

**Interactive Music writing in the Age of AI:
A retrospective analysis and the future for game music.**

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Abstract

In this thesis, the practices, workers and monetary aspects of interactive music industry has been investigated.

As the terminology regarding this industry is observed to be ambiguous, each of the elements that make up the industry and where they came from were explored.

Once the definitions and their relevance to industry have been established, the effects of progressive technology on this industry have been hypothesized. As technologies such as Virtual Reality and Augmented reality are still limited to niche area of console gaming and just recently making their appearance on mainstream, they have been only mentioned. However, with the all-encompassing nature of Artificial Intelligence technologies and what they offer to software industry in this thesis it is hypothesized to impact the industry on its population of workers and their financial and professional practices.

As the industry has been observed to be in a stable state financially and dependent on the gaming industry itself, it is proposed that the biggest impact will be in their use of technology and how they can bring new dimensions to future games have been discussed.

Furthermore, as these effects have been described anecdotally, to observe the psychosomatic experience a more developed game music can offer, an experiment game based on earlier studies in the field have been conducted. While the research has shown some existence of these said effects, the unstable sample set has been deemed not sufficient to prove the hypothesis and suggestions have been made in the same direction for bigger and more curated sample groups.

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Experiment Material:

The game “Purple guy” used for the experimentation in this thesis is available at:

<https://gamejolt.com/games/purpleguy/537349>

Available on: 26/09/2020

List of Abbreviations

AI: Artificial Intelligence

VST: Virtual Studio Technology

MIDI: Musical Instrument Digital Interface

DAW: Digital Audio Workstation

VR: Virtual Reality

AR: Augmented Reality

NPC: Non-Player Character

SCI: Sensory, Challenge, Imaginative immersion

Et al: ... and other contributors

Et seq: ... and the following pages

f.: ... and following page

e.g.: for example

1. Introduction

In this paper, the reports regarding the socio-economic aspects of the industry were based on surveys done by GameSoundCon over the years 2014, 2015, 2016, 2017 and 2019, each involving above 400 global industry professional respondents with usable insights. Although this data is limited to visitors of the portal, it gives useful insight about individuals who are involved in games music industry and the comparison of each year's variables were important in understanding stable or unstable dynamic trends.

In addition, to understand the future of the industry, the practices of the professionals of the industry were explained.

The reports involved, salaried and freelance workers of the industry. Variables such as annual incomes, years of experience, their backgrounds, education levels, use of implementation tools, use of live musicians and gender inequality has been taken to account. As these reports were compiled as annual snapshots, in this thesis, the trends on these variables have been observed and compared to extrapolate information regarding the future of the industry.

Furthermore, the term “Age of AI” means that most of today’s computing technology uses abundant use of AI and what it offers. Such as analytics, user curation, platform business models, data collection, metrics...etc. It is hypothesized that much like CD technology effected it in the past, a wide and more abundant use of AI technologies could have a drastic effect in the interactive music industry regarding its business practices, financial size and expertise. The scope of each of these elements were studied with case studies and arguments were supported via the reports on the industry.

2. Interactive Music

The term Interactive music is an ambiguous one. While for the purpose of this paper it means music/sound implemented in games, according to academics¹ it is one part of game music, the other being adaptive music. According to this definition, interactive music refers to sounds/music in games that are caused by player interaction, whereas adaptive music refers to sounds/music caused by the virtual game world environment. In this paper, interactive music, as it is commonly used, will refer to games music and adaptive music will be explored separately.

Although for the consumer it may seem like a basic part of the game, it has a chaotic production line of labor that goes into designing, composing, performing, producing and implementing sound and music to games. Furthermore, the occupation of creation and implementation of audio into games had and still has many job titles attached to it, all spawning from its rather turbulent history.

As shown in the following table,² a scan of 100 job posts of the market shows that the job requirements game music professionals has many variations. In addition, the employers' choice for hiring a games music professional, their choice of trait is experience, by 69% of the job posts scanned by the researchers. This implies that the employers are well aware of the chaotic nature of this role in games production and that they always prefer to go with what has worked in the past.

¹ cf. Collins, K.: Game Sound, London 2008 p. 4

² Schmidt, B: GameSoundCon; How to get hired as a game sound designer 29/072020 p. 2 et seq.
Available at: <https://www.gamesoundcon.com/post/game-audio-job-skills-how-to-get-hired-as-a-game-sound-designer>. Available on: 26/09/2020

Requirement	Percentage
Experience	69
Formal Education	37
Music Composition	23
ProTools	38
Reaper	31
Wwise	63
FMod	24
Unity	23
Unreal	41
Scripting	48

Figure 1 – Requirements in scanned job posts and their percentages

Furthermore, as the same survey³ scans through the job titles of said game music jobs, it has less variation but still ambiguous meanings.

Job Title Includes Phrase	Percentage	Notes
Sound Designer/Audio Designer	70%	"Jr. Sound Designer" (5%) "Sound/Audio Designer" (35%) "Senior/Expert Sound Designer" (18%) "Lead Audio Designer" (5%)
Technical Sound Designer	9%	Includes "Audio Technical Designer"
Composer	6%	
Manager/Lead	6%	
Other	7%	Dev Support: Audio Audio Mixer Dialogue Supervisor SFX Engineer Audio Engineer/Audio Design Engineer

Figure 2 – Job titles in scanned job posts and their percentages

The majority of jobs in the market looking for game music professionals, refer to the position as sound/audio design.

They may all mean the same thing but in order to understand the games music industry and its future, all these terms have been defined for clarity.

³ Schmidt, B., supra, p. 2

2.1. Sound design

A sound designer works with synthesizers. Using whether real life recorded sounds (samplers), electronically produced (oscillators) or most commonly today digitally (VSTs), they focus on the *timbre* of sounds rather than the note they play.

In their early ages synths ambitiously were produced to replicate real-life instruments. They were designed to sound as realistic as possible to sound like a string or woodwind ensemble. However, the technological restrictions of the period only could allow so much. Today these synths are more remembered for their distinctive sounds rather than realism.

Nevertheless, they mark the definition of sound design and paved the way to VSTs (Virtual Studio Technology) that are indispensably used in any kind of media music production. They are like the early synthesizers only digital. Since digital audio production is far more flexible and cheaper, the possibilities of sounds that can be done with VSTs are infinite. Sound designers are the producers of these libraries as well as being the consumers, to provide non-musical elements to games.

Reports⁴⁵⁶⁷ done over 6 years indicate that the majority of game music professionals use virtual sounds at their projects. Except for large budget productions very rarely a game developer will use a full live recorded music and only around 30% will use “live sweetening” referring to the type of music that is mostly done digitally and with minimal number of live musicians just to give the “feeling” of reality.

