

Post-production sound: a new production model for interactive media

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Abstract

One of the most profound differences between film sound design and game sound design is that where film contains linear visual footage against which any number of sounds can be synchronized and blended, a game triggers individual sounds based on events occurring in the game at non-specified times. Broadly speaking, films are about emotional immersion within a narrative, where video games concern physical immersion in a universe of action and reaction. Games therefore require a radically different production philosophy from that of film, yet one that replicates the involvement of a dedicated audio post-production phase at the end of the project. This period would allow consideration of all the elements of music, dialogue and sound effects as fully integrated parts of the final game. Post-production sound design and mixing are therefore where video games can finally begin to articulate themselves with a similar sound design language to that of film.

Keywords

video game sound
post-production
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next-generation sound
design

With the next generation of video-game consoles (Playstation 3, Xbox 360) dramatically increasing the amount of visual detail and cinematic feel of in-game action, even greater expectations are placed on in-game sound to generate a similar cinematic aural environment. While these expectations do not affect all games, console games in particular are affected by an increasing cinematization of graphics, narrative and, consequently, sound. Sound post-production, as a distinct phase of production in interactive media, has been overlooked within the medium's brief history. In film production it is argued that sound is not involved early enough in the production process, whereas in video games, sound is frequently involved from day one, and yet it is the additional involvement of sound at the *end* of a games project that provides the biggest missed opportunity. Games are in great need of a dedicated and recognized phase of post-production audio in which final qualitative changes can occur. The notion of a post-production phase implies that the production phase of visual edits, design changes, technical pipelines and game play have been locked down and finalized, which is something that rarely happens early enough on a video-game production to impact positively on the soundtrack. It is in this respect that video-game sound can clearly learn from some of cinema's production models.

Film post-production

Post-production is one of the defining features of cinema's industrial and artistic processes. The practice of capturing footage known as 'production'

1. The voice-overs for CG movies need to be collected during production so that the animators can tailor the animation to the vocal performance; they are therefore the only analogue asset generated during production. During post-production sound however, many other analogue assets are collected and edited, such as Foley and sound effects.
2. It should be noted that post-production on many live-action films is now almost as intense as that of pure CG film, due to their reliance on post-production visual effects.
3. Features represent basic units of functionality within a video game. For example, a particular game may have a feature in which the player becomes invincible for a variable amount of time; the feature consists of program code, game design (which ensures the feature works with the game play) presentational elements of visual effects, and sound.
4. Feature tuning is the method by which the parameters of a feature are tuned to maximize their effect; for example, tuning the amount of time an invincibility mode lasts, in order to make game play more challenging.
5. Debugging is the process at the end of production, after tuning is complete, where errors in code or in program scripts are found and

has always been followed by a period of presentational framing of the recorded footage, usually in the form of editing prior to exhibition.

Post-production evolved within the industrial practices established by the dominant sound film production model of 1930s Hollywood. The three separate phases of production that emerged out of this system were pre-production, production and post-production. The latter phase includes picture editing, the creation of framing devices such as titles, credits and, at the very end, the application of audio to the final picture. This final period of post-production gained increasing importance for audio with the arrival of Dolby Stereo to film in the 1970s, and again with the arrival of digital sound production and reproduction in the early 1990s. This allowed an unprecedented amount of detail and dynamics to be considered for the soundtrack of the picture (Sergi 1999: 1). The current western tradition of film-making has now firmly entered a phase of what can be described as *extreme post-production* in which proportionally less emphasis is placed on the collection of production assets and increased time is spent in post-production. In many cases much of the actual production period now includes various forms of digital production.

Video-game production models

Video-game production is so embryonic compared to cinema that it has yet to evolve a standardized production process. Indeed, the myriad of creative approaches taken by different game developers have in the past been resistant to the notions of a fixed mode of production. Yet the similarities between film and narrative games, particularly in terms of digital production, are becoming more marked.

