HOW CAN SOUND CONTRIBUTE TO CREATE MORE IMMERSIVE EXPERIENCES IN VIDEO GAMES?

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ABSTRACT

This paper describes and analyses ways in which sound can be used to increase immersion in video games.

Keywords

Immersion, video game audio, diegesis, RAM, procedural audio

INTRODUCTION

People who play video games tend to experience a feeling of being absorbed by the game and a total disconnection with the real world. This feeling is known as immersion, and is an important indicator to determine a successful game design [22]. In order to immerse the players, the traditional way of filling the gap that exists between the virtual and the real world has been to increase the graphics capability [18]. Sound, however, has been an overlooked aspect of games, and its vast potential to immerse has been ignored.

The purpose of this research is to present a critical evaluation of the ways in which sound can contribute to increase immersion in video games. The paper first describes a framework of the types of game audio and the definition of immersion. It then presents ways in which each type of sound can be used to increase immersion. Next, it portrays current solutions to issues hindering the use of better sound in games. Finally there is a discussion and a conclusion. The media examples can be found on http://immersivesound.blogspot.co.uk/ or in the accompanying cd.

UNDERSTANDING GAME AUDIO

The most common classification of game sounds distinguishes between *dialogue*, *sound effects* and *music*. This classification is based on standard production paths involved in the recording and editing processes of game audio [14].

Friberg [12] makes a wider classification of sound effects in games:

- Avatar Sounds: sounds related to avatar activity, such as footsteps, weapon shooting, and bumping into objects.
- Object Sounds: Sounds that indicate the presence of objects.
- Character Sounds: Sounds generated by non-player characters.
- Ornamental Sounds: Ambience music or sounds that are not essential, but enhance the game experience.
- Instructions: Voice instructions are mostly used in games for the blind.

These classifications provide information regarding types of sounds but not regarding the functionality of game audio. The IEZA model, developed by Sander Huiberts and Richard van Tol is a design-oriented model for the roles and functions of game audio. The model has two dimensions: diegesis and interdependence. Diegesis is divided into *diegetic* sounds (audio belonging to the game world such as footsteps, weapons, and ambiences) and *non-diegetic* sounds (sounds that do not belong to the game world, such as music, beeps when pressing buttons, and HUD effects[1]). [20]

[1]HUD means Heads-Up Display: Progress bars, score updates, and other information related to the game interface.

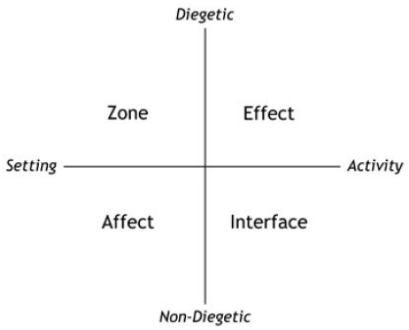


Figure 1. IEZA Model[15]

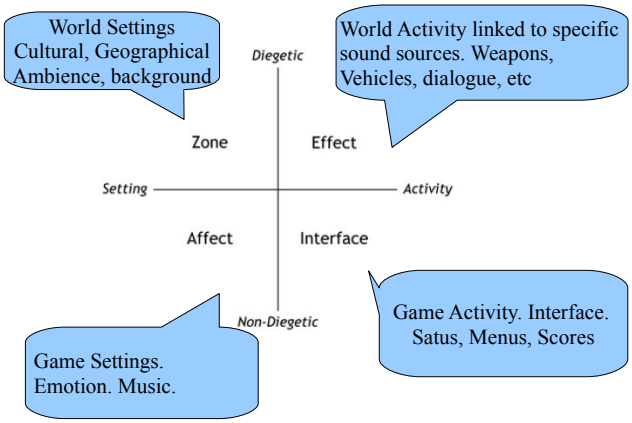


Figure 2. IEZA

The diegetic domain has two categories. *Effect* are on-screen and off-screen sounds that are linked to specific sound sources from the game world. These can be either triggered by the player or by the game itself (avatar sounds, weapons, vehicles, dialogue, footsteps. See *Example 1) Zone* are background sounds that expresses the cultural, geographical, and/or topological settings of the diegetic part of the game environment. Examples of zone sounds are wind, rain, and street noise, among others *(Example 2)*.

