditiy is another example, still often accompanied by a small ui animation. The sound of being near a secret in Tomb Raider, the sound of particularly creaky floorboards that might smash in Gears of War.

I don't see them as hugely different to audio tricks in film though, they both communicate something to prepare yourself for, it's just the nature of the medium of games that it is interactive and you can (usually) choose to respond. But they both do the same job. The difference for me perhaps is that in a game you are playing a character and you have the choice of responding to the tell tale sound and often a large part of the game is if you are able to respond in time, or with skill, or if you choose to respond at all, perhaps you choose to hide in a closet from an alien rather than run. In a film you are watching someone who has already made those decisions and they've made them for the same result, it's a matter of perspective and story telling.

These are all things that exist in both games and film, and music to an extent too. Perhaps i'm in a club and i hear the tell tale sound of a certain type of music, i don't like it and choose to hide at the bar ;) watching everyone else having made their decision to stay and dance, all in their own way with different levels of skill haha

Are you looking to group and classify sounds into different categories e.g. diegetic/acousmatic etc or just discuss how that might be different in games and film?

Cheers
Steve

Steve Whetman | www.audiobeast.io | +44(0)7540 242 633

Sound Design | Recording | Audio Direction | Games | Film

Stuart Bradley Newsom. Founder of indie game studio: Naughty Shinobi.
https://www.linkedin.com/in/sbnewsom

Stuart Bradley Newsom
Online | 12:29 PM San Dimas, California, United Sta...

Today

would you approach it?

I'm thinking, along the lines of that a sound could be a mechanic on it's own and any value from the game could be used to change a sound, so that it may be the warning of "everything" really.

I go about functional audio the same way I go about character design. The shape and visual acuity needs to be distinct enough so the player can recognize its function or start to build a clear image of it. Functional sound needs its own aural shape, with a unique pattern that doesn't fade with the environmental noise. A good example of where I had to apply this was in my latest unofficial tribute to an 8bit icon, Dangerous Dave. Now that the game has made the switch to first person, every sound needs to be distinct enough so the player knows what monster just spotted them from around the corner. In a game filled with bleeps and bloops, I need the monster to have a distinct signature when they spot the player. So with I had to work with the mathematical equivalent of sound design, modifying the vibrato, frequency, pitch, sweep all to create a distinct alert to the presence of an Enemy. So I came up with a half a second Blrooargh sound. 9:24 PM

Of course, its really difficult to work with sound direction in an 8 bit environment, but I felt that the limited environment is a good descriptor of how important functional audio can be at the core. 9:25 PM

ah, so when you were setting up levels and these monsters, you did have in mind that the player would hear the monster, perhaps before seeing them? 9:25 PM

via Skype

So, to avoid reinventing the wheel, I took a look at Wolfenstein 3D. Every monster had their own 'Call' that signaled to the player who just spotted them. All of this so the player can build a mental Pokedex of experiences they had with that type of monster.

Another great example through past experiences, was the monsters in Doom. Every monster had a 'idle state' growl of sorts. Whether its the whine of Pinky demon from two rooms down, or the sadistic laugh of the Archvile. Sound also accompanied pretty much every state, from Idle to Chase to Death, each with its own unique signature.

All future sound engineers need to experience these sort of environments to comprehend how vastly different tackling sound design is in gaming. haha 9:56 PM

Matthew Florianz. Lead Audio Designer at Frontier Developments.
https://www.linkedin.com/in/matthewflorianz

Subject: Fwd: YO!
Date: Fri, 4 Dec 2015 08:31:07 +0000
From: Matthew Florianz <matthew@matthewflorianz.com>

Hi Bjorn,

Nice to hear from you! Things are very well at Frontier, the Elite team are doing amazing things and indeed I have moved onto Planet Coaster which is a wholly different ballgame, a lot of fun! Interesting technical challenges.... large data sets :)

I may have a similar problem with email being send from my Sumo account back in the day, perhaps direct questions are the way to get your quotes re-affirmed? I think the way you described leitmotif as a principle that does not just apply to music is correct.

