

Multimedia Musical Content Fundamentals

by David Filip

If you're a musician, you're probably reading this because you want to create music and sound effects for your own video games or for your employer. While this article won't go into the programming aspects of music, there are some important practical considerations to make before you even write a note. Your audio work will help to tell the video game's story, so great care must be taken to make sure the cutscenes, sound effects, and in-game music work perfectly.

Non-Interactive Films

As interactive as video games are, there are still times when you'll have to do traditional film-style scoring for a non-interactive film or in-game cutscenes. Your first step before composing is to watch the video portion of your scenes multiple times. Notice the emotional tone set at each moment, the type of sound effects that are scheduled to be in place (or are already there) and the use of dialog.

Themes can be written to introduce characters, actions, and important objects or symbolic images, but remember that your music is heavily restrained by the flow of time. Long themes are nice to have in a film where several minutes can be directed to one character's introduction, but video game cutscenes often jump from one moment of action to another, possibly ruining the flow of musical thematic development. Motives are more easily developed in short periods of time and convenient for this use. For those who don't know, motives are very short themes whose inner-workings are used and exploited throughout a piece. The world's most famous motive is "Da Da Da Dum!" from Beethoven's 5th Symphony.

The sound effects and dialog are also important for shaping your music. The people you'll see in these cutscenes are yelling, shooting, and punching each other for a reason. You won't want to make your symphony louder than they are! There are a few ways to achieve this goal.

First, compose your work so it's unlikely for music to interfere with the dialog. This means the melodic content can be kept simple enough that very little change is perceived in the music while the speech takes center stage - save the extra fast segments for another time, an action scene, or even cut the music out during speeches if you feel the words are strong enough without the music.

Another way to keep music from intruding is to keep your instruments' volume a bit lower during spoken segments. This is especially useful if a fast action scene requires fast music, and dialog appears in the middle of the action. Lowered volume in this case helps keep a frenetic pace throughout while the words can be understood clearly. The

music, of course, will not be heard clearly, but it shouldn't have to be when the dialog takes over.

A third option is to adjust the instrumentation. This can be as necessary for the dialog as the sound effects depending on where the frequencies will conflict. When a missile whooshes past the screen and smacks into the enemy base, there will be many more bass frequencies in the audio effects than treble. The same bass dominance appears in many other popular sound effects like machine guns and engine noises, and your drums and bass-heavy instruments will need attention to help enhance the clarity of these effects. Longer, slower bass notes can keep the sound effects and motion in the music equally clear. It's important not to cut the lower instruments out completely because listeners will notice a sudden drop-out of bass parts as much as they hear the effects. The idea is to compose smoothly, with these effects in mind, and without the audience noticing.

A variation on this idea is to find the frequencies of the special effects with a spectrum analyzer and create a notch filter or equalizer setting that lowers the frequencies in the music that are important to the special effects. This allows both the special effects and the music to be loud without having one's tones go against another's, but do this with care - if you have a song that lacks some frequencies for too long, it may appear to be thin and unnatural. There's no magic formula about how many frequencies you can take out or put back though - just listen and adjust it all until it sounds right, and see if it sounds clearer than lowering the music's volume.

Quality Compromises in the Worst Case Scenario

An example of an action scene's audio track can be heard in the `exsound.wav` file. Yells and explosions are about as common as anything in a video game, so this is an excellent teaching aid. A frequency analysis shows that the explosion only has energy up to about 5 kHz, and the rest of the frequencies present are around my sound card's -90 dB noise floor. In short, it has very few high frequency components and many low frequency components. Other sounds, like my voice in this example, have additional high frequencies present. Check for "frequency analysis" or "spectral analysis" in your audio editor's help file so you may try this yourself. Taking a look at the components of difficult sounds will help you to know how to deal with them.

Difficult sounds? Yes, but not because there's anything wrong with the voice or explosion I used. Imagine if you intended to use the music in `exmusic.wav` to accompany the scene, though. This is a orchestra section with bass-heavy timpani drums, especially designed to wreak havoc with the tone of explosions in the low frequencies. Mixing this music with these sound effects is a sound designer's worst nightmare...they'll NEVER mesh as well as if the composer took care to avoid the clash of frequencies. If you're ever put into a situation where this becomes a reality (sometimes the music is already in place but you need to add bassy effects) I have some tips to make the compromise between musical quality and sound effect quality less painful.