Interface sounds express the player activity and events triggered by the game in the non-diegetic part of the game environment. These sounds are produced either as a response to player activity or as a response to game activity. Examples are health and status bars, pop-up menus and the score display *(Example 3)*.

Affect sounds express the emotional, social and/or cultural setting of the non-diegetic part of the game environment. Music and horror effects are included in this category *(Example 4)*.

The second dimension of the IEZA model, *interdependence*, concerns the expression of the game. The left side contains categories regarding the setting of the game (Zone and Affect). The right side of the framework contains categories that provide information regarding the activity of the game (Interface and Effect).

IMMERSION

According to Grimshaw, immersion is a state of engagement and mental absorption in a game, where self awareness is lost and there is a distorted perception of time[13]. Brown and Cains highlight the time-based aspect of immersion, and define the term as a process with phases[4]. *Engagement* is when the player invests time and attention learning how to play. *Engrossment* is when the player feels less aware of the surroundings and self, and the last stage is *total immersion*[2], in which the player experiences a sense of total disconnection with the outside world [4]. The time-based aspect of immersion is key to the analysis of sound in games, as sound itself is time-based [14].

In addition, Ermi and Mäyrä [10] suggest three dimensions of immersion: a sensory dimension (engaging with the sensory aspects of a game), a challenge-based dimension (engagement with the flow[3]) and an imaginative dimension (engagement with the imaginary/fantasy world).

Game audio can contribute to increase each dimension of immersion in different ways. The first one relates to optimising gameplay and improving usability by providing appropriate information and feedback. This functionality mostly concerns *Interface* and *Effect* sounds. The second function concerns *Zone* and *Affect*, and relates with *dynamising* and making the game experience more intense and thrilling[4][14].

[2]Note that some texts use similar terms that overlap with the definitions mentioned above such as *Telepresence or presence* (the user experiences a total disconnection with the outside world, and feels transported to a virtual world [13]

[3]*Flow*: Peak experience of high enjoyment in a game. It is used as an indicator to analyse successful game design, and focuses on engagement due to an appropriate balance of concentration, control, challenges, development of skills, and feedback [22]. See appendix A.

[4]See Appendix B

There are numerous genres of video games and exceptions regarding IEZA occur; some games have sounds with functions that blur the lines between the framework. This paper, however, centres on generalities that apply to most types of games, excluding for example, music and puzzle video games.

THE ROLE OF AUDIO ON IMMERSION

Realism - Enhancing the sensory dimension

The same as in film, through *synchresis*, game audio can influence the perception of the image, creating a definite impression that makes sound seem natural and unnecessary, as if it were just duplicating a meaning [6]. As most of the games occur in unrealistic contexts, sound must meet the audience's expectations (often based on cinema) and reinforce credibility within the fantasy, which sometimes might imply the abandonment of scientific principles [8]. For example, in *Halo (example 5)*, the spaceships and battles in outer space produce sounds, even though in real life there is no sound in space.

Either based on the real world or on cinematic expectations, sounds belonging to *Zone* and *Effect* must present a high level of detail [14] in terms of sound propagation and physical materials to make the graphics seem credible and consistent [20]. *Zone* and *Effect* sounds must be programmed by filtering high frequencies and attenuating volume of sounds over distance, spatialising point sources, having adequate reverbs, and maintaining coherence regarding materials and acoustics [20]. These aspects will increase the sense of presence, making the imaginary world seem real.

Spatial audio is also key to induce feelings of presence [2]. Surround sound systems involve more the players by masking the real world sounds. Headphones seem to be effective to immerse too, as they isolate the player from the real world environment [2]. Spatial sound can be used to suggest depth[5] using off-screen sounds to make the space seem wider [14].

A proper sound balance and a dynamic mix are also essential to increase the sensory dimension because long sessions of gameplay may lead to auditory fatigue [7]. A player might decide to pass a level in just a few minutes, but might also spend hours in a scene picking up all the objects on his way. Thus, dynamics are essential in order to make the player enjoy the game for longer periods of time [14].