I think as game developers, and therefore as audio designers too, we always have to look for story. This isn't the straightforward literal story that game marketing can use to give people handles for conversation, but the more abstract notion of how we present our experience as an inclusive proposition. Games require interaction so we have to be aware of how the interaction is experienced. We must think beforehand of the intended experience in terms that include the person sitting in front of their screen and interacting with the game we have yet to make.
In the interactive medium of 'games', creative engagement goes both ways :)

When we create audio there are some rules (don't annoy, don't be repetitive, reinforce the experience). These rules define our 'craft' and offer some objectivity with which we can measure good or bad audio design. What makes audio design 'great' is a more tricky proposition and not so bound to 'craft' (though it is an essential ingredient to get there) as it is more akin to artistry. It certainly helps to be able to grasp and understand the audience at every stage of development, long before there is something to play. Creating leitmotifs is a tool that helps a lot as it forges cross-beams throughout the creative process. A grounding of the audio design rather than solving each problem like an isolated case.

This also makes it easier to think about audio design as a whole. It is important not to separate out gui, voice over or music during the creative process and then rely on a technical solution solely (the mix) to try and bring it all together.

As sound designers to be good storytellers, we have to be good communicators, both in our own teams, but also towards and audience that does not yet play our games.

One thing that makes our job so difficult to grasp (beyond a certain level of skill) is that going beyond the common rules for good and bad sound design, requires very matured technical and emotional skills. It is very hard to get this in a single person and even harder to get it in a team. I think it is one of Jim Croft's (many) great achievements at Frontier to have created just that. Again communication is key here, having a very mature and healthy level of internal critique and co-operation.

I hope this helps, bit rushed as I write it on the bus, but I am sure you can fish out anything useful if it is there for you.

Best of luck finishing it, please let me know when and where I could read it?

Matthew

Sent from my iPad

On 3 Dec 2015, at 09:06, Bjørn Jacobsen <bj@cuyo.dk> wrote:

Hey Matthew.

Sorry for sending this to your vgm mail, but I lost the other address.

How are you? and how are things with ELITE or perhaps with other projects there?

I have a favor to ask, I am finishing up the thesis and the book proposal and I have found out that I have lost all our previous email correspondences. They were sent from my work email at CCP and I was wondering if you accidentally still had them? more specifically your replies to me?

Martin Stig Andersen. Composer and Sound Designer at Playdead.
https://www.linkedin.com/in/martinstigandersen

Bjørn Jacobsen 19:45
jeg har taget de her noter og tænkte på de følgende ting undervejs. Det er primært bare min egen tekst ud fra hvad du sagde, så ikke nødvendigvis direkte citater.

A secret level in limbo can be found by standing in the right spot and jumping at the right time, the right spot can be found be hearing the sound of the footsteps change and have a different sound when in the right location.

A sense of time and a pulse within a game can be used for puzzles, a way of indicating that the player must time his or her moves in order to proceed. An aural signal can be a way of warning the player before danger appears.

When a player is working on a specific puzzle, the game can provide feedback in order to let the player know when they made a right or wrong move or that a combination of moves was correct, in order to proceed.

This can be a way to increase the drama, emotion and narrative of the puzzle at hand, but also be a way of informing the player of their puzzle completion status.

Music can also provide the same puzzle progress information, it could be split into parts depending on the amount of complete the puzzle is, so moving from part 1 to 2 to 3, but if music goes back to part 2 again, then it means that the puzzle is either failed or restarted.

Bjørn Jacobsen 19:47
Limbo had a great example of a bear trap providing a sound while being manipulated by an NPC character, a giant spider. This to attract the players attention towards the object and use the stomping of the spider to fall, once it does, it does so out of frame but it is clearly audible that it falls.

A gravity puzzle, which has a very clear drum pattern instead of a normal tick sound for indicating time passing between the changes in gravity, giving a clear indication that the puzzle must be solved in a specific way between each of these changes.

Bjørn Jacobsen 19:48
Det er det. 😃 Du kan jo lige se om det stemmer med hvad du mener og rette til hvis der er nogen indvendinger. 😃

og tak for snakken, det var, igen, rigtig fedt.

Martin Stig Andersen 19/01/2016 22:15
Selv tak, det ser fint ud 😃

Held og lykke med det

Bjørn Jacobsen 22:17
Fedt 😃 og tak

jeg sender en kopi så snart at jeg har sendt det afsted i morgen

Martin Stig Andersen 22:19
👍

Martin Fisker. Pilot at Norwegian Air. Facebook correspondence. In Danish. https://www.linkedin.com/in/martin-fisker-9337138a