A spectral frequency check reveals that exmusic's strongest frequency points are from 100 Hz to 1300 Hz, comparable with much of the explosion's low frequency strength. By pulling out a few low frequencies from exmusic, I created exmusic2.wav. This file's only difference is that I took a few of the offending frequencies out (from 100 to 500 Hz at 10dB) with an equalizer.

Rather than rewriting the music, this quick EQ job makes the voice, explosion, and the music all intelligible in the same scene at the same time because each gets its own fair share of the frequencies. The file exmixeq.wav mixes both the EQ-adjusted exmusic2.wav and the exsound.wav files as an example of well done frequency editing, while exmixvol.wav helps the exsound.wav become clearer by using exmusic.wav with the music's volume lower in the mix.

These changes are simplified in the equations below:

```
exsound.wav + exmusic2.wav = exmixeq.wav (no volume  
adjustments were made)  
exsound.wav + exmusic.wav = exmixvol.wav (exmusic's volume  
was lowered by 15% in this mix)
```

Obviously the mix would be better off with less bass-heavy music, but this illustrates the trade-offs between frequency cutting and volume balancing in music. Volume balancing places a higher emphasis on the dialog and frequency tricks give the sound effects and music equal balance. The frequency tricks make the music spread out through more frequencies to make it appear louder and clearer because the loss of bass in the music was balanced by the frequencies present in the sound effect. Experiment with these files yourself to see how to make the explosion clearer with your own software.

Of course, to avoid any of this hard work and any of the quality losses, the best defense is always to write and record music that compliments the effects - the more frequencies you use between all the sounds, the fuller your audio recordings will be, and the less time you have to spend worrying about imperfect audio, the better.

A great deal of care needs to be taken with music for non-interactive video because viewers are only likely to hear it once, and everything has to fall into place with the player's first impression. As such, there is never any one rule above to use - always let your ears be your guide when putting it together.

Sound Effects

This facet of sound design has few rules. Musicians can create every sound from scratch in their personal studios (whether these are recorded by a microphone or generated in a computer), can take pre-recorded sound and use that, or combine the two. I'll describe the easy option first.

Using Prerecorded Samples

You can find a gun, a fist-smacking sound, an artificial shark chomping sound, or whatever you want from audio sample CDs that allow unlimited use. The quality of the sounds from these compact disks range from decent to excellent, and the prices can run from five dollar sample CDs from office supply stores to hundreds or thousands of dollars for painstakingly and professionally produced material.

These CDs are the only place you'll want to take prerecorded sounds from, so do NOT record something straight from a movie, song, another video game, or anything else unless you have permission first. That's plagiarism, plain and simple, and when sound engineers are hired to make distinctive sounds for a company, you can bet that company won't want the material ripped off. The cost of a useable effects CD is much lower than the legal fees that plagiarism risks.

Legal defense benefits aside, sample disks are also extremely helpful in nearly any audio development circumstance. With these, the primary way to make a sound that's specific to your video game's world is to take this vow: "I will never use sounds straight from the effects CD."

You aren't alone out there. The odds are pretty high that someone else will use the same sample CD you will in a video game, but yours will always be unique if it's customized in the right ways. Add reverb, chorus, delay, filtering, EQ, distortion, time stretching or any necessary effect to make the sample take on as many characteristics of your game's environment as possible.

Another way to make samples unique is to combine them. Two simultaneous computery beep patterns can make the difference between a good new science fiction effect and a sound that makes people groan "it's just a rip-off of Forbidden Planet." Any sound can be juxtaposed with any others to produce something new, so experimentation with different sounds and relative volume levels can be an important factor.

As above, reverb, chorus and other effects can customize sounds for your game further. Adding these effects is even more important to put all of the combined sounds in the same place, i.e. putting the same type of distinctive reverb on many effects will make the listener believe all of those effects are happening in the same sound environment. Be sure to save all your settings so you know how to each sound was made - even if it isn't your goal to recreate that sound again in your current project, you may wish to recreate it in the future.