According to Liljedahl, one of the reasons why sound has so much potential to involve the player, is that in real life we perceive and automatically interpret sounds as results of events occurring in the physical world. "*sound connects you to the physical world by telling about physical objects and events that involve physical objects" [18]*. Even when we listen to recorded sounds from speakers, sounds evoke memories and the human brain immediately starts making associations. Thus, high quality auditory worlds in games are crucial to engage the player. According to Huiberts, high quality sounds mask the sounds from the user environment[14].

Feedback and time perception - Enhancing the challenge-based dimension

Challenge-based immersion occurs when players feel that they are succeeding and advancing on the game. It concerns the flow, or cognitive processes such as developing skills, problem solving, interacting with the game and competing with others [14]. In order to engage with the game, players should receive appropriate feedback on their progress towards their goals, immediate feedback on their actions, and should always know their status or score [22].

Interface – Feedback

Symbol, punishment and *reward* sounds inform if a player fulfilled or not an objective. These must provide a clear message to the player and are usually not varied in order to do so [20]. Super Mario's coins sounds, for example, are bright and clear, and never vary. Even if the player listens to the coins over and over, the sounds will produce a pleasant feeling because they confirm an achievement. Similarly, *feedback* sounds such as confirmation and notification information[6] should be clear and consistent throughout the game [20].

Zone – Navigation and orientation feedback

Humans use omni-directionality to navigate [18]. For example, sounds coming from all over warn about cars, buses, or dangers. As humans are used to omni-directionality to navigate, providing immediate and continuous feedback (resembling auditory perception) can contribute to more immersive experiences[18]. *Zone* sounds can help the player navigate, providing temporal and spatial information. Sound can orientate the player; it can indicate an enemy's proximity, and help anticipate and warn a player about danger. [16]

Influence of sound on the perception of time

Sound can influence the perception of the time spent on a process [4]. This is useful, for example, during the engagement stage of immersion, when the player is learning the rules and the controls of the game. The music can help to make the process shorter.

Emotion - Sound to enhance the imaginative dimension

The same as in film, sound and music in games can induce emotions [6]. Imaginative immersion occurs when a player feels empathy with the situation or character of a game. The

[5] See Chion [6]- Extension

[6] Confirmation of action feedback includes: NPC Status Feedback: (Confirms status of enemies and non-player characters), Player Status feedback, and Weapon Status Feedback [20]

following are aspects that contribute to imaginative immersion.

Convincing voice acting

Non-convincing dialogue can break immersion. The game *Heavy Rain,* for example, has excellent graphics, plot and music. However, the game loses its strength when characters speak. Immersion is interrupted because voices are unexpressive and seem like the characters were reading a script [21, 5]. According to Liljedahl, dialogue is the best way to communicate information because speech and human voices are natural parts of human society. Convincing dialogues make the players forget they are playing through a medium and help make the game interface less visible and less obtrusive to the player [18].

Dialogue presents several challenges. Not knowing in advance what events are going to happen is one of the reason's why dialogue is usually recorded out of context and ends up being unconvincing. Besides, huge amounts of dialogue are required for all the possible interactions in a game. According to Bridgett [3],

> "*Depending on how many characters there are, and the AI behaviours the characters have, there could be as many as 10,000 to 15,000 individual contextual reactions that will need to be written."*

The types of dialogue include *Story* (scripted scenes, cut-scenes, full motion video games), *In-Game Dialogue* (characters, pedestrians, and enemy reactions), and *Scripted Mission Dialogue* (main and ancillary mission information) [3]. The problem with having so much dialogue has to do with disk space and memory concerns. How to achieve enough variety when there are disk space limitations? This topic will be discussed later on this paper.

Characterisation of objects

Sound can influence emotions of players through characterization of objects. For example, two exact weapons can be defined differently by the sounds. The fact of choosing a powerful sound, or a weaker sound, can affect the emotion and gameplay style of a player. Environments can also be characterized through their acoustic properties and spatial location of off-screen sounds [20].