Martin Fisker 08/12/2015 14:27

På Boeing 737 bruger vi ikke retning på lyden. Vi får kun lyde præsenteret, som vi kender betydningen af og som skal henlede vores opmærksomhed på et problem. Lydene er prioriterede således at vigtige advarsler afbryder mindre vigtige advarsler. F.eks. har vi TCAS (traffic alert and collision avoidance system) der med lyde advarer os om at vi er på kollisionskurs med andre fly. Når vi får en warning som "traffic, traffic" begynder vi at orientere os efter den anden flyver. Næste skridt er en command i form a "climb" eller "descend". Hvis man forestiller sig at vi samtidig var ved at flyve ind i en bjergside, så ville vores TCAS aural warning blive afløst af EGPWS (enhanced ground proximity warning system) af f.eks. et "pull up terrain". Logikken er således at de mest alvorlige alarmer vinder over mindre alvorlige. Det er mere kritisk at ramme jorden end at komme for tæt på andre fly i luften.

Inden start tester vi altid vores alarmer ombord. Af de vigtigste kan nævnes motorbrand (en klokke), vejrradaren (windshear warning), EGPWS (impact med jorden), stall warning. Stall warningen er lidt anderledes end de andre alarmer fordi lyden ikke genereres af en speaker. Der er en motor der roterer et vægtlod der roterer i selve vores styretøj (yoken). Det skaber vibrationer i selve styretøjet og en høj raslende lyd. Så ved vi at flyet er tæt på stall (se videolink) https://www.youtube.com/watch?v=NtQqb7rstrQ

Vi har også warnings mod overspeed, som er en højfrekvent bippen. De fleste lyde skal helst ikke minde om hinanden så de kan forveksles ved en fejl. Enkelte alarmer har samme lyd, men kun hvis de absolut ikke kan forveksles. For eksempel er lyden der skal forhindre at man starter i forkert konfiguration (f.eks. ingen flaps på vingerne) den samme lyd som advarer om at trykket i kabinen er tabt over 10.000 ft højde.

Under take off får vi hastigheder læst op af en stemme der fortæller os, hvornår starten ikke længere kan afbrydes. Det frigiver ressourcer for piloterne at vi kan holde øje med andre ting.

Med hensyn til motorproblemer er det særligt det der hedder engine surge and stall som vil generere meget høje eksplosionslyde i hele flyet. se link ca. 1:30. https://www.youtube.com/watch?v=4EJl1--q2YQ

I simulatoren vi tæner i er lydene selvfølgelig genereres digitalt, men vi ved hvordan forskellige motorproblemer lyder. Ofte diagnosticerer vi ikke problemer baseret kun på lyde, men det hjælper os. Hvis vi f.eks. hører lyder af engine stall, men ikke har indikationer på motorerne, så er det sandsynligvis et dæk der er sprunget under start. Giver også et ordentligt knald.

Lydene i cockpittet kommer ud af højttalere der er placeret flere steder i cockpittet. Men vi får også samme lyde i vores headset. Vi har headset med noice cancelling funktion på under hele turen.

I uvejr kan vi også få advarsler på windshear (skiftende vind), som kan være farlig for flyet. Den starter med en høj 2-delt tone og så en stemme der advarer. hør ved 23 sek (de fleste andre lyde er også i klippet). https://www.youtube.com/watch?v=W5Z-d1Zx02o

På anflyvning har vi alerts der fortæller os om vores højde, en stemme der læser vores højde op direkte fra en radio-højdemåler. Der er også horn der advarer os, hvis vi for eksempel prøver at lande uden hjulene uden. "too low gear" plus et horn der hyler konstant. Vi har adgang til at slukke de fleste advarsler manuelt. Hvis for eksempel en checkliste guider os til at lande uden landingshjul, så kan vi slå den fra, så vi ikke bliver forstyrrede af et utal af alarmer.

Lige angående den "low speed", så er det en ekstra sikkerhed vi har fået indbygget efter et bestemt styrt i amsterdam. De opdagede for sent at farten var kritisk lav og Boeing besluttede at lave en ekstra advarsel udover selve stall-alarmen. Den kalder "low speed, low speed" når vi kommer ned på en hastighed på 1,3 gange stall hastigheden og derunder. Man vurderer at det kunne have hjulpet piloterne på turkish airlines til at reagere hurtigere. Hvis man så stadig ikke gør noget rammer man stall warningen (den ryste-lyd), men der er det muligvis for sent at gøre noget i visse situationer under landing.
https://en.wikipedia.org/wiki/Turkish_Airlines_Flight_1951