The realism of VSTs is achieved by not only recording the real-life sounds, but also recording their transitions from each note to another. This is many combinations. Furthermore, another important aspect of VSTs are that they are dynamically recorded. E.g. a violin player hired for a sound designer production, the player is likely

⁴ Schmidt, B.: GameSoundCon: Game audio industry survey 08/2014, p. 12. Available at: https://13238686-dfad-ebf7-099d-cece13be0057.filesusr.com/ugd/ebb935_ebd473f704ea4ccab342db1962a18da4.pdf. Available on: 26/09/2020

⁵ Schmidt, B.: GameSoundCon: Game audio industry survey 08/2015, p. 15. Available at: https://13238686-dfad-ebf7-099d-cece13be0057.filesusr.com/ugd/ebb935_109f128500324e33aac33f9a37fb6c9e.pdf. Available on: 26/09/2020.

⁶ Schmidt, B.: GameSoundCon: Game audio industry survey 08/2016, p. 11. Available at: <https://www.gamesoundcon.com/post/2016/08/17/game-audio-industry-survey-2016>. Available on: 26/09/2020

⁷ Schmidt, B.: GameSoundCon: Game audio industry survey 08/2017, p. 12. Available at: <https://www.gamesoundcon.com/post/2017/10/02/gamesoundcon-game-audio-industry-survey-2017>. Available on: 26/09/2020

to be asked to play the same note many times softly and loudly to corresponding to 127 dynamic levels of MIDI (standardized coding language for music writing for computers) scripting. It is tedious work requiring highly skilled and experienced professionals producing it.

With MIDI today, the range of sounds that can be produced are infinite and this is what many sound designers do besides producing sound libraries. With free packages that come together with digital sound editing tools, sound design is the most basic skill a game musician is expected to have. To be able to quickly produce sound bites for projects. (such as a laser beam sound for a space shooter).

2.2. Audio Engineering

Audio engineer is the role of recording, mixing and mastering audio and making recordings of performances sound as good as possible. Not necessarily a profession related to gaming up until CD technology became de-facto standard gaming unit.

Audio engineers' most prominent skill is with mixing consoles, microphones, performers (or Foley artists) and studios. The emergence of consumer format music in video games created a need for more sophisticated DAWs (Digital Audio Workstations), that are software versions of the mixing consoles in studios. Using different audio file formats was a technique used by game developers and to satisfy their needs, DAW companies would provide more and more sophisticated audio compatibility and editing tools, saving time and money.

By using DAWs audio engineers (and sound designers) produce "stems" to be used in games. Stems are individual elements of recorded music. If a rock band is to be considered, this would mean that the stems would be drums, bass, guitar and vocals separately. Audio engineers produce and optimize these individual pieces of music and submit them for implementation.

In the field of gaming today audio engineering is a very common skill required by employers since today's game music production tools are making heavy use of audio engineering and editing skills.

2.3. Composer

Over the past 5 years, reports show that there is a steady 70-75% presence of game music professionals with Bachelor's degree in the game music industry. 72% of this is has a degree in Music⁸ rising from 50% in 2015.⁹

Composers represent the music 75% of this group. Game music composition programs that are becoming more and more complex, composers are educated about the more cerebral aspects of sound and music.

Not just intensifying scenes with few more sounds, composers are taught a groundwork of film music techniques and build game music production techniques on top of it.

This means that, when writing music for a game, composers take part in spotting sessions (discussing which parts of the media need music), temp music (temporary music selection to use as placeholder), dramatic composition and orchestration techniques. Since the layering of sound effects and music is such a blurred line in games, it is reported over the past 6 years that an average 75% of games composers also do sound design for the projects they work for.

Furthermore, reports show that even with large productions included, game music is only half live performed music. Composers are trained to use sound libraries and reports also show that composers mostly perform the entire project themselves using them. Hiring professional instrumentalists and orchestras are an expensive investment and unless the project has a dedicated budget for it, it's not often to do it.¹⁰

Besides university graduates, a game composer may or may not have the number of titles discussed above. This is why experience and referrals are very important when being hired by a game developer for a project.

⁸ Schmidt, B.: Game Sound Con: Game Audio Industry Survey 2019, supra, p. 13 f.

⁹ Schmidt, B.: Game Sound Con: Game Audio Industry Survey 2015, p. 19

¹⁰ Schmidt, B.: GameSoundCon: Game Audio Industry Survey, 2016, supra, p. 12

2.4. Voice-overs

Voiceovers are of specific importance to games, and other media audio because human voice is recognized as most unambiguous sound type.¹¹

This should mean that the best and easiest instrument to put in a game be just voice recorded and that should be it.

However, with the use of voice comes the problem of language and the risk of wearing out the player with repetitive phrases.¹² This is why in successful productions; voice is usually used sparingly.

Voice overs are important for localization of games. As more and more games are targeting global markets, recording the original voices in the local language is a service game localization companies offer.

2.5. Performer

Performing musicians in game music are not often. As long as the project has a budget for a live band/orchestra performing musicians can be hired. Otherwise it is at the composer's or sound designer's discretion to hire live players. Reports show that the use of live musicians is more preferred by larger budget games.¹³ As discussed earlier, composers mostly prefer to perform their own music using VSTs and performers for game music usually make income by serving other non-gaming sectors of the game music industry.

2.6. Audio implementation

Whilst it is recorded that very rarely the game music professionals would know or perform scripting services in game projects, many game companies prefer audio implementation experts to composers, more popularly today who use Wwise.

¹¹ cf. Liljedahl, M.; Grimshaw, M. (ed.): *Game Sound Technology and Player Interaction: Concepts and Developments* Chapter – 2 Sound for Fantasy and Freedom, England 2010, p. 31

¹² Liljedahl, M.; Grimshaw, M. (ed.), *supra*, p. 39

¹³ Schmidt, B.: *GameSoundCon: Game Audio Industry Survey 2017*, p. 12

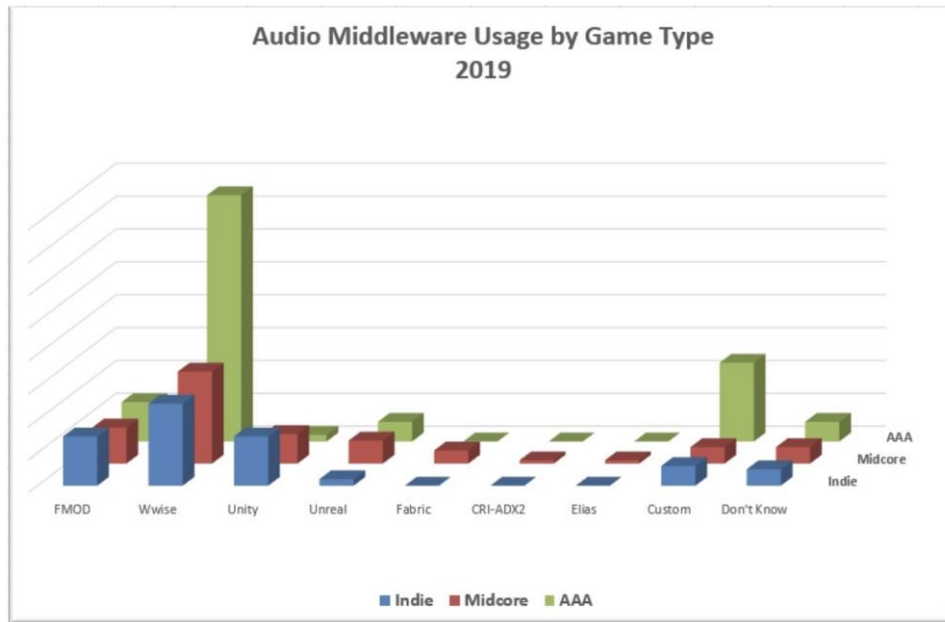


Figure 3 - 3rd party audio-middleware usage by reported survey takers

The reason for not using Wwise for indie or casual games is budget. Most non-AAA productions use Unity or similar game engines which have their own audio scripts to do this without acquiring a middleware.