Games have a great deal in common with the current extreme digital visual production methods in film; their reliance on digital manipulation of images is such that the production phase is completely reliant on digital work, from animation to game-design code and scripting. The closest contemporary film-production analogy for video games is the wholly computer-generated (CG) movie, examples of which abound from Pixar studios. The only analogue commodities created during production of these films are the voices of the actors; everything else, as in games, is digitally produced in an intense production period.¹ The CG film invests a tremendous amount of time on sound post-production, due to the fact that there is no production sound generated in the vacuum of digital sets. In this way, the sound for a CG movie, like that of cell animation before it, is created in post-production, and can be described as extreme post-production audio.²

In a typical, well-planned video-game production, as elements of the game become locked down, the project approaches what are known as 'Alpha' and finally 'Beta' phases, after which all work on the game's features ceases due to the need for stability of the game code. In order for the game to become stable enough for public release, all features³ and feature tuning⁴ must be cut off so that testers can debug⁵ the game. Only problems critical to the game's core features and stability are fixed after Beta, and no new content or features are put into the game. Following this Alpha–Beta model (Figure 1), any notion of post-production audio is challenged as there is little time for it to be squeezed in prior to a complete content lockdown.

Pre-Alpha	Alpha	Beta	Gold master candidate	Gold master
(Major features complete)	(Rigorous testing of the features in the game begins – any game crashes are reported as bugs)	(Feature complete and tuning of all game-play elements are complete)	(Submitted to console manufacturers for testing)	(General availability release)

eliminated. These errors are usually found by a team of game testers.

Figure 1: The five development stages of software ‘post-production’.

The model described in Figure 1 has become a common, although not exclusive, mode of production among console-based-game developers. The proliferation of this production model, in which audio, along with the other elements of production is locked down at the Beta stage, has resulted in a call from frustrated content providers and game developers that sound should become more involved in the process of game development from the beginning. While sound is now involved in game production a lot earlier, particularly by those with in-house audio teams who are involved in the planning and production of the games from day one, it is in fact the post-production audio phase that is overlooked during the scramble to lock down and stabilize the game.

Establishing and planning interactive sound post-production

The crucial and distinctive philosophy behind specifically *interactive* audio post-production is that it must include every aspect of in-game interactive sound rather than simply focusing on only mixing the pre-rendered, non-interactive cinematic movies (cut-scenes) that appear in the game. Mixing these cut-scenes has traditionally been an easy thing for an audio post-production studio to do, as these are merely short movie scenes that are played at certain points in the game and can be easily separated from the game itself. However, mixing in-game sounds is vital for an aesthetic balance between pre-rendered cut-scenes and in-game action. Giving a mixer tactile control over every sound played back in the game, in real time, has traditionally been overlooked by game developers and where the biggest qualitative improvements are to be made. As far as the user (or audience) is concerned, until very recently games have been too loud and over-compressed; they have exhibited little dynamic range when compared with cinema.

Game post-production audio therefore needs to be defined as a period where the entire game design and game art is locked and tuned, at which point all the elements of the soundtrack can be considered as a whole. It is at this point that sound effects, dialogue and music are all in place and can be tweaked, replaced, moved and mixed in their relation to the finalized visual and game-play elements of the product. In the current production climate of video games, this may appear a utopian view of game production, yet it is something that can be achieved with good planning. To achieve

6. A useful example of bug fixing: if a game has a feature through which a player can at any time open a menu and choose what music track they want to hear (but a game tester repeatedly tries to reproduce this behaviour and finds problems with the feature) a bug-tracking database will be used to log a bug onto the 'owner' of that feature. The owner will then take the necessary steps to reproduce the bug and endeavour to fix the problems described in the bug. The bug will then be marked as fixed and the tester who submitted the bug will verify the fix by once again testing the feature. They will either close or re-open the bug based on the results.

Pre-Alpha	Alpha	Beta	Sound Beta	Gold master candidate	Gold master
(Major features complete)	(Rigorous testing begins)	(Feature complete and tuning complete)	(All sound content and code is finalized, mixed and tuned)	(Submitted to console manufacturers for testing)	(General availability release)

Figure 2: A post-production audio production model.

this effectively, a new model in which post-production audio is visible on everyone's schedule at the start of a project should be inaugurated. This planning is necessary in order for the audio team to be able to work on completed elements of the game.