Visse alarmer kan godt lyde samtidig. F.eks kan vi have stall warning samtidig med EGPWS-alarmen "terrain, pull up", idet de kommer af to forskellige lydkilder. Men når højttaleren er i brug (og i headsettet), så bliver kun de vigtigste alarmer afspillet. Både vores alarmer om at vi er ved at ramme jorden og vores vejr-alarmer (windshear warnings) henleder vores opmærksomhed på et display. Der kan vi se visuelt, hvilken situation vi er i. For eksempel hvor i rummet at uvejret vi skal udenom er placeret. Eller hvor bjerget vi er ved at ramme står. Som hovedregel skal vi reagere på alle alarmer med mindre at vi 100 pct sikkert kan afvise dem som værende fejl. I visse lufthavne står der skorstene under anflyvningen, hvis os kan generere falske windshear alarmer i cockpittet. Dem kan vi selvfølgelig ignorere.

Håber det giver et lille indblik i lydene ombord på 737 😀

Martin Hollis. Game Architect, Formerly Nintendo and GoldenEye for the N64.
https://www.linkedin.com/in/martin-hollis-185492

Thesis

martin.hollis@pobox.com 7:44 PM
To: b@ojo.dk

Bjorn,

This is interesting! Thanks for the questions. Sorry I have written quite a bit in the last forty minutes.

I think you mean for the word 'informant' to specify sounds that give information to the player, whether or not it makes sense to see them as part of the fictional world. You want to focus on harder information which is especially relevant to the playing of the game, rather than information like 'It is raining' or similar emotional or scene setting signals which might be removed without changing the pure central game.

It's a useful word! (Did you coin it?).

Some informant sounds might be logically consistent with the nature of the world, for example you might hear footsteps from a person who you cannot see, but who is close. This is consistent with our own physical reality. Other sounds might not be entirely consistent, but only somewhat. For example the footsteps might be audible at a far greater distance than is physically plausible in the real world, nevertheless the player can learn of the presence of another character in an acceptable way. This is a distortion or exaggeration of reality, I've used it many times in the past without thinking or reflecting, because it is so ingrained in the culture of games. Also, film feels able to move from place to place instantly, and occasionally this only impacts audio, for example 'The Conversation' (1974) directed by Coppola separates action in the frame from action in the soundtrack several times.

Certainly many games give out sounds that tell of changes in the environment far away, for example the player picks up a key which instantly unlocks a safe on the other side of a colossal world, yet you hear the sound of the safe unlocking. I can even say this is normal, because the player wants to be informed that the key had immediate effect and the designer generally wants the player to have a clear idea of the effects of their actions. The sound is similar to the visual technique of a brief cutscene which cuts to the safe and shows it unlocking before returning to the character. We can say that is an informant cutscene. To be clear, some games use a cutscene, but many games use a 'cut sound' which can be heard despite the enormous distance between player and event.

Taking the idea to an extreme, the player might hear a sound which is connected to the non-player character in a context which makes no sense in a real world way. For example in a Pokemon game the player might be challenged by a puzzle and hear 'Pika Pika Pika' as a clue to use that particular Pokemon. I can't presently think of a game that gives a clue or that breaks out of our reality or the reality of a game to provide such a message but it could certainly be acceptable. I think it would have a slight hallucinatory character, unless players were accustomed to this as a part of the grammar of games.

Moving on from considering whether the sound is consistent with the rules of the world, I know of many games which use sound in unusual ways.

'RGBriefcase' by George Buckenham, David Hayward and Jonathan Brodsky has no screen or graphics of any kind, but is simply a briefcase. The object has 12 large buttons for the player to press, and emits sounds as the player discovers the rules of the game. The player manipulates the state of the game learning only through sound. http://v21.io/games.html

'Exile' 1988, BBC Micro. This is an epic world exploring game with a single astronaut exploring a malign world. It is heavily physics based. Exile has no HUD, but if the player presses a certain key the game will sound out the player's energy levels. If the player has 5 Megajoules of energy remaining they will hear 5 synthesized bell sounds, something like a clock or bell tower ringing. Is it part of the machinery of the space suit? We assume it is, but it functions exactly as some HUDs function in the sense that it may or may not be diegetic. It is ambiguous and undefined which world the sound comes from, our world or the game's world.

'Papa Sangre' is a game without graphics, for iPhone. I was told it was created by Hide & Seek in collaboration with others, a London studio which ran from 2007 to 2014. I don't know how the game works, but you can read https://en.wikipedia.org/wiki/Papa_Sangre I see it says Somethin' Else developed it and doesn't mention Hide & Seek.