For AAA games the reason is compatibility. AAA games have their own game engines and thus their own sound implementation scripts. The audio implementation is done by specialized experts who are software engineers.

It should be observed that recently Wwise has risen to become a more popular implementation tool for AAA games over the past 6 years.

3. How is music implemented in games?

3.1. Real-time synthesis

In the 80s and early 90s the term game music professional wouldn't necessarily mean anything other than a programmer specialized in audio programming.

In the early ages of home-computing, game music has been mostly defined by the console the games were made for. Nintendo NES, Sega Mega Drive, IBM PC and Commodore 64 all had their specific sound chips with differing capabilities.

With these restrictions in mind real time synthesis refers to what goes in the video game console as the sound gets produced. The source code of the game calls for a sound to be played at a certain event and the specific sound frequency gets played at a specific time and length. Depending on the sound chip of the console, music and sound could be played at vary multiple levels. The programming/implementation of music for games in this era required highly skilled professional programmers (of the specific language for the console). For this reason, it was a niche practice.

MIDI (Musical Instrument Data Interface) is a special type of script that VSTs can interpret and make sounds. Today real-time synthesis in games is used via MIDI, VSTs and other audio implementation scripts.

3.2. Advent of CD games

In mid 90s. CD technology became available for home computing. CDs were already becoming a standard packaging for consumer music market and this meant that audio could be implemented into games via the already compatible sound format of the CD in what was known at the time as "CD-quality".¹⁴

With the advent of CDs, games became more cinematic. Accompanying the live-action video quality of games of this time, CD quality music not only became the norm but also created a reaction to the former real-time synthesis.

The importance of CDs in game music has been that it opened up the consumer music market to gaming. Games developers could now use pop music in their games and popular musicians could make income from games. Any regularly produced consumer/cinematic music, sound effect or voice recording could be played when the

¹⁴ MacDonald, G.: A History of Video Game Music, p. 20. Available at: <https://www.gamespot.com/articles/a-history-of-video-game-music/1100-6092391/>. Available on: 26/09/2020

game calls it, only limited to audio memory capacities of the CDs. As long as the format of the audio was CD compatible (aiff, mp3, wav...etc.) it could be in the game.

On the other hand, to save memory, game developers would dump the audio in the consumer music format (that could be played by a non-computer CD player), separate from the source code, only to be located when called by the program. This meant significantly interruptive loading times between the scenes of games as the needle of the CD rom player would switch back and forth between the data of the music and the data of the game.

Furthermore, this was the time when games musicians were just learning the basics of game music design. As realistic sounds and music tempted a lot of creativity, it had restrictions beyond the memory of the CDs.

Cinema is a linear artform. It has a beginning a duration and an end that is uninteruptable. As game musicians realized with the “hit or miss” nature of the games of this era, games were different than films, that the control of the flow and narrative was in players’ hands. This meant that the consumer of this media could move forward, spend more time than expected at a location, back track or just choose different paths to play the game. This highlighted the necessity and importance of adaptive music. When the music was not composed and sounds not implemented with player behaviors and necessities in mind, music for games could be too repetitive, frustrating and disrupting/distracting to the gameplay.

3.3. Adaptive music

For scholars, the term adaptive music is defined as the type of music/sound caused by the environment of the virtual game world as opposed to interactive music which are sounds caused by player input. In this paper, a more common and popular definition will be used.

Adaptive music is the core contemporary practice of a game music professional. Music is not only written, recorded and sounds designed but also transitions, layers and their triggers are implemented, all done to make the music of the game sound as one composed piece tailored to player’s progression in the game seamlessly switching from one individual piece to another.

Layering is the stacking of audio on top of each other. In cinema this wouldn’t be a separate phenomenon than orchestration or audio editing, but in games layering

indicates to the player the modes of a scene. **E.g.** while exploring a level in a first-person shooter, the player may encounter an enemy and to raise the tension of a scene the game musician may introduce extra layers of orchestration and more complex musical elements. Not to mention, in many cases, these would be added on top of an already layered voices of characters and sound effects that are to be expected in the scene.

Transitional elements can be described as their name suggests, they are composed musical bits specifically to transit between one music to another. When a game gives the player a landscape to explore, it could take a long time for the player to proceed to the next part of the game. Transitioning is an alternative to writing long pieces for scenes in games. **E.g.** a level in a first-person-shooter game would be divided into locations. As the player switches from one of these locations to another, so would the background music. In order to avoid the music change being choppy, game music professionals would implement these transitional bits in between to make the music change, be seamless and adapt to the players exploration of the scene.

In their game *Monkey Island - 2*¹⁵, game musicians Peter McConell and Michael Land programmed iMuse, a music scripting development tool that allowed the implementation and execution of cues of each scene with transitions in between that turned the music for the game to one uninterrupted piece.

iMuse was just a more sophisticated form of practices of the real-time-synthesis era. Today it is not possible to find this script or use it. But it was essentially a prototype for the software today known as middleware.

3.4. Audio Middleware

Middleware programs are what connects music production and game development.¹⁶ As discussed, in the past these programs would be specific to the game, console, project or company. Today as standardized middleware is popularly in use, musicians, mostly of film-scoring, composition or audio engineering backgrounds are able to take part in game development process implementing audio themselves. All the techniques discussed so far (real-time synthesis, live recording, transitions, layering... etc.) can be implemented into game.

¹⁵ cf. Sweet, M.: *Writing Interactive Music for Video Games*; USA 2015. p. 99

¹⁶ Wwise. Available at: <https://www.audiokinetic.com/products/wwise/>. Available on 26/09/2020

Today this is the final technological milestone of game music. Whilst some large companies still prefer their own audio implementation scripts dedicated to their own game engines and indie games prefer the source code to implement audio, audio middleware such as Wwise has been on a steady rise over the past decade.

What middleware allows today is technically explored in an article¹⁷ by explaining the technical details of the term "Real-time-mixing". What real-time-mixing is that the properties of the sound and music would mix accordingly to the player's progress, turning the activity of game play into essentially an audio engineering session in real-time, to mimic the physical reality as accurately as possible. Make the sound reach the player from different locations, from different distances and with acoustic effects that change in property according to play progress.