On Your Own: Without the Sound Effects CD

To create totally new "alien" sounds from CD material, one doesn't necessarily have to go far from Earth. Animal noises, coughs, and ambient sound effects can all be combined in shocking and unexpected ways with more traditional sounds. They can be

twisted even further from recognition by reversing the waveform, and stretching out the sound effects.

As an example of the possibilities, I recorded a bass, a guitar chord, a high guitar harmonic, and a howl together in Normal.wav. It sounds pretty bad as it is, but it takes on an odd, ethereal quality in expand1.wav simply by stretching the time out with the "sndwarp" feature of my Csound editor. The same "normal" file takes on a more ominous tone in expand2.wav, and sounds aquatic in nature in expand3.wav. Remember that each of these samples are derived from the same file, and each in turn was adjusted using sndwarp with different settings. This is just the beginning! Extraordinary results can be achieved with any sound so it behooves you to experiment with effects until the right timbre is reached.

In-Game Music

Whether you choose to have an interactive musical score, Redbook Audio, MOD files, midi or whatever, you must remember that people will be playing your video game a lot. No matter how many songs you put into the game, the audience is likely to hear each over and over. Volume can usually be changed by the user for the music and sound effects in a PC game so balance with the effects isn't an issue like it would be in the cutscenes. The main problem here is repetition.

Games usually take several hours to complete so music must set the mood without becoming too familiar to the listener. It would get annoying to listen to one song repeat over and over in your CD player; you wouldn't want gamers to think your music is just as bad, so here are some ways to keep the music fresh.

Watch Your Hooks

If you have a melody that you can whistle to, that's a theme. In most forms of music, it's a good sign when people have it caught in their heads, but remember that dozens of hours can be spent playing a single game. After a while, players may just shut the music off since they know the theme too well to enjoy it.

The main ways to avoid this are the polar opposites "simple hooks" and "complex hooks." Rather than trying to use a hook in a traditional musical sense of getting the listener to think of the music, your job is to draw the listener into a game's environment. Traditional pop song forms and lullabies can work well in children's games (since you want the players to relate to it immediately) and can work for any genre of video game. It will, however, automatically be perceived as "familiar" by the listener. This strong familiarity may not have the intended immersive effect for many video games.

I'll evaluate simple hooks as our first way to break out of familiar territory. In this context, simple does not mean easy to perform or lacking in compositional forethought; anything with a type of repetition that will keep the audience's attention is more like it. A drumming pattern or series of special effects can set a mood just as well as a theme can,

and by occasionally adding small segments of thematic material, it can be enjoyed without being tediously predictable.

Sometimes it's a good idea to present a short melody that has so little change and content that the listeners will perceive it as a part of the background rather than a dominating force. This can have the same effect as the drum or bass part in drawing an audience into the game. Often this music focuses on this repetition in bass and percussion to emphasize the beat, the tone of digital effects on music more than the notes themselves, or thicker chords instead of strong melodies.

Popular examples of the "simple" approach with slow, steady emphasis on chord progression can be heard in the Protoss music from Starcraft, digital effects and sparse use of melody appear in the Zerg Starcraft music and the Mechwarrior II soundtrack, and catchy but simple bass and rhythm effects were used especially well in Doom and the Command and Conquer games. Can you name anyone who played Red Alert and didn't bang their heads to "Hell March?"

Complex hooks, again in the context of video game music that will keep the players' minds off the volume control, can use any of the elements above (or really anything from any type of music imaginable), but must contain a strong melody as well. The key is not to repeat that melody so often it'll become familiar right away and annoying later. Make sure the song branches off, breaks out of the verse-chorus-verse pattern, or just that you write more songs when you want melodies to be the driving force in the game's music.

Music may not affect the gameplay, but no one expects to sit down and listen to the same recognizable melody a hundred times in an hour. Warcraft and Warcraft II, the Star Wars games and movies, Rise of the Triad, and the Lucas Arts adventures put a lot of melodic content into their games, and this kept the music fresh for repeated listening.

There's also an amusing point to make about the distinction between complex and simple hooks in music: When you put enough melodic twists and counterpoint into a song, the distinction breaks down and disappears. It gets to be so thick and complex that a listener can't perceive everything he hears but is drawn into the scene by the combination. Not to keep harping on Beethoven's 5th, but by using a simple motive in so many complex ways, his symphony had the effects of both complex and simple hooks.