I hope some of this is some help.
Trust you are great,
Martin.

Andrew Barnabas. Composer.
http://bobandbarn.com/
https://www.linkedin.com/in/andrew-barnabas-b492

RE: Stuff to quote :D RE: Thesis

Andrew Barnabas
To: Bjorn Jacobsen

2 attachments: Sidebrief Preview Download

All good!

From: Bjorn Jacobsen [mailto:b@ojo.dk]
Sent: 18 January 2016 20:52
To: bart
Subject: Re: Stuff to quote :D RE: Thesis

Hey Andrew,

Here are the corrections from our conversation. I will edit the various paraphrasings from the transcribe so that they fit with these.

There is a big difference between music and sound in games, sound is easier to use as a mechanic, as with music it can be hard to remove stuff and still have the basics of music working at the same time.

Prisoned is for ps2.

Low string cello for cave entrance.
Cave had a small cave.

Icing on the visual cake. Sonic icing on a visual cake.

because the program didn't know what the player was doing.

even if a game is on rails, the game can only clever to be linear as a film, but will still contain the odd timing because of the players actions cannot be predicted..

unpredictable elements because of the interactive elements in games.

some cues in the script. what was on the page did not convey perfectly into the screen for various reasons.
Didn't quite come across during recording or for any reason whatsoever.

Bjørn Jacobsen
Audio Designer - 3D Interactive - Cajo Sound

Phone Contact: (+45) 30 137 909
Mail: b@ojo.dk
CVR: / VAT Registration: DK31793219

On January 18, 2016 at 9:41 AM Andrew Barnabas <bart@bobandbarn.com> wrote:

Hey B!

Happy to assist any problem. Some of the stuff here isn't quite quoted correctly.

Ta!
B

Sent from my iPhone

On 14 Jan 2016, at 11:46, Bjørn Jacobsen <b@ojo.dk> wrote:

> Hey Andrew
>
> hope you had a great party among the sheep. :)
> I have a few, and here goes, some are direct quotes and some are just me paraphrasing what I picked up from the conversation:
>
> "Sound and music is a mechanic on it's own, and there is plenty of games where audio is used as such." (You mentioned some game. Odyssey something? where you had to talk to clowns and the talking part was the dominant feature?)
>
> "There is a slight difference between music and sound design, and sound design is better for use as a game mechanic on it's own. Sure you can remove stems and alter the music to fit the current situation, but the chance of the player actually picking up on this might come too late, but with sound design you can have a much more direct link between an event and the sound."
>
> "some older games had this, Quake is a great example where you could hear when players around the map would pick up various items, such as armor, and the pick up sound would give up their location on the map".
>
> "Prisoned, for the PS2 in 2003, with a cave entrance that needed more attention, there was a direct request on how to do so, and we added a small chord sound, a drone, to the entrance, which lead many more players to investigate the sound, so the visual one of the cave wasn't doing enough".
>
> "sometimes music and sound is just icing on the cake". (which is a nice way of putting it, I have been looking for a way to explain it and I always just called it "a luxury that could be ignored almost".)
>
> "Technology helped a lot when it got better, back at the dawn of video games or even quite a long way into the 90's, syncing up even the most simple variables to the music was hard. Much different from today, so back then it could be hard to simply change the music because of a combat situation, which today is almost a requirement in games."
>
> "In film and in unusual scenes you can tweak anything you want and make it perfect to the frame, this has not been possible to do in games and is still a goal that many composers and sound designers wish to achieve, we have gotten closer, but not remotely close to the linear abilities in film, if only we could know what the player thinks or foresee their next move, it would be much easier." (This fits well with a number of arguments that I have put together, trying to explain how interactivity is the key to games, but certain games are so linear that they are almost film, which could be argued then that a film is "the perfect linear game"- which also leads one to the next thing we discussed.
>
> "Unless you have a game 100% on rails, linear, without any deviation what so ever from the predictable, then it cannot be done, to sync up the music and the sound directly to a specific frame and emotion."
>
> "not knowing which path the player will choose, not knowing how they will move their viewpoint, means that if this was for a film, it would be the same as not knowing where the camera was going or standing during the recording of a scene".
>
> "This doesn't make film and tv scenes uninteresting, it is just a different setup and different conditions, in games the score is forced to be able to loop indefinitely if the player decided to stay at a specific location forever".
>
> "In film we are supporting the emotion of the scene at hand, in some cases the script and the visuals of the film cannot create the correct emotion alone and that is where music and sound design becomes the bridge to the right emotion. In games you can have the same emotion, but games can both be narrative and non-narrative and the music and sound design needs to be quite different depending on whether it needs to support this or not and whether you want it to be a bridge between the emotions of the visuals or strictly just symbolism game events"
>
> "the journey of a film has already been decided, the emotions and choices of the characters to any situation has already been chosen, the unknown factor of the players actions is the key difference which makes it difficult to achieve the right emotion or situational music all the way in a game".
>
> that's it :)