Project-management resources play an important role in how the post-production audio process can work most successfully. The success of a post-production audio approach lives or dies by enforcement of the lock-down of visual, design and tuning of all non-audio elements of the game. It is impractical to work on audio when visual and design elements are still fluid and constantly changing. The ideal place for post-production audio to fit into game production is immediately after all visual and design tuning has been locked down at Beta. At this point all cinematics and cut-scenes would have been locked down and the game would be playable from beginning to end. At this stage, bug fixing⁶ is the only work that is being undertaken by the game team. This should afford a minimum two-week period to pre-mix (or master) all the dialogue and music, and to pre-mix cinematic elements of the game, including Foley creation. It would also require a minimum four-week period during which the audio can be post-produced off-site (as in film), or in a different in-house location. Audio is always the last part of a ripple effect brought about by the 'tuning' of the game's visual or game-design data, so this new Sound Beta period is necessary in order to contextualize everything that has been locked down up to this point. Figure 3 shows the Sound Beta phase in greater detail.

While the pre-mixing can occur in the conventional audio-development environment, there are many advantages for the post-production sound design and mix to occur away from the game-development environment. Depending on budget, one might use an external mix stage at a film sound post-production facility, or an in-house dedicated mixing suite,

Pre-mix	Sound design	Final mix
(All dialogue, music and SFX are mastered)	(Prioritized sound effects are replaced)	(All in-game sound is mixed)

Figure 3: Sound Beta, or sound post-production, is broken into three phases.

bringing in skilled external mixing staff to work on the final phase of the project. This is necessary because for in-house resources working on projects for several years at a time, a change of scene can provide a completely new perspective on the game. Not only this, but working with other professionals such as a film sound mixer or sound designer can provide a much needed set of fresh ears to a project. This is invaluable in terms of bringing a degree of objectivity and the inevitable final sheen of quality that post-production affords to the game audio at this final critical stage.

Regardless of where the post-production occurs, it must be in a listening environment that best reflects the home-theatre exhibition space of the consumer sound system. The listening configuration must be correctly calibrated so that what is being heard is a true representation of how the game is meant to sound. This is essential, as critical artistic decisions are being made here about the final levels and equalization of all the audio in the game, and this is somewhere that THX can help greatly in calibrating the final mixing environment⁷ (Jackson 2005: 1). Post-production game audio can thus be conceived of as a final filter through which all sound must pass before it gets to the ears of the game player.

In cinema production, a typical post-production sound phase consists of sound-effects design,⁸ dialogue editing, sound-effects editing and one of the most essential phases of audio post-production, that of mixing. The mix usually takes the form of a dialogue pre-mix, sound-effects pre-mix, music pre-mix and final mix. In the final mix, each of these three elements are taken onto a sound stage, one that mimics the theatrical exhibition space of a movie in terms of scale, and all the elements are balanced artistically at the service of the narrative. With DVD sales now driving much of the continued revenue of a film, a DVD mix is now also done, where the mixing space is re-arranged using near-field monitors, to reflect specifically the ideal arrangement of a home-theatre environment. It is this latter configuration that makes the most sense for video-game mixing.

As in film, the post-production phase for games needs to be meticulously planned in advance. Schedules must be drawn up and staffing requirements must be allocated – this will help when budgeting and, if using an external studio, will enable them to arrange their schedules and block off enough time, resources and facilities for the production. As an example of a four-week, off-site post-production, a project could utilize the following:

- *A sound designer, working for two weeks in a sound-design suite.* Someone responsible for the sound-effects design elements of the post-production audio. Ideally, consulted much earlier in production regarding the needs of the project.⁹

Weeks 1 and 2	Sound designer	Sound effects editor	Technical support
Weeks 3 and 4	Sound mixer	Sound effects editor	Technical support

Figure 4: One example of external post-production staffing requirements.