3.5. Other roles

Whilst being the defining tool of game audio implementation, middleware use on its own is not enough to describe the roles of a game music professionals in games. Even today, with dedicated teams of specialized audio professionals, the roles and the elements of game music value chain have very blurred lines between them, and so many of them overlapping with one another, as it is reported over 6 years that 33% of game music composers also reported of taking on additional roles in games projects.

In summary, a game music professional may have one or more of the discussed roles in a game. Since CDs became the main form of packaging games, today with Blu-Ray discs, the occupation and its definition are very broad. This is why employers prefer an assurance such as education and experience when hiring them.

¹⁷ cf. Taylor, G.: Blessed are the noisemakers; All in the mix - The importance of real-time mixing in video games 20/02/2012. Available at: <https://gameaudioinnoise.blogspot.com/>. Available on: 26/09/2020

4. How can Artificial Intelligence effect game music?

In this paper, it has been hypothesized that there are a number of ways the AI, over the ages, changed and will change the industry of games music, all pointing to the direction of a more improved adaptive music.

4.1. Affordable software

In the past game audio and audio engineering tools (DAWs) were scarce and expensive. Standard music production tools such as Avid's Protools, Digital Performer or Logic were mostly exclusively used by professional studios.

Digitalization effected this shortcoming of the audio engineering industry. The availability of physical copies of the software were no longer limited by the shipping difficulties and logistical structure of DAW software companies.

Today the creation of big data pools highlights the value of owning a data-base of users and active communities. This helps making it more feasible to offer free products to user via subscription, freemium/premium or other platform business models. It is because of data analysis and data collection that Twisted Wave¹⁸, Soundation¹⁹, Bandlab²⁰ and even Wwise for implementation all using different monetization models.

This is not limited to offer no frills products to casual producers. While still the professional audio production tools and DAWs use traditional one-time-payment purchase business models, because of the value of user database with payments only required for commercial published products above a threshold revenue, anyone who is interested in producing music have a range of free and/or more affordable products to use.

This is likely to have increased the already dominating number of independent producers in the industry.

¹⁸ Twisted Wave, Available at: <https://twistedwave.com/>. Available on: 26/09/2020

¹⁹ Soundation, Available at: <https://soundation.com/>. Available on: 26/09/2020

²⁰ Bandlab. Available at: <https://www.bandlab.com/>. Available on: 26/09/2020

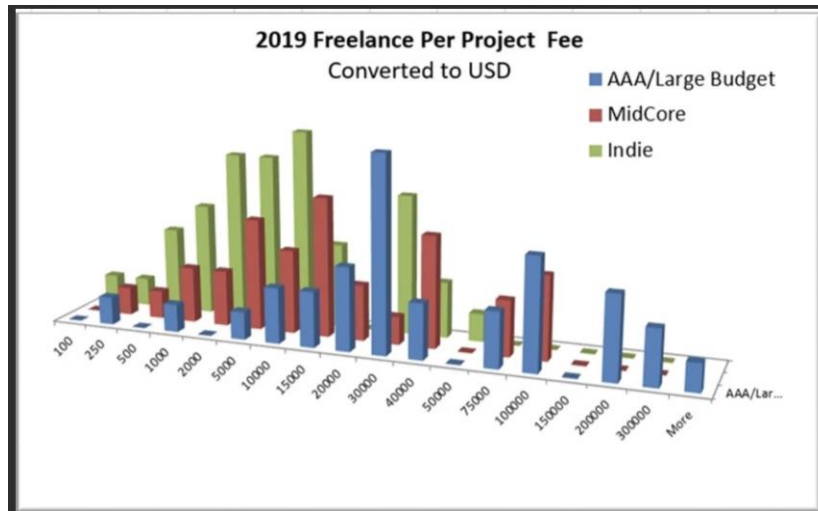


Figure 4 – 2019 income allocation for freelancer game music professionals

As the reports suggest, over the past 6 years, the rates for salaried employees of professionals did not change outside the 70-80k\$ annually and an increasing number of salaried employees do freelance work on the side. This group makes up the high end of the above graphic.

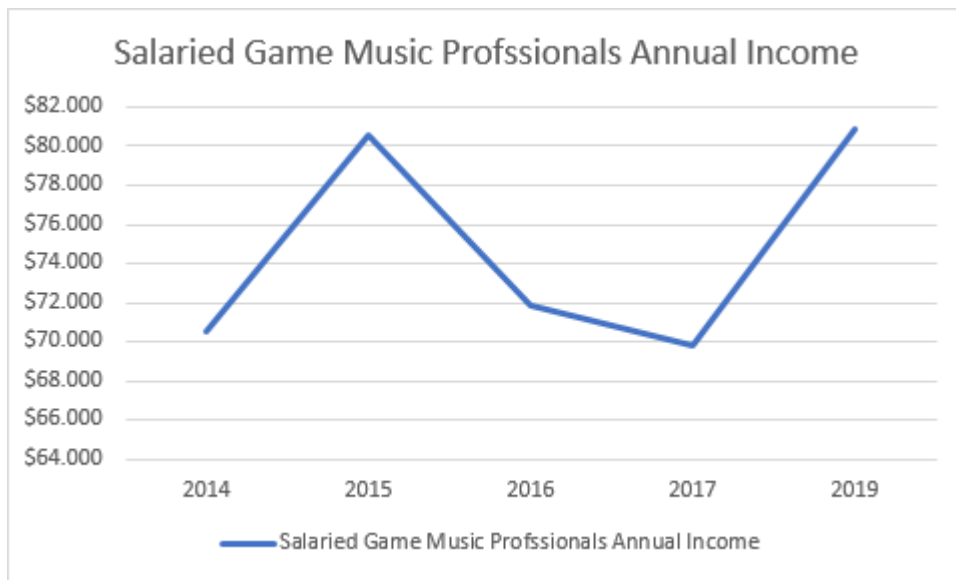


Figure 5 – Salaried employee income over the years

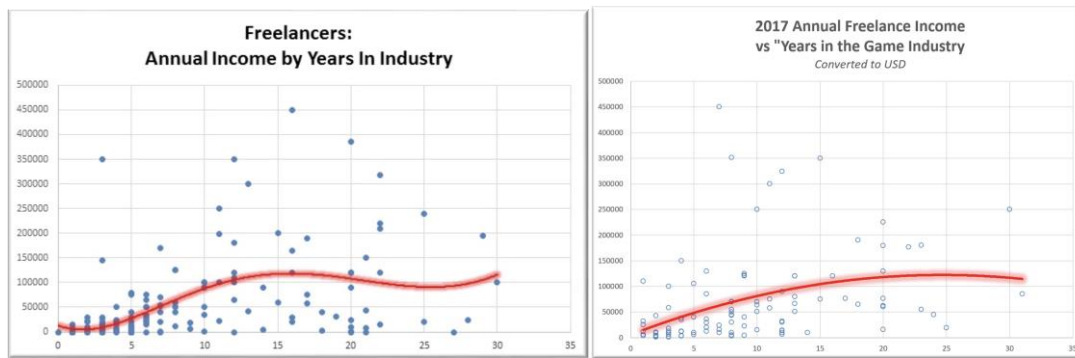


Figure 6 – Annual income vs Years of experience trends

Above graphs are a comparison between reports of surveys done in 2016 against 2017.²¹²² One thing that is observed here is that the hired freelancers had more varying experience/income ratios in the earlier survey and a more proportional trend in 2017. It can be stated here, that game developers have standardized their methods of hiring game music professionals during this period.