Simon Holm List. Sound Designer, freelance. Composer. Facebook conversation.
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Simon Holm List 14:02

Efter 10 år med spil-projekter der ikke rigtig blev til noget, både på hobbyplan og lidt som freelance sound designer og komponist, kom jeg for alvor kom ind i spilbranchen i 1999, da jeg startede som sound designer hos Io Interactive. Jeg blev ansat til lave lydeffekter og skabe lyduniverset til det allerførste Hitman spil, 'Hitman: Codename 47'. Dengang var der mange begrænsninger for, hvad der kunne lade sig gøre mht. lyd i et computerspil. Man kunne også møde flere i branchen, som måske ikke kunne se, hvor stor betydning lyd har for hele stemningen i et computerspil og mente at lyd bare noget man lige hurtigt drysser ud over spillet (dem kan man vel egentlig stadig møde idag).

RAM var også en udfordring. Det gjaldt altid om at barbere lyd-filernes størrelse ned til et absolut minimum (og så gerne lige lidt mere). Det var altid en kamp at få tildelt mere RAM. Derfor var det essientielt at kunne genbruge lyde og variere dem så meget så muligt, så spilleren umiddelbart bemærkede, at man genbrugte dem.

Hitman var (er?) et spil hvor det som udgangspunkt drejede sig om at skabe en realistisk verden, som spillet foregik i. Så for at skabe et troværdigt lydunivers, arbejdede jeg først og fremmest meget med baggrundslyde, derfor var det først og fremmest, som du skriver, musikken vi brugte til at informere spilleren, fx. om der var fare på færde.

Under udviklingen af de første Hitman spil, blev jeg/vi mere opmærksomme på at bruge lydeffekter til at fortælle spilleren om forskellige ting. Fx. var fodtrin en vigtig informativ lyd, der kunne fortælle om der var nogen på vej rundt om det næste hjørne, så man skulle overveje at gemme sig, eller gøre sig klar til action. Hvis ens taraget havde en bestemt type fodtøj på, kunne man måske finde ens target ved hjælp af lyden fra hans/hendes fodtrin.

I 'Hitman 2: Sielent Assassain' kunne man gøre folk bevidstløse, og for at indikere både at de ikke var døde, og at de kunne vågne op igen, lå de og stønnede, når de var bevidstløse. Det kunne godt være ret syrret at gå forbi en bunke af bevidstløse folk, der lå og stønnede, men det virkede. 😐

Simon Holm List 14:07

Dialogen fx. mellem to vagter kunne på samme måde som fodtrin bruges til advare spilleren. Men deres dialog kunne også indeholde information, som spilleren har brug for for at kunne løse hans missionen - eller give ham information om, hvordan han på en nemmere måde løser missionen.

Simon Holm List 15:59

I både 'Freedom Fighters' og 'Kane & Lynch' havde vi helikoptere med masser af firepower, nogle af dem var nærmest gunships, og de var alle dødbringende. Vi ville gerne advare spilleren i god tid, så han/hun havde mulighed for at reagere på, at der var en helikopter på vej. Derfor kunne man høre noget af lyden fra helikopteren langt væk. Efterhånden som helikopteren kom tættere på, kunne man høre flere lyde fra helikoptoren - høje, voldsomme, brummende og larmende helikopter-lyde, for at fortælle at nu var det altså snart for sent...

Bjørn Jacobsen 16:01

Nice. Lige præcis

Jeg har skrevet en del om fodtrin, eksemplet med at skatten ligger begravet i den våde del af haven og dine fodtrin lyder af mudder og vådt når du er det rette sted

Simon Holm List 16:03

Ahh ja - super. Det talte du også om, da holdte foredrag om informativ-lyd til Spilbar, kan jeg huske.

*da DU holdte foredrag...