7. THX have for many years been involved in calibrating the listening and production environments of film-exhibition spaces and audio post-production studios. They ensure that speaker levels, positions and EQ curves are consistent so that that audio designers and mixers hear the same thing as the audience. THX games certification ensures video-game audio and visual production environments are similarly calibrated.
8. It should be noted that film sound is certainly not perfect in its production model; it is still often the case that many sound designers are only brought onto films at a very late stage, rather than being involved in recording and collecting sounds much earlier in production.
9. A sound designer, in the sense of video-games post-production, is someone who is involved in conceiving, recording, editing, combining and creating either non-natural or natural sound effects for the period of post-production. This is not to say that they cannot be involved much earlier with several points of contact throughout production. The filmic definition of a sound designer is often supplanted in video games by that of a sound director, who is responsible for all the elements of the soundtrack as a whole and not just sound-effects design.

- 10. A sound programmer, a role not found in film, is a member of staff who is responsible for creating all the audio playback code in the game. They are involved for the entire duration of the project, and their role is essential in post-production in order to maintain stability as the sound design and mix is carried out.
 - *A mixer, working for two weeks on a sound mixing stage.*
 - *A sound editor, supporting all four weeks with a separate sound-design suite.* A sound editor is someone who is available at all times to source and cut new sound effects whenever they are required.
 - *Technical support for all four weeks.* This is a staff member who is on call for the duration of the project to help with any technical issues, from computer networks to troubleshooting the audio gear being used.
 - *Sound director and sound programmer.* All four weeks need to be overseen by the project's sound director/audio lead as well as the sound programmer.

- 11. LFE or low frequency effect, often also known as sub-woofer channel information, in a 5.1 mix.

- 12. Vivendi's *Scarface: The World Is Yours* (2006) for PS2, Xbox and PC had a five-week post-production period in which post-production sound design was carried out at Skywalker Sound by Randy Thom, and where the game was mixed using in-game mixer snapshots on a DVD sound-mixing stage calibrated by THX. Volume, pitch, reverb sends and LFE were the only parameters available on the mixing desk.

There are many technical reasons why a true post-production mix has not been achievable for video games up until now. These reasons are related mainly to limited memory and loading schemes that allow for information such as volume, high and low pass filters, reverbs and other DSP effects to be run and edited in real time in a video-game engine. Control of even rudimentary mix values has, until very recently, been seen as something that is exclusively in the sound programmer's¹⁰ realm, rather than that of a sound designer or mixer. (Peck 2004: 10). In addition to this, the availability of real mixing-desk technology, with a familiar tactile interface, allowing for the balancing all the elements of a video-game's soundtrack, has been unavailable for games. Recent advances have been made through the availability of extra processing power and software DSP on the next-generation consoles (such as the Xbox 360 and the Playstation 3), and also the availability of easily configurable MIDI hardware mix surfaces (such as the Mackie Control Universal and the Pro Tools Pro Control). Mixing in games can be defined as the availability of software mixing elements useable by the sound programmer and sound designer, potentially linked to a hardware mixing interface that allows easy tactile control over multiple parameters per sound channel. A further defining feature is that of grouping multiple sound channels together, for example grouping all individual dialogue sounds together to a master dialogue channel.

While post-production mixing *has* been achieved on previous-generation consoles such as Playstation 2 (PS2) and Xbox games with limited parameters such as volume, pitch, reverb sends and LFE¹¹ levels being mixed,¹² it is only with the advent of the newer consoles and their software DSP that true manipulation of all the sounds in the game can be achieved in real time. It is with these developments that post-production audio can now flourish into an essential phase of video-game production, planned for and firmly positioned, at the end of a project.

Post-production sound design during Sound Beta

During production, sound effects are added to the game at the same time as other game features are implemented. These sounds may never really be final until the design, art and animations are locked. The sounds developed in production prove functionality (that a sound can be played and create the desired effect) and create a memory footprint (the amount of space that is taken up by loading that sound into memory or streaming it from the disk). Some of the sound-design work done during production will be final and make it into the finished product. However, as game-design

and game-play elements are very fluid, this work can change drastically right up until the end of production. The advantages of a post-production period for sound-effects design are clear; the effects can be reconsidered and finalized once the visual and game-design elements are fully tuned.