Setting

In video games, non-diegetic music and zone sounds usually have the same functions as in film and television [7]. The ways in which music induces emotions on the player will not be discussed because it shifts the main focus of this paper[7]. However, regarding music, it is worth mentioning again the non-linear aspect of games. The composer does not know in advance when the player will move, or act, win, or lose; and most video games are usually not designed based on beats and bars of music. Thus, there has to be a system that allows the music cross fade at appropriate moments or that adds masking effects to camouflage the transitions of music. Another option is to write the music in such a way that it can cross fade at any point[8] (although this would mean not using rhythm, or tonal music) [20]

In terms of sound effects, Diegetic ambience sounds can set the mood of a scene and evoke a time period, a culture, a place, a feeling or a memory [20].

> '*Another extremely important and often overlooked element in sound design is ambience. Ambiences can sometimes create a mood even more than music. Even a small hum from a computer or distant waterfall or wind through trees enhances the experience tenfold.*' Rabin [19]

Sound must meet cultural expectations in order to be credible [20]. For example, in *Uncharted 3: Drakes Deception,* some of the game's scenes take place in the city of Cartagena, Colombia, 20 years ago. All the street ambiences and voices make an appropriate geographical and cultural context of the city (*example 6*). Similarly to film, the use of symbols and signals is an effective tool to evoke emotions.

Story

In games, sound can influence a player's tension by implementing mixtures of diegetic and non-diegetic audio. Note that the player is the audience and at the same time the character. Daniel Kromand explains how in BioShock, F.E.A.R and Silent Hill 2, "t*he collapse of the barrier between the diegetic and non-diegetic soundscape is a strategy to build a horror atmosphere*" [17]. Kromand affirms that in these games, the whole soundscape and atonal music mingle in a way in which particular sounds are hard to tell apart, confusing and producing frightening feelings to the player.

ISSUES

In the same way that sound contributes to create immersive experiences in games, bad game audio design can break immersion [14]. When sound is not convincing, the feeling of presence is diminished. When the goals and feedback are not clear, the sense of flow is interrupted. When the sound is not coherent with the cultural settings and the voice actings are not expressive, the empathy of the player is disrupted. All these ways of breaking immersion have to do with design decisions and the sound designer's knowledge

[7]See Chion [6] for theory on music and emotion.

[8]See Burney [5] for examples of interactive music techniques

regarding audio functions. However, beyond design decisions, there are also technical implementation issues that prevent the use of all the potential of audio to immerse.

The current method for creating game audio is to use sampled sounds and store them into disk. To conserve disk space, sounds must be compressed, and then loaded into RAM to decompress them back for playback[9]. The problem with RAM is that it is limited and expensive. As mentioned throughout the paper, video games require large amounts of sounds because every single object has many possible interactions. Also, the non-linearity nature of games leads to long sessions of gameplay. Thus, due to memory constraints, games frequently face the problem of repetitive audio. Repetitive sounds are un natural and destroy immersion (*example 7*) [24].

In an interview for Gamasutra, Brian Schmidt, head of the Xbox audio team, and Gene Semel, audio director of Sony Computer Entertainment America, mentioned that the PlayStation3 and the Xbox 360 provide around 30 to 64 MB of RAM for audio[1]. According to the *Game Audio Tutorial* [20], portable platforms like the Nintendo DS provide around 500kb of RAM for sound, and mobile phones usually have less memory. The Wii console has around 8 MB. How to achieve a wide palette of good quality sounds to immerse the player when there is limited RAM? The GAT book illustrates the problem with a triangle of compromise with three options for game audio:

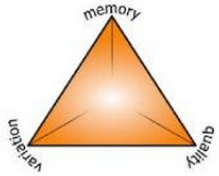


Figure 3. Triangle of compromise from the Game Audio Tutorial [20]

1) Many high quality sounds and lots of variation, but no memory (so it is not viable).

2) Few High quality sounds that fit in the memory budget, but no variation.

3) Lots of variation that fits into memory, but less quality of sounds.