Simon Holm List 16:19

Vi har også i et Hitman-spil, tror jeg det var, prøvet at lede spilleren på rette vej ved hjælp af blinkende lysstofrør - både lyden derfra og det visuelle blink. Jeg ved dog ikke, hvor godt det virkede, og om der overhovedet var nogen der opdagede det. 😐

Niels Bye Nielsen. Composer on HITMAN
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Jonas Breum Jensen. Senior Sound Designer at IO Interactive.

Jonas Breum Jensen [jonas_breum@yahoo.com]

Hi Bjørn,

I have left your questions in blue and added some comments in black.

One of the things that I am explaining is that we are using music to specifically inform the player of his or hers current situation in the game. The obvious may be that we are in situations, like combat, where the music is very brutal and in-your-face to express danger, but the more subtle changes are far more interesting.

I'm not sure I agree that we use music to explain and specifically inform the player in Hitman. We use it to build drama and tension. For example the goal of the music in the combat example you mention is not to be an informant telling the player that the AI state is in a combat-state, but to increase the intensity of the player experience.

Hitman is an immersive game where you interact with the gameworld, not a strategic game where you interact with the game-rules. In many cases in Hitman the game rules are not shown and interacted with directly, but are instead hidden under a game world simulating the logic of a semi-realistic world. This is also where the music lives – as a vehicle for building drama and for rewarding/beefing up the player.

Therefore when we give musical feedback it's more about rewarding the player and building empowering sensations. Or about making the game-world feel threathening and and providing intensity to the game experience.

But there is a lot of indirect information hidden in how the music behaves. Fx we play a suspenseful stinger if you are getting close to an NPC when you are trespassing. Or we play a rewarding little musical phrase when you done an especially powerful disguise. I guess you could learn to navigate by these musical changes, if you wanted to (a little bit like watching B-horror movies in a specific mode, where you try to spot clichés in the language of the music and find joy in predicting the jump-scare before it happens).

How complex can the music be setup? How possible is it to alter a single layer of the music, just because we are in a situation with some specific Booleans being true?
Can you give me some examples?

The goal of our music design is to be able to adapt quickly to the multitude of gameevents the improvisational playstyle that our game caters for provides. But also to be able to deliver a musical experience that is coherent and that builds drama over longer time periods. To achieve this our music is composed and set up in different dimensions, that can adapt in different ways and in different time.

First we have three macro modes that take care of the broader strokes in the game (a horizontal approach): An ambient/stealth mode, A combat/hunt mode and a Mission Accomplished mode. A mission will follow this dramaturgy most of the time: Back and forth between ambient and combat. Then accomplish objective (or fail). Then go into Mission Accomplished mode.

The different macro modes are divided in several layers with different intensity that we can crossfade between to create tension (a vertical approach). We do this based on a lot of different gameplay rules (fx when the player picks up a disguise, hides a body or walks into a specific location).

These rules are defined in a way where they can interact and create emergent behaviours. Let's say you start out by rigging a deadly trap, then you change your plan as you play along because your intended target surprised you, so you have to improvise. And end up knocking your target out with a hammer you pick up in the spur of the moment. The music will try to interpret these discrete and semi-random game events as part of a coherent dramatic moment/story and try to string a meaningful dramaturgic musical experience together.

On top up this we have a number of stingers that takes care of immediate feedback. We try to implement these in a way where we foreshadow events as well as react on events.

When playing Hitman Absolution, your previous game, there was an ability to play on the highest difficulty rating, removing all UI options and all graphical cue's, which left only the audible references to be heard, how was this planned? And how much guidance was there in this?

This was a happy accident. As fas as I'm aware we didn't know about the "purist" mode in the sound department in time to design towards this difficulty setting. Luckily the audible feedback could stand on it's own without it's graphical counterpart.

The system was a combination of the so-called attention HUD sound and the disguise-geiger. The Attention HUD sounds would match visual arrows around the main character that would rise like compass needles, when an NPC was becoming suspicious of the player. The disguise geiger would foreshadow this by playing subtle geigercounter sounds when the player was doing illegal stuff, but before the NPC would become aware of it.

Example could be that, when playing the highest difficulty it was possible to hear if you were in the midst of being spotted by an NPC, without the visual cue in the form of an arrow which you would see on lower difficulty settings.
That is a very concrete example of what I call an Informant Diegetic Sound, so how would you think that this could be used in other parts of the game?