Use Expectations

It's important to know your music's intended audience. No matter how emotional an Indian raga may feel in its own context, the typical audience of a video game is accustomed to music from the western world. If you stray from conventions, it's likely to sound alien to the audience. Likewise, if you're familiar with academic music, you may be tempted to use your new knowledge of tone-row rearrangement to create an atonal soundtrack Shoenberg would've been proud of in his heyday. Resist this urge.

Serialism is fine for a graduate student's doctoral thesis, but as a professional you have to realize that atonal music has been branded in the mainstream audiences' minds as 1950's horror film soundtrack material. This is not to say you can't use any type of music you want, but you and your audience are all prisoners of pop culture. When a string section takes a low note up a minor 2nd and stops, everyone will remember Jaws and will automatically think something ominous will happen. Don't be caught unaware of the pop culture connotations your music will have, and always use these expectations in ways that will to enhance the video game's mood.

Finally, here are some other pitfalls to avoid in music and sound effects creation:

1) Incongruities

If you change your musical style in a game, have a reason for the change. Command and Conquer's soundtrack has an eclectic mix from many genres of music which works very well, but Starcraft: Brood War's Terran music is not as lucky. If you play as the Terrans you'll hear a perfectly fine orchestral work with complex hooks for the UED, but only as a part of one track - then it shifts back to the original guitar, synthesizer and orchestra music from the original game. In short, the differences are an instant reminder that only one new Terran song was added to the expansion pack. Don't change your game's musical style without a good reason.

2) Too much of a good thing

Yeah, you might come up with a fantastic sounding death scream for your enemies, but use it sparingly. After a dozen kills it'll sound ridiculous, and further on it'll sound like there was little forethought in the effects department. As with machine gun sounds, explosions, and other effects, remember to introduce a lot of variation. If you use multiple sound effects for the same type of weapon, action sequence, punch or whatnot, you'll have a much more polished product.

3) Use sound to let people know what's going on

Along the same lines of #2, it's nice to give distinctive sounds to every action so the player can know what's going on and what to do about it. Even if different enemy characters share the exact same type of machine gun, they might fire in different sounding bursts to signify one enemy or the other. Both weapons have the same in-game purpose, but differentiate them as much as possible. This allows the sound effects to provide gameplay information about who's shooting at the player, and that's much more than "ear candy."

4) The sounds of silence

Soundtrack writers in the old newsreels said they used silence for the image of a nuclear bomb because additional music would have taken focus away from the power of

the event. With a little strategically-placed silence, big events will seem just as big as they should.

5) *Know the flow*

Always make sure you know when and how your music will be used in a project. On one website's audience-draw movie, I wrongly assumed that there would be a break between parts. While unconcerned with the flow from one download to the next, I wrote a separate musical intro and outro for each episode. When the final product was placed on their website though, every part was put into one big download, with no break between episodes. I cringed at each scene change because I knew I could have managed the transitions better, and I never made the same mistake since. Make sure you don't either, and find out exactly how the project will be presented before you compose for it. Assume nothing!

And to review from the this article...

- 1) *NEVER use the sound effects directly off an effects CD. Change each effect in some way that makes it a part of your game.*
- 2) *Unless music that follows the typical pop formula is crucial to your game, use the simple or complex hooks to avoid the feeling of repetition.*
- 3) *Use your audience's expectation about different types of music to your product's advantage.*

You just have to remember what your audience or employers want, how to achieve it, the mood most people will expect from the game, and the mood most people will feel when they hear the music and sound effects in place. Make them feel, know, and live in that world. It's time to get started!

David Filip is a sound designer, musician, voice actor, composer, writer, and programmer, currently attending the University of Washington in Seattle, WA. His music can currently be heard in PC Gamer's "Corporal Dan: Revelations" and its movie trailer. Both can be seen at

<http://www.pcgamer.com>
<http://www.pcgamer.com/features/movies-colin.shtml>

And "Cold Slither Month," the internet finale to Zartan's Domain featured over 30 minutes of David's recorded material including voice acting and production, simulated live band performances, funk, metal, rap, and orchestral music. It can be heard at

<http://homepages.ihug.co.nz/~rwh/index.html>

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