Today, the game industry uses the following techniques to create non-repetitive design in video games:

Small Files

Except for music, each sound must be converted to mono, edited to have just the necessary waveform, and if possible, resampled. Sounds like low room tones can be resampled to very low rates without compromising their quality. However, not all sounds can be down sampled, as they might lose important original properties. It is thus necessary to prioritize sounds. The GAT book suggests the following sample rates for sounds [20]:

44 KHz – High Frequency sounds of key importance to the game

22 KHz – Player weapon sounds

18 Khz – Dialogue

11 Khz – Distant ambience or room tones

Re Use of Material

Re using audio samples for different objects and changing sound parameters to modify their properties, can enrich the soundscape of a game without increasing the audio space limit[19]. Effective techniques include:

- *Pitch Shifting*
- *Filtering and attenuating volume*
- *Randomizing pitch, volume and time*
- *Vertical Combinations (for debris, explosions)*
- *Horizontal Combinations: Concatenation (footsteps, fire crackles, radio crackles)*
- *Concatenation using multiple sample rates (explosions)*
- *Oscillators (variable wind)*

Overlapping looping sounds

Looping sounds in room tones or machinery can be detectable by a player and destroy immersion. A way to camouflage the loops is to use at least another looping sound that overlaps with it. As each loop has a different pattern, the resulting effect will make repetition imperceptible [20].

Dialogue and repetition

A partial alternative for repetitive dialogue, is to avoid it whenever it is possible. For example, it might be better to use confirmation sounds effects like electronic beeps instead of speech. If the game director dislikes beeps, the dialogue can be programmed to be turned off at certain moments. The use of filters to process speech can help to achieve variation. In sports games, narrations are built through concatenating words [20]. Note that this technique not always obtains good results because voice intonations might sound out of context. There are currently no other satisfying solutions for repetition in dialogue.

Cases in which repetition is accepted

Note that as mentioned previously on this document, symbolic sounds such as collectible items, rewards, and HUD menus are expected to be repetitive to provide a clear

message to the player. Sounds produced by mechanical systems such as a weapon firing, are also accepted to be repetitive as it resembles the effect in real life [20].

DISCUSSION

Even though game audio is a relatively new field of study, academics have started to build a common understanding of the main functions of sound and their relation with the different aspects of immersion. However, memory and disk space constraints prevent sound designers from exploiting the full potential of sound to immerse. Current practices do not solve the underlying problem of space limitations. As games are designed with larger and more complex imaginary worlds, even with more RAM and disk space to store sounds, the task of designing the sound for a game will eventually be extremely time consuming due to the almost infinite possibilities of sounds.

Andy Farnell has been emphatic on promoting procedural audio as an alternative to the current approach of game audio design. Procedural Audio is non-linear sound, generated in real-time, that follows certain algorithmic rules. It varies every time it is played and no data needs to be stored [11]. In contrast to conventional game audio methods, procedural audio consists of an external process that creates the sound, instead of a person triggering (or composing) it [8]. It allows building sounds from scratch based on physical modeling [11]. In other words, instead of recording and implementing a sound for each object and possibility of interaction, the sound designer would focus on programming the behaviour and qualities of classes of sounds, obtaining more variety using less disk space and RAM[9].

According to Karen Collins, several factors have slowed down the process for adopting procedural audio in games. The fear of disappointing audience expectations is one of them. People are used to very high quality music, and going back to synthesis and MIDI will not appeal the audience [6]. Besides, the game industry has standardised a highly developed process of audio content creation based on sampled sounds, and there is a lack of education regarding procedural audio. Before procedural audio can be practiced in games, sound designers must be able to match (and surpass) the quality of game audio currently available.

FINAL THOUGHTS – FUTURE RESEARCH

Analysing the ways in which game audio can increase immersion is important not only for creating better games. Further research in this field would benefit the cousins of video games: the audio-games and the smartphone/tablet games. In audio games for the blind, sound is the only resource to provide immersion, thus, expanding the knowledge is required on how auditory perception works. In mobile entertainment, small screens and low quality of graphics demand alternatives to compensate the loss of immersion due to these issues. Research on procedural audio opens new possibilities for more interactive and immersive experiences that would benefit all modalities of interactive games.