I don't think I would see the attention HUD sound feedback as a diegetic sound. It's definitely an informant, but in my mind it belongs to a Non-Diegetic area of the storytelling elements in the game as well as other HUD and GUI feedback sounds informing the player of "gamy" aspects and states of the game experience.

In my mind the term informant diegetic sound would call to mind fx AI dialogues from NPCs warning the player that the game is aware of an illegal act, but doing so within the universe of the game.

I actually think these academic categories are highly relevant in game production. I personally use them as tools for clarifying the design goals.

Is a specific sound design meant to provide information to the player?

If so its valuable to consider in what way? Is it information about the game-logic – the rules, workings, and states of the game (This could maybe be called "hypermediacy" where the game points at itself as a game directly to inform the player about possibilities).

Or is it rather information about the universe-logic, being the simulation of NPC intelligence and awareness, simulations of physical laws etc. in the gameworld? (this could be called "immediacy" – where the main goal is to help build the believeability of the game-universe)

Or is the main goal to help build the aesthetics and style of the game?

Thinking about how diegetic sound elements could be used in the game to inform and affect gameplay, some examples could be: Acoustics – where sound propagation in the simulated acoustics spaces would tell the player about threats and possibilities. Event sounds that would provide affordance in the game world (Fx a generator sound that would tell the player about an interesting interaction possibility). Sound life from characters – dialogue, foley, footsteps. The sound of the players own movements interacting with the environment – reverberation showing the space, footsteps telling stories about the ground, cloth foley informing you about the nature of the disguise your wearing.

Similar examples for non-diegetic elements: Interactive music, GUI feedback sounds directly informing the player.

Br. Jonas Breum Jensen

Ian Schreiber. Game Designer. Assistant Professor at University of Rochester, New York.
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Ian Schreiber 25/10/2013 05:28

Hi there,
Sorry for the delay in getting back to you on this - when someone sends me a message over Facebook and we're not "friends" yet, it puts the message in this weird other inbox and doesn't notify me, so I didn't realize it was there!

If it's not too late, yes, would be happy to discuss with you. I'm a game designer with no audio experience, but I can definitely give plenty of examples where sound in games is not like film. Off the top of my head:

* Shadow of the Colossus, wonderful score, but it changes depending on the situation (when you get close to an enemy it gets more intense seamlessly, without just suddenly stopping and starting different tracks). There's no parallel for that in film really; even with something like a crossfade in film, you still know exactly when that happens so you can write the music knowing exactly when you want the sound to abruptly (or gradually) shift. In this game, the "when" is under player control and can happen any time.

* Many stealth and survival-horror games (Metal Gear Solid, Alone in the Dark, etc.) use sound as an important audio cue for the player, such as hearing the footsteps of patrolling guards or the heavy breathing of a nearby monster around the corner. Not only do you have to come up with these sounds, but it's generally the sound designer who is tasked with scripting WHEN they play, which is not trivial (i.e. you want footsteps to sound louder the closer they are to you, but "close" may not just mean straight distance since there might be a wall between you and the enemy). I assume with film, you'd just need to sync the fx to the footage, without having to do physics and trigonometry calculations to determine volume and direction.

* There's a brilliant indie game called Everyday Shooter (by Jonathan Mak) that you should find and buy and play right now if you haven't already, it's basically an overhead-view retro-style arcade twin-stick shooter type game that treats each level as if it were a music track on an album. The levels are timed, with enemies showing up in deterministic patterns that sync really well with the background music, and just about everything the player does (shooting enemies, getting killed, collecting pickups, etc.) adds little sound riffs so that it's almost like the player is contributing to the song through their play. I doubt you can find ANY parallel between the sound in this game and anything in any other medium.

* AudioSurf, another indie game that basically accepts any music track you give it and builds a procedurally-generated beat-matching level. Here, there isn't even any scoring, by definition; the game has to be designed to work with literally any soundtrack.

* More traditional beat-matching games like Dance Dance Revolution / Guitar Hero / Rock Band. Here the challenge is finding and using licensed music intelligently to create a particular gameplay experience. It's not just "find an awesome song to listen to" or "find a song that matches a certain environment or mood or whatever" - it's about finding songs that are fun to "play" as well as listen to. I bet the process for choosing licensed music for Rock Band was very different from choosing licensed music for a typical summer blockbuster movie soundtrack.

If you'd like to know anything else, feel free to follow up by direct email - - or just send me a friend request here so I know when you write again 😀

Out of curiosity, what school are you getting this degree at? I like to keep tabs on stuff like this.

Thanks for writing,
- Ian