When replacing sounds during the post-production sound-design phase it is important that they retain the memory footprint of the originals. This is crucial for the stability of the game code at the end of the production, as adding sounds that are physically larger in memory size will inevitably result in the game running out of its allotted sound memory, which will in turn cause the entire game to crash and be unplayable.¹³

The replacement of sounds in a post-production sound-design phase, as throughout the entire production, requires that the sound designer can identify an event for which a particular sound is required, feed a sound into the game and then hear the sound back in the context of the event that triggers it. The methods by which sound is processed, re-sampled and implemented, all contribute to the way that a particular sound changes when it is played back by the game's sound engine. Once a sound designer hears these changes in the context of the game, s/he can make decisions about how then to alter any individual sound, before refining it and replaying in the context of the game. The faster this process can be iterated, the better for the sound-design process. If sounds can be added into the game without the need to stop the game and rebuild the game data each time a sound is replaced, this provides the best chance at very fast iteration.

As an example of what can be achieved in post-production sound design, several very important sounds can be replaced that have a fundamental effect on the sound of the entire game. In the post-production sound-design period carried out for *Scarface: The World Is Yours*, it was decided to prioritize the sounds of the weapons that Tony Montana uses in the game. The M16 weapon is the first that the player gets to use in a climactic scene re-enacted from the end of the *Scarface* movie. It was decided that this weapon should be made to sound more powerful and distinctive from all the other enemy fire that could be heard in the scene. The weapon sound was completely redesigned by Randy Thom, and even given a higher sample rate¹⁴ so that it stood out more clearly from the cacophony of sound that was created by all the other combat effects in that scene.

Interactive mixing

On next-generation platforms, the core question is no longer 'How much audio can we physically play at any one time?', because in previous-generation technology such as PS2 and Xbox, the limited amount of sound RAM demanded an ascetic approach to sound design. The question is instead, 'What should we play at any one time', and doubtless a more pertinent question is, 'What should we *not* play, what do we *remove*?' This is often an editorial question at the pre-mix, or even final-mix stage, when sounds are more often removed than added. The mixing stage of interactive entertainment is essential in re-enforcing and controlling the sound direction of a game. It is conceivably the most critical part of video-game sound production, much as it is perceived in film post-production (Ondaatje 2002: 104). A video game could have sound designers, dialogue and music directors working on the project from conception, yet many of

13. This is certainly just as critical in next-generation game development (PS3, Xbox 360) as in previous generation production. A steady memory footprint is essential at the end of a project in its Beta phase, and while there is more sound memory available on the newer consoles, memory is certainly still a finite resource to be respected.
14. The majority of sounds in the Playstation 2 and Xbox versions of the game were at 24khz. For Tony Montana's M16 the sample rate was increased to 32khz. This had the effect of rendering it much clearer than all the other sounds in the game.

15. Sergi (1999: 21) states: 'The Hollywood listener is bestowed with an aural experience which elevates him/her to a state which [one] may define as the super-listener, a being (not to be found in nature) able to hear sounds that in reality would not be audible or would sound substantially duller. This is a new breed of spectators who can expect screen objects to fly above their heads into (and out of) the auditorium.'

the real decisions about the 'sound presentation' of the game can only be made at the post-production stage, particularly the mixing stage. Organizing and allowing time for a dedicated mixing phase of video-game development therefore becomes not only a luxury but an essential part of sound design on an interactive project.

Even in previous-generation titles, with their limited sound memory, there would often be so many sounds playing at once as to make important auditory information incomprehensible. This situation is potentially increased ten-fold on next-generation platforms, given that the increase in available sound memory allows for around ten times as much sound to be loaded into the game's memory and therefore played at any one time. Being able to understand dialogue, for example, is an absolute pre-requisite in film, and is even more important in the communication scheme of video games, as increasingly more information is made available to the player via spoken dialogue rather than on-screen text. The ability to 'carve out' certain sounds, such as music, or lesser important background conversations, whenever an important line of dialogue is played, is a fundamental feature of interactive mixing.