It is also important to point out that over the years, reports show an abundance of payment methods to hired game music professionals, by minute of music, per project, per hour, licensed, work-for-hire per, royalty, bonuses...etc.. This can be interpreted as the efforts of game developers trying more cost-efficient ways to acquire music for their games and game music professionals inventing new ways to make the most out of their project.

Along these findings, the affordable software made possible by AI and platform business models music software companies use, the lower income segment of freelance data is likely to increase. Given that it is stated many per/project fees that were not paid were excluded from this data, it is highly unlikely this will affect any financial growth in the industry but rather bring diversity to this segment of the field. Although if gender equality is to be used as a variable for diversity, it is unlikely to predict a significant change here too since reports also show that women in the industry has barely rose by 3.6% over the course of 5 years and gender-equal income is still an issue although minimized.²³

²¹ Schmidt, B.: GameSoundCon: Game Audio Industry Survey 2016, supra, p. 6

²² Schmidt, B.: GameSoundCon: Game Audio Industry Survey 2017, supra, p. 6

²³ Schmidt, B.: GameSoundCon: Game Audio Industry Survey, 2019, supra, p. 5

4.2. AI Curation

In 2012 a game Hotline Miami²⁴ was released.

The game, initially a casual flash game, has 8-bit pixel-art graphic style, and a gameplay that was borrowed from GTA 1, about twenty years prior with an additional mouse control added in. The game doesn't have full motion animations but rather cutscenes with basic talking animations to reveal its convoluted plot.

What the game was most notable for was its difficulty setting and carefully acquired music. The game restarts the level from the beginning every time the player is defeated and any slightest error by the player would result in an abrupt game over. Players have to play the same levels countless times over and over just to finish in normal difficulty.

The game was nominated for a number of awards including "Best Overall Game" rivaling the AAA blockbusters such as Diablo III, Borderlands 2 and League of Legends, and won Best Sound Design and was listed in Best of 2012 by IGN and on its seventh week of release was reported to have sold 130,000 copies.²⁵

How could such a graphically primitive game with such an unforgiving gameplay could be successful.

The music of the game was a very carefully adapted playlist,²⁶ like a techno compilation album and each track assigned to a level looping. With some added basic sound effects the implemented music didn't have much regarding complex adaptive transitions or layering effects that are common in games.

What Hotline Miami did was to juxtapose the frustration of an unforgiving game with the intensifying effects of professionally and independently produced electronic consumer music, performed by a handpicked group of successful DJs and electronic music producers.

²⁴ Hotline Miami, 2012. Available at: https://store.steampowered.com/app/219150/Hotline_Miami/. Available on: 26/09/2020

²⁵ cf. Purchase, R.: The Hotline Miami Sales Story and More, 11/12/2012. Available at: <https://www.eurogamer.net/articles/2012-12-11-the-hotline-miami-sales-story-and-more>. Available on: 26/09/2020

²⁶ Author not named: Hotline Miami Artists. Available at: <https://hotlinemiami.fandom.com/wiki/Artists>. Available on: 26/09/2020

This concept is still, while not common, observable in more recent indie titles such as *The Stanley Parable*²⁷ and *Getting Over It*²⁸. Much like *Hotline Miami*, both these titles have rather inconvenient gameplay designs. However, they both have a sound/music design that dominates the game with not music but voice narration. Whether to narrate the otherwise incomprehensible ongoings and progress in the game or to soothe the frustrated player with some poems or light music after an unforgiving game over.

Whilst the music or sound recording were done with the decision making of the developers of these games, AI is likely to play a role in this.

Spotify in 2018²⁹ announced a partnership with Xbox and PS4, making it available in these consoles. More importantly, the music could be played during game play, to replace the implemented ones.

Use of Top 100 Billboard tracks in music has been a tradition of EA Sports games, each annually-released game filled with top hits of its release year. But with Spotify taking part in actual gameplay, revealed information regarding what gamers prefer to listen to for how long depending on the locations as long as providing curated playlists for specific games.

Spotify lists some preferences of music when players were listening to during their gameplay experience. This is very valuable information for game developers, especially for large companies. Knowing the top trending music preferences of users from location to location can be an important aspect of decision making when making games more appealing and targeting more localized and niche markets. Sound and/or music is can be a powerful agent in constructing algorithm metrics and is currently used by companies outside the gaming industry to provide more curated content.

²⁷ *Stanley Parable*. Available at: https://store.steampowered.com/app/221910/The_Stanley_Parable/. Available on: 26/09/2020

²⁸ *Getting Over It*, 2017. Available at: https://store.steampowered.com/app/240720/Getting_Over_It_with_Bennett_Foddy/. Available on: 26/09/2020

²⁹ cf. Author not named: Find Perfect Gaming Music on Spotify 24/08/2018. Available at: <https://newsroom.spotify.com/2018-08-24/find-the-perfect-gaming-music-on-spotify/>. Available on: 26/09/2020

4.3. AI Written Music

AI written music is outside the realm of gaming. It serves mostly consumer or cinematic music types, but their practices are similar to those written by gamers. That AI composing software uses algorithms and curated database patterns to create musical structures. How this concept applies to games will be studied via a case separately.

It is the phenomenon of machines composing and producing unique musical pieces of their own.

The building blocks of this technology is not new. In 1990 a software called Band in a Box³⁰ was released. Still in the market, this software is designed for the use of music students and teachers.

The software has a list of styles that can be chosen by the user.

The user can write “chords” to be played and the software can play the chords in written succession at the given style.

The reason that such a technology would be possible so early in software industry in 1990 is not a secret technical ingenuity, higher memory or hardware. The reason was that the software would only play contemporary and mainstream styles of music. It was the simplicity of the music it was designed to play.

Classical and cinematic music are more complex than e.g. jazz music which is what the software was mostly designed for), country or funk. The rhythmic and harmonic (types of chords) structure of these popular styles are debatably limited. Unlike classical music, in these popular styles, there is not much effort that goes into covering up the harmonic and rhythmic structures with complexity, which is one of the principles of classical composition. For contemporary styles, basic instruments such as the bass, drum and the chord patterns would be easily programmable. The number of instruments can be obvious to almost any listener. The software using these programmed structures for country, pop, jazz music allowed users to put in chord symbols and the music would be played at a given tempo for a given duration and repeat in the desired key providing perfect practice band to music students practicing.