[9]See Appendix C

REFERENCES

1. Brandon, Alexander. (2008) Next-Gen Audio Square-Off: PlayStation 3 vs. Xbox 360 . http://www.gamasutra.com/view/feature/3814/nextgen_audio _squareoff_.php?print=1

2. Bracken, C. Campanella, and others (2010). Sounding Out Small Screens and Telepresence: The Impact of Audio, Screen Size, and Pace. Journal of Media Psychology. 22(3):125-137. www.sciencedirect.com

3. Bridgett, Rob. (2009) A Holistic Approach to Game Dialogue Production. http://www.gamasutra.com/view/feature/132566/a_holistic_approach_to_game_.php?page=2

4. Brown, E. & Cairns, P. (2004). A Grounded Investigation of Game Immersion [Electronic version]. University College London Interaction Centre (UCLIC). Conference on Human Factors in Computing Systems. Vienna, Austria. http://portal.acm.org/citation.cfm?id=986048

5. Burney, Naila. SoundAutopsy. Little Big Planet, and Example of Interactive Music. http://soundautopsy.blogspot.co.uk/

6. Chion, Michel. Audio-Vision: Sound on Screen. (1994) New York ; Chichester : Columbia University Press. http://esdi.pbworks.com/f/Michel%20Chion%20Audio-Vision%20OCR.pdf

7. Collins, K. (2007a). An Introduction to the Participatory and NonLinear Aspects of Video Games Audio. [Electronic version]. In Hawkins, S. and Richardson, J. (Eds.). Essays on Sound and Vision. Helsinki University Press, Helsinki. http://www.gamessound.com/interactive.pdf

8. Collins, K. (2008a). Game sound: An introduction to the history, theory, and practice of video game music and sound design. Cambridge, MA: MIT Press.

9. Collins, Karen (2009). An Introduction to Procedural Audio in Video Games. http://uwaterloo.academia.edu/KarenCollins/Papers/198757/_An_Introduction_to_Procedural_Audio_in_Video_Games._

10. Ermi, L. & Mäyrä, F. (2005) Fundamantal Components of the Gameplay Experience: Analysing Immersion [Electronic version]. In Proceedings of DiGRA 2005 Conference: Changing Views - Worlds in

Play. http://hdl.handle.net/1892/1604

11. Farnell, A (2007). An introduction to procedural audio and its application in computer games. http://obiwannabe.co.uk/html/papers/proc-audio/node14.html

12. Friberg, Johnny (2004) Audio Games: New perspectives on game audio http://www.cms.livjm.ac.uk/library/AAA-GAMES-Conferences/ACM-ACE/ACE2004/FP-18friberg.johnny.audiogames.pdf

13. Grimshaw, Mark (2011) Player-game interaction through affective sound, in: Game Sound Technology and Player Interaction: Concepts and Developments (Internet). IGI Global, Hershey, New York, pp. 264-285. www.dawsonera.com

14. Huibert S. (2010) Captivating sound: the role of audio for immersion in computer games. PhD Thesis. http://download.captivatingsound.com/Sander_Huiberts_CaptivatingSound.pdf

15. Huibert S. Tol R. (2008) Gamasutra.com IZEA a framework for game audio.

16. Jørgensen, Kristine. (2008) Audio and Gameplay: An Analysis of PvP Battlegrounds in World of Warcraft. http://gamestudies.org/0802/articles/jorgensen

17. Kromand, Daniel. (2008) Sound and the diegesis in survival- horror games. *Proceedings of the Audio Mostly Conference - A Conference on Interaction with Sound . http://www.audiomostly.com/images/stories/proceeding08/pr oceedings_am08_low.pdf*

18. Liljedahl, Mats (2011). Sound for Fantasy and Freedom, in: Game Sound Technology and Player Interaction: Concepts and Developments (Internet). IGI Global, Hershey, New York, pp. 22-43. www.dawsonera.com

19. Rabin,S.(2005).Introduction to Game Development. Massachusetts: Charles River Media, Inc.

20. S. Richard; D. Raybould (2011) The Game Audio Tutorial : A Practical Guide to Sound and Music for Interactive Games. Oxford : Focal Press.

21. Stuart, Keith (2010) Voicing concerns: the problem with video game acting. http://www.guardian.co.uk/technology/gamesblog/2010/mar/ 16/games-controversy

22. Sweetser, P., & Wyeth, P. (2005). GameFlow: A model for evaluating player enjoyment in games. ACM Computers in Entertainment, 3(3).