As the mixer works with the game and identifies particular moments that require particular sonic points of view, the narrative requirements for the mix will take shape. Certain narrative and game-play moments will require particular and specific perspectives for the sounds that the player experiences. Hearing the sounds through a character's point of view at particular times in the game may involve only focusing on a particular sound effect in order to denote the importance of an object or event to the character or narrative. This results, as in recent Dolby-sound film, in the creation of a 'super-listener' (Sergi 1999: 21).¹⁵ A 'point-of-view' sound direction is one of the fundamental elements in equating game sound with film sound, in that its central principle is one of communicating what the players, and game characters, hear at any one time, rather than arbitrarily hearing every sound play at the same level. Cacophonous moments can certainly be used very effectively in video games, yet they need to be designed and mixed with great care, and need to service game play and story. In this way, mixing is where video-game sound can finally begin to articulate itself, using the same sound-design language as its motion-picture counterpart.

Developing interactive mixing techniques for sound removal at the end of the game-production process is one of the most demanding developments in the next-generation audio landscape. The entire process involves having control of volume, pitch, panning, DSP and EQ of potentially every single sound in the game. It also requires sophisticated data optimization, grouping of sounds into mix categories and makes significant demands on the amount of time, and therefore planning, given to audio at the end of the project.

The physical presence of the sound programmer at the post-production phase is crucial. It is their responsibility to be able to connect a physical external mixer control interface to the audio engine and to get this to feed information about the audio levels both from and to the game as it is running. Coming up with a system that can easily edit and store mixer presets is also essential in order for the post-production mix to work quickly and efficiently. Also being on-site and supporting the whole post-production phase is essential for a sound programmer, in that many code changes will be

necessary to achieve the desired results. An entire game can take many days to play through from start to finish, and mixing as it is played will take even longer. The length of game play must be a factor in the amount of time considered for both post-production sound design and mixing.

The interactive pre-mix

A pre-mix for video-game sound should be undertaken in much the same way as film pre-mixing and must be done before the mix stage for the final post-production. Each broad element in turn, sound effects, dialogue and music should be taken in isolation and pre-mixed. A good example here is dialogue: all the different game characters and all the different cinematic scenes should have their levels independently mixed. In this way, all dialogue can then be attributed to a group fader called 'dialogue' which can be manipulated with the reliable knowledge that it is all of a consistent level. Pre-mixing can only occur after the music and dialogue have been mastered. Mastering is essentially a form of destructive pre-mixing that may become redundant in the next-generation landscape of real-time DSP processing. This is because the volumes and amounts of compression applied to large groups of audio material, such as music, can now be altered in real time using DSP.

The narrative components of video-game mixing

It is difficult to conceptualize mixing in a medium that is not linear, where any number of generic or specific events can happen at any time during the game. Bearing in mind the radical difference between the narrative medium of film and the non-linear process of triggering events in games, mixing must also be arranged to coincide with game-play events. In this way a variety of different 'mixer snapshots'¹⁶ can be triggered to coincide with the game events they are connected with. In a movie the mixer can sit down and go through the film a scene at a time, but the mixer for a video game has a whole different set of challenges to overcome. The narrative, as such, consists of actions and consequences that the player initiates. Video-game mixing can therefore be thought of as an interactive combination of the following:

- Geographical locations (*generic*: interiors, alleyways, streets, and *unique*: coconut-grove bar, cigar shop)
- Generic game-play events and rules (shooting a weapon, conversations, day, night, low-health etc.)
- Mission-specific events (cinematic scenes, scripted camera movements, scripted events, etc.)

All these added together create an interactive narrative: at any one moment a player can be in a particular location, experiencing a particular event and engaging with their own particular game-play events such as shooting. These combinations are what create the game's overall narrative fabric and therefore provide the basic components for the sound mix. An interactive mix can be approached by first mixing all the generic locations, then all the generic game-play events. Then, by playing through the game from beginning to end on the mix stage, the unique mission-specific

16. A mixer snapshot is game code that represents the values of every parameter on a mix board. Different snapshots can be used for different conditions and events in a game, such as low health, day or night, a particular location, a particular moment or a cinematic scene. By using mixer snapshots, interactive events can have attributes such as volume or LFE information that are dynamically changed based on game play as the different snapshots are triggered.