Working with live musicians has been a luxury even for working musicians in early 90s. At the time, the only way to find a “backing track” to practice musical improvisation

³⁰ Band in a Box, 1990. Available at: <https://www.pgmusic.com/>. Available on: 26/09/2020

and performing would be to buy a Jamey Aebersold record with the desired songs in it. Band in a Box offered a very practical and versatile alternative to this. It didn't feel like a real band, but it was enough to assist music students to practice, offering supportive, user defined backing tracks to musicians or music teachers.

Although today Band in a Box is not without competitors such as iReal Pro, it had one feature that was most curious. It not only had a list of backing tracks but also it had a list of soloists. If so desired, the user would pick one of these soloists (e.g. a solo in the style of Charlie Parker or Sonny Stitt...etc.) and Band in a Box would generate a solo melody that somewhat resembled the style of the musician picked that played over the chords written by the user at given speed and key, showing all the notes played at the same time. Using an earlier version of machine learning, the music technicians would spot patterns in renowned artists solos and implement them to the software in algorithms.

Today, there are examples of music composer/software programmers who on social media showcase their skills of writing algorithms that compose music in any style and offered as a service of its own.³¹

Furthermore, the successor to Band in a Box, iReal Pro³² is one of the most popular music training and production tools in the music industry. It uses a traditional one-time payment purchase business model that is available in iOS, Mac, PC and Android, however its open source database is what makes it valuable. iReal Pro has a community that constantly shares content prepared to be used with the software. In other words, the list of styles become somewhat user curated. This not only offers limitless amount of content to be explored by the user but also for first time users or casual users, anyone can buy, download content and start using the software in mere minutes.

Today there are number of ways that uses machine learning to provide music composition services.

The key word here is machine learning. The difference between the AI systems of 90s and today is machine learning, the ability to collect and reserve mass data by algorithms.

³¹ AIVA, 2016. Available at: <https://www.aiva.ai/>. Available on: 26/09/2020

³² iReal Pro. Available at: <https://irealpro.com/>. Available on: 26/09/2020

4.4. Problem Formulation

In this thesis, it has been argued that AI trends of the past decade and forward, will affect the industry of interactive music writing. The focus of this has so far been on the business practices the industry quantitatively. Findings show that game music professionals are increasingly becoming freelancers. Salaried employee incomes haven't changed significantly over the past 5 years. There is an increasing number of "on the side" income earned by employed professionals but that also has been found to be fluctuating in value, signaling no drastic upcoming change as well.

AI curation is likely to liven the music heard in games in the future with better selected music but for consumer market, not interactive music industry. Furthermore, there is an increasing number of VST use and only big budget games use cinematic live orchestras that is very much dependent on what the company has for a budget.

Even more importantly, a salaried employee on average has been noted to make 70-80.000\$ a year. Of which have very ambiguous titles in games already and most probably doing non-gaming jobs as well.

What can be quantitatively expected from games music industry is that even if a drastic growth were expected, it would be only a fraction of the games industry. With industry being so small and limited to what game developers can spend on audio, the data collected and compared does not show substantial change in money made in this field. This also includes that the source of the data is limited to its number of visitors and survey takers.

With these findings in mind, the next chapter of this thesis investigates, why is making music for games is important and what research has been done in it. There are many experiments and psychosomatic studies done on this subject and this is likely to impact the most on the industry. More games such as Hotline Miami or Stanley Parable, but using more unique, diverse and individualized techniques of interactive music writing is hypothesized to enrich the experiences offered by the games.

The following chapter also builds on these findings. Since it is clear that the industry won't be more lucrative than usual significantly, it is intended to highlight the importance of what new experiences can game music offer. To observe this effect in a pure and basic set up, a specific game was designed comparing no-music, static music, and adaptive-music versions of the same game in three different levels of equal difficulty. Furthermore, the game was tested on voluntary participants, to observe their

enjoyment of the game. Participants were tested using techniques based on earlier studies in the field involving maths questions and time estimations.

5. How does game music work?

5.1. Get Even (2017)

Get Even³³ is a game that was released in 2017 for PC, PlayStation and Xbox.

Olivier Deriviere, the composer for the game breaks down³⁴ his approach to the project.

Get Even is not a VR game, just regular 3D graphics. However, the in-game character wears a VR headset. As the player explores areas of the game environment, the in-game-character has flashbacks of memories triggered by what is seen in the VR headset (worn by the character) and the player starts navigating in the memory of the in-game-character. This is many different layers of reality.

Olivier's approach to this complex structured reality was innovative. Olivier explains that if a music was just played in the background, it would feel synthetic and not at all express the complex experience the game is meant to offer. Olivier's approach was to assign single sounds, or notes, to specific areas of the level. These notes would be harmonic with each other and according to the progress of the player, calculated time and length, would eventually form a melody, that would be the background music of the game.

Starting with real-time synthesis, real-time mixing and today real-time composing, making the player the composer of the music in games and game music professional as the designer of the premise of the music and its algorithms.

This is more in line with AI written music concept that were mentioned previously in this paper and is made possible via the use of audio scripting middleware Wwise. Using middle, the adaptive aspects of game music can be pushed further and further, In the following chapter of this paper, the importance of adaptive music and its effects will be explored under the light of earlier studies and literature written about the subject. Furthermore, a game is designed to specifically study the effects of adaptive versus non-adaptive background music on players with techniques based on these

³³ Get Even, 2018.

Available at: https://store.steampowered.com/app/299950/GET_EVEN/. Available on: 26/09/2020

³⁴ cf. Deriviere, O.: Is Hybrid Interactive Music the Future? Part I - How I used Get Even as an R&D platform for Interactive Music, 27/03/2018. Available at: <https://blog.audiokinetic.com/is-him-the-future-of-interactive-music-part-i-how-i-used-get-even-as-an-rd-platform-for-interactive-music/>. Available on: 26/09/2020

studies. Whilst the results of the experiment have been mixed, in its most basic setup, it was intended to observe what unique ways music/sound of games can affect its players.

Much like in other mediums of media music, games-music works subliminally too. It is not meant to be the lead role, but a reliant supporting role to highlight game play, graphics and narrative of the game.³⁵ By doing this the purpose of game music is to immerse the player further into the played game, increase playing time and strengthen the connection of the player to the game.

There are many studies that look into the effects of music.

One example study³⁶ does experiments to test the immersion levels of players with a game with music against without music. After their experience with the game, the subjects are asked to perform tasks to test their disorientation from the game. The study concludes that subjects with less gaming experience showed more signs of disorientation and impairment of real-life tasks from the game. They experienced more loss in keeping track of time during gameplay as well as taking longer time to perform the tasks asked from them post-experiment.