23. Tompkins, Joshua (2011) Games Thirst Review: Uncharted 3: Drake's Deception. http://www.gamesthirst.com/2011/11/03/games-thirst-review-uncharted-3-drakes-deception/

24. Vachon, Jean-Frederic (2009). Avoiding tedium: fighting repetition in game audio. *AES E-Library A*vailable through: Leeds Metropolitan Online Library Database. http://www.aes.org.ezproxy.leedsmet.ac.uk/tmpfiles/elib/201 11128/15158.pdf

Game References

BioShock (2007). 2K Games, Feral Interactive.

F.E.A.R (2006). Vivendi Universal.

Silent Hill 2 (1999) Konami, Konami Digital.

Halo (2011). Microsoft Studios.

Heavy Rain. (2010) Sony Computer Entertainment.

Super Mario Bros. Nintendo.

Uncharted 3: Drake's Deception. (2011) Sony Computer Entertainment.

APPENDIX A - FLOW

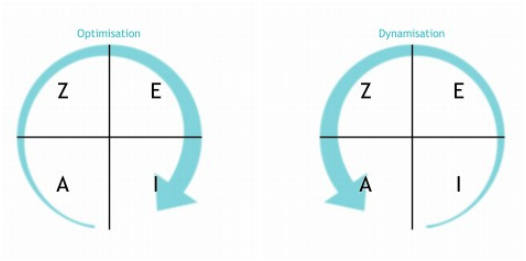
Flow is a concept used to analyse successful game design. The GameFlow model proposed by Sweetser & Wyeth mentions the following criteria to determine if games are engaging enough to be successful:

• Concentration: Games should require concentration and the player should be able to concentrate on the game
• Challenge: Games should be sufficiently challenging and match the player's skill level
• Player Skills: Games must support player skill development and mastery
• Control: Players should feel a sense of control over their actions in the game
• Clear Goals: Games should provide the player with clear goals at appropriate times
• Feedback: Players must receive appropriate feedback at appropriate times
• Presence: Players should experience deep but effortless involvement in the game
Social Interaction: Games should support and create opportunities for social interaction

According to the FlowModel, the feedback criterion is divided into the following parts:
• Players should receive feedback on their progress towards their goals
• Players should receive immediate feedback on their actions
• Players should always know their status or score (Sweetser & Wyeth, 2005).

The presence criterion is divided into the following parts:
• Players should be less aware of their surroundings
• Players should be less self-aware and less worried about everyday life or self
• Players should experience an altered sense of time
• Players should feel emotionally involved in the game
• Players should feel viscerally involved in the game (Sweetser & Wyeth, 2005).

APPENDIX B
GAME AUDIO FUNCTIONALITY AND IEZA



"The two perspectives on the functionality of game audio, optimisation and dynamisation represented
in the IEZA model. Generally, the Interface domain is primarily aimed at conveying i nformation.Affect is primarily used for the stipulation of a mood, thus making the game more intense".

Taken from: Huibert S. (2010) Captivating sound: the role of audio for immersion in computer games. PhD Thesis.

APPENDIX C
Procedural Audio

"The designer now works more like a programmer creating and modifying sound objects...Simple operations such as scaling can be automatic. For example, if the sound designer works on an object that models a metal cylinder, and if a tin can is scaled up to a steel barrel the sound may scale as easily as the 3D artist changes the size of an object mesh. If the barrel is now textured with a wood material the sound automatically changes to become a wooden barrel"
Andy Farnell

Advantages of Procedural Audio:

- More audio content: Sounds can be automatically generated for all possible object-to-object interactions instead of recording and processing thousands of audio files to be stored on disc.
- More variety: Allows more variation and dynamic level of detail with real-time parameters.
- Asset control: Management of code instead of managing large amounts of data kept on secondary storage as wav files and having to reference them against events lists.
- No RAM required: Procedural audio is CPU intensive.
- Highly dynamic and flexible: Allows flexible choices at runtime, even at the last stages of the production process.
- Object based: Based on the behaviour and physics of objects.

Reference: Farnell, A (2007). An introduction to procedural audio and its application in computer games. http://obiwannabe.co.uk/html/papers/proc-audio/node14.html