17. A tunable transition time is the amount of time, in milliseconds, that a mixer snapshot morphs from one set of faders to the next. It can be thought of as the amount of time it takes a fader to go from one setting to the next; for example, a fast cross-fade would be expressed as 100 milliseconds, whereas a slow cross-fade would be expressed as 5000 milliseconds.

events and environments can be mixed, while revisiting the generic events as they occur in the context of these environments. It is possible to give each action and location its own mixer snapshot, with a tuneable transition time,¹⁷ that can be triggered along with the relevant game event. Each snapshot contains information for all faders that are required to change. This provides an initial approach for planning the mix. Pre-definition of all the generic events, all the unique events, all the locations, all the cinematics, and assignment of unique mixer snapshots, will allow mixing to occur with very little set-up time on an actual sound stage.

An example of how a mix element can be used effectively in a game is that of making interactive dialogue audible to the player at any time it occurs. In *Scarface: The World Is Yours* (2006), at any time in the game the player can inaugurate dialogue from the character of Tony Montana by pressing the circle button. When this button is pressed, a contextual line of dialogue will play. In combat situations, the pressing of this button will issue a 'taunt' from Tony to his enemies, which in turn increases the likelihood of those enemies going into cover. Due to the amount of sound effects playing during a combat scene, such as explosions, bullet fly bys, bullet ricochets and impacts, as well as enemy taunts, the dialogue issued by Tony may well be inaudible if there are a lot of other effects playing. In this case a mixer snapshot is called each time the circle button is pressed which slightly reduces the volume of the less important sound elements at that time. This effectively carves out some of the sound so that the dialogue can be more clearly heard above the other effects. When Tony's dialogue event has finished, the mixer snapshot is released and the previous mix values are returned to the game.

Mixing for different platforms

While the use of surround sound in cinema is often referred to as being a potential distraction from the narrative (Thom n.d.: 7), in games it is a critical navigational tool for the player. With this in mind, surround must be given careful attention during the mix, in order that such pertinent information as the position of enemy fire is being effectively passed to the player from the off-screen space. On previous-generation consoles, different mixes needed to be considered for Playstation 2's Dolby Pro Logic 2 and Xbox's Dolby Digital 5.1 surround formats. In next-generation consoles, any advancement that is potentially made into realms of 7.1 or 10.2 also need to be considered for a completely different mix to take advantage of the speaker configurations that those technologies make available. Generally, on next-generation consoles, a game will be mixed for the standard 5.1 Dolby digital, and checked on stereo systems and mono systems. If 7.1 speaker configurations become available, then the game would need to be mixed for 7.1 and checked on a 5.1 system. Mixing, as a qualitative decision process, should consider the highest and best possible auditory playback environment, and check against the lower configurations for compatibility.

In summary

A dedicated post-production audio phase, in whatever form it may take, is not a luxury, but should be an essential phase of production. It is work that can only be done when all the cinematic and visual elements are finalized

and experienced within the context of the game play and, not least, when all mastered audio content is complete and up to date in the game. Only at that point can critical tuning and polishing decisions about the audio be made accurately. Music, sound effects and dialogue can all be balanced and given appropriate foregrounding depending on the various narrative game-play permutations initiated by the player. The point of view of character(s) in the game can be both established and underlined during a mix of all these sound elements. While there will certainly always be unavoidable last-minute content changes in video-game creation, as there are in film, there must also be a clearly enforced and logical lockdown date that recognizes and re-enforces audio as the final qualitative phase of production.

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Since 1999 Rob Bridgett has worked exclusively in sound design for interactive media, in particular video games, working on *Vanishing Point* (2000), *Sudeki* (2004) and *Serious Sam: Next Encounter* (2004). He recently completed sound direction on Vivendi Games' *Scarface: The World Is Yours* (2006), for which he pioneered a five-week post-production audio phase at Skywalker Sound. This involved working directly with Randy Thom on two weeks of post-production sound design and a further three weeks of interactive mixing. The mix utilized a tactile Mackie Control mix interface connected directly to the game, which enabled a motion-picture film mixer, Juan Peralta, to mix the game using a familiar fader interface. Contact: Rob Bridgett, c/o Radical Entertainment, 8th Floor, 369 Terminal Avenue Vancouver, BC, Canada V6A 4C4.
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