Another study³⁷ has focused on the correlation between game preferences and music preferences. The study concluded that there is some correlation between game genre preferences and music that went with it, regarding game genres such as action, shooter, skill, strategy and parlor.

Yet another study³⁸ focuses on connection between visual, verbal and sonic stimuli over two different games designed prior to the experiment. The study concludes that verbal stimuli in games should only be used sparingly. Whatever that can be communicated to the player without using language, it should be communicated without language, if immersion is desired.

³⁵ cf. High, A.: Gamasutra: Is Game Music All It Can Be? 07/11/2012, p. 2. Available at: https://www.gamasutra.com/view/feature/181003/is_game_music_all_it_can_be.php. Available on: 26/09/2020

³⁶ cf. Zhang, J.; Fu X.: Journal of Psychology & Psychotherapy; The Influence of Background Music of Video Games on Immersion, Vol. 5/ Issue. 4, 07/07/2015, p. 3.

³⁷ cf. Boetch, I; Georgi, R. ; Bullerjahn, C.: The Influence of music and video game preferences on the perceived effects of music while gaming ,2015, p. 76

³⁸ cf. Liljedahl, M.; Grimshaw, M. (ed.), supra, p. 35

Same study³⁹ also concludes that whilst graphic memory takes up most of our sensory perception and audio is only a secondary support for it, immersion is not achieved by a dominance of either but a dynamic interplay between them. Furthermore, since our ears cannot be closed for senses like our eyes and eyelids, it's hard to avoid hearing sounds.

The study also states sound to be an ambiguous stimulus. This is why in games when a sound with no visible source becomes visible, it creates a sensory impact. This is the dynamic interplay. The classic game Doom exploited this concept and became very successful on it. Whilst Doom didn't have adaptive music or any technological audio superiority to its contemporaries, it had enemies behind closed doors. Players could hear the noises of monstrous enemies before entering rooms and this played a big role in inducing fear in the game. The players were given clues about challenges they were going to face and without visual representations of these threats, a space was left for players' imagination. This is referred to as extra-diegetic music/sound.

The study⁴⁰ claims that all sound is never fully perceived. It states that we never fully see what a sound is being caused by.

Whilst this may sound like a philosophical argument to think over, it essentially the purpose of all game music professionals, to provide a sonic depth in a game via adding subtle details into it. A slight detuning of a piano key can be the difference between sweetness and dread.

³⁹ cf. Liljedahl, M.; Grimshaw, M. (ed.), *supra*, p. 24

⁴⁰ cf. Liljedahl, M.; Grimshaw, M. (ed.), *supra*, p. 25

5.2. Cinema and Game Music

The term diegetic is often referred to cinematic music, when the music for a scene is in the reality of the scene, e.g. if the character in a movie lying in a bath tub listening to radio, the music for the scene is music of the radio and it is diegetic.

It is stated that game music, much like other media music, is made “to picture”.⁴¹ It is based on the fact that our auditory senses are deeper and more subconscious than our visual senses, and that audio is there to complement the visual elements of the media, to fill in the gaps left by the visual perception, to add another touch of detail.

Scholars of the field refer to this difference as linear and non-linear forms.⁴² Consumer music or film music both are very linear mediums. They have a start and end which is not alterable. However, a game music is not linear. This in turn changes the way tension and release inducing effects of linear music work. Thus, it becomes a different practice. If a composer was to use adaptive music to tailor the audio content according to the gameplay, it has to be taken to account that the player can take unusual ways to play the game, back track or even just do nothing over the course of the game. This is one of the obstacles that game composers need to overcome to truly implement immersive adaptive music in their projects.⁴³

5.3. Audio and Listening

An earlier study proposes a model of listening modes hierarchically;⁴⁴

- a. Two Preconscious listening modes: focus on subjective, emotional and associative responses evoked by the sound
- b. Two Source Oriented listening modes: focus on how the listener physically perceives the sound and what caused it.
- c. Three Context Oriented listening modes: focus on the purpose(s) of the sound, symbolic or conventional meaning and contextual relevance to the environment.
- d. Quality oriented listening mode: focuses on physical qualities of the sound (pitch, loudness, length...etc.)

⁴¹ High, A: Gamasutra; Is Game Music All It Can Be? 2012, supra, p.2

⁴² Liljedahl, M.; Grimshaw, M. (ed.), supra, p. 33

⁴³ cf. High, A., supra, p. 11

⁴⁴ cf. Tuuri, K.; Mustonen, M. S.; Pirhonen A., Audio Mostly 2007: 2nd Conference on Interaction with Sound, Conference Proceedings: Same Sound - Different Meanings: A Novel Scheme for Modes of Listening, Finland 2007, p. 14

Listening modes show that sounds can be used to evoke emotions and associations to communicate details of events.⁴⁵ The interplay of sensory, symbolic and contextual information these listening modes process, is what causes the emotions sounds and music induce.

Studies state that there are 3 important aspects of audio that differentiates it from its visual counterparts:⁴⁶

- a. Omnidirectional: Sound reaches us from all directions, unlike light which travels linearly. On the other hand, the ability to focus our perception on a single voice in a crowded loud environment is referred to as “the cocktail party problem”, that was a term coined in 1953.⁴⁷ Nevertheless, we cannot turn away from sound.
- b. Uninterruptable: Our ears do not have lids like our eyes do. It is more difficult to fully avoid sound than visual
- c. Ambiguous: Our hearing can perceive -on a subconscious level- information that is not visible to eye. This is the foundation of the ambiguity of sound.

5.4. Elements of game music/sound

The sound types that players encounter in games can be summarized as below: ⁴⁸

- a. Speech and dialogue (human element)
- b. Sound effects (physical element)
- c. Music (emotional element)

Sounds can be used to represent off-screen elements of a scene. When this is done, the viewer or the player has a stronger sense of physical reality. In games when this off-screen implication is used in the favor of gameplay, this effect is even further strengthened.⁴⁹

Moreover, 3D-positioned audio can create a strong sense of physical reality in player's perception.⁵⁰ Although this concept applies to all audio including sound effects, speech and even music, “background” or ambient sounds do not behave this way.

⁴⁵ cf. Liljedahl, M.; Grimshaw, M. (ed.), supra, p. 24

⁴⁶ Liljedahl, M.; Grimshaw, M. (ed.), supra, p. 29 f.

⁴⁷ Bregman A. S.: Auditory Scene Analysis, Venezia, 1990 p. 529

⁴⁸ cf. Sonnenschein, D.: Sound and Design; The Expressive Power of Music, Voice and Sound Effects in Cinema, USA 2001, p. 219 et seq.

⁴⁹ cf. Zhang, J.; Fu X., supra, p. 2

⁵⁰ cf. Liljedahl, M.; Grimshaw, M. (ed.), supra, p. 32

It is argued that our senses have tendencies to fill in the gaps in order to make a coherent definition of the collection of stimuli that reaches us.⁵¹ If we can't hear the person we're trying to listen to, we tend to fill in the gaps via watching the lip movements of the person. This concept is referred to as "global change"⁵², stating that what we perceive is the interaction patterns of audio and visual perception, that we "see-hear" rather than "see and hear".⁵³

Auditory stimuli leave more space for interpretation than visual.⁵⁴ The omni-perceptive nature of our senses allows a more thorough mixture of its reflections than light, much like a sonar sound does enter the areas where light can't. Our ears are tuned for this, so we do have a more ambiguous perception of sound than light. That we never get the full picture with sound. This is described as a disadvantage.⁵⁵ However, in a more recent article it is questioned how this ambiguity could be used as a tool.⁵⁶ The ambiguity that is presented by audio stimuli can be used to better construction of games. The article concludes that there is a need to interpret and disambiguate the sounds of a game by the player and this can be used as an asset for the game.

The effects of sound on the gameplay is that of creating a virtual space in player's consciousness.⁵⁷ Creating a physical reality, verifying to the mind that what's being shown on the screen is real. It also is theorized that a silent game would feel surreal and dream-like since the physical reality has not been created and mind is not convinced of the reality of the images shown on screen. A rectangle on screen moving from left to right horizontally will look virtual and surreal to the viewer but if the action was accompanied by the sound of a rock grinding on pavement, it will suddenly become more real.⁵⁸

5.5. Applied to Games

The connection between the player and the game is analogized as a bridge; between the physical world and the virtual world.⁵⁹ It is a game's purpose to build this bridge

⁵¹ cf. Liljedahl, M.; Grimshaw, M. (ed.), supra, p. 30

⁵² cf. Polotti, P.; Rochesso, D., supra, p. 350

⁵³ Liljedahl, M.; Grimshaw, M. (ed.), supra, p. 30

⁵⁴ Liljedahl, M.; Grimshaw, M. (ed.), supra, p. 30

⁵⁵ cf. Sengers, P.; Gaver, B.: *Staying Open to Interpretation: Engaging Multiple Meanings in Design and Evaluation*, USA, 2006, p. 1

⁵⁶ cf. Liljedahl, M.; Grimshaw, M. (ed.), supra, p. 25

⁵⁷ cf. Liljedahl, M.; Grimshaw, M. (ed.), supra, p. 32

⁵⁸ Liljedahl, M.; Grimshaw, M. (ed.), supra, p. 32

⁵⁹ cf. Liljedahl, M.; Grimshaw, M. (ed.), supra, p. 23

between these two separate realities in order to submerge the player in the game. It has been a rule-of-thumb for the gaming industry to build as big bridges as possible to facilitate immersion via the use of more realistic, cinematic 3D effects and motion. This gap between the realities could be filled more efficiently by use of other means. By shifting the balance between eyes and other modalities, games of new natures, new ways and new purposes can be produced.

VR and AR technologies excluded; today's graphics technologies are saturated.⁶⁰ This wasn't the case in the early ages of gaming. Graphics technology is at its peak and it is argued that the next step for games development will be on the audio field. Better constructed music/soundscapes accompanying the cinema-like visuals in an interactive reality will be the future of gaming.

The hurdles of a composer in a game project is stated as:⁶¹

- a. Tells the story of the area or level
- b. Remains in the players attention
- c. Doesn't over-repeat to demotivate the player
- d. Fits in with the music in the rest of the game.

It is also mentioned that most composers will write an interesting score but telling the story, considerations of repetition, player behavior and cohesion with the rest of the game will be overlooked.

Sounds and music in games can be categorized depending on their sources in 4 groups

- a. Avatar sounds: Sounds that are triggered by player's character
- b. Object sounds: Sounds that are triggered by objects in the game
- c. Character sounds: NPC sounds
- d. Ornamental sounds: Non-consequential atmospheric/cosmetic sounds. (e.g. background music)⁶²

Background music is important for the immersive effects of the game, over its players. It can not only help communicating the progress of the gameplay to the player but also

⁶⁰ cf. High, A., supra, p. 19

⁶¹ High, A., supra, p. 11

⁶² Friberg, J.; Gardenfors, D.: Audio Games: New Perspectives in Game Audio, Stockholm 2004, p. 151

to creating a “real physical space” in player’s mind. Studies have shown that feedback given to the player’s progress in a game makes it more playable. It is stated that background music helps to bring more three-dimensional experience of the game to the player.⁶³

In video games sound and music is usually used to convey the mood and presence. However, there are elements to a game that require more informative forms. Use of human voice and speech is a very versatile form of sound in this case. To communicate the instructions, to announce a game over or start to the game, to reveal score...etc. Since human ear is tuned to the range to hear the frequencies and tones of the human voice, hearing recorded human voice can be very impactful in a game. But with voice recording, the drawback is that language can be restrictive.⁶⁴

The basic framework of a composer writing music for games is described with the horizontal and vertical dimensions in the virtual game space and gameplay.⁶⁵ Horizontal dimension of the music refers to covering the area of the level environment; all connected with transitional elements. Location of the player in the game environment decides what the music will play for the game. The vertical dimension of game music implies the layered structure of it in support of the modality of the game.

The purpose of these dimensions and modality is to contribute to the Gameflow concept. Gameflow concept suggests sound and music in games should serve the following criteria in the following aspects of gaming-player interaction;⁶⁶

- a. Concentration
- b. Challenge
- c. Player skills
- d. Control
- e. Clear Goals
- f. Feedback
- g. Immersion
- h. Social Interaction

⁶³ cf. Zhang, J.; Fu X., *supra*, p. 2

⁶⁴ cf. Liljedahl, M.; Grimshaw, M. (ed.), *supra*, p. 38

⁶⁵ cf. Liljedahl, M.; Grimshaw, M. (ed.), *supra*, p. 34

⁶⁶ Sweetser, P.; Wyeth, P.: *GameFlow: A Model for Evaluating Player Enjoyment in Games* St. Lucia 2005, p. 5 f.

Studies link these criteria to the forementioned listening modes.

The two important criteria related to the focus of this paper are Feedback and Immersion. When magnified, Feedback criterion serves the purposes of:⁶⁷

- a. Receiving feedback on progress towards goal
- b. Immediate feedback on immediate actions
- c. Awareness of status and score

Moreover, Immersion criterion broken down as:⁶⁸

- a. Less awareness of physical reality
- b. Detached from everyday life
- c. Altered sense of time
- d. Emotional involvement
- e. Visceral involvement in the game

5.6. Immersion

The term “immersion” is described as the ability of a game to draw its players in. This was based on the use of the term by the reviewers of games on web-portals.⁶⁹

Study summarizes the effects of immersion to the player as;⁷⁰

- a. Detachment from the real world.
- b. Loss of sense of time
- c. Feeling of being in the virtual world.

Some researchers also categorized immersion as;

- a. Perceptual immersion (such as in movies with no involvement but observational).
- b. Psychological (such as in games, involved in the virtual environment.)

Further categorization of immersion is also done subjectively. SCI model is proposed to explain the effects of background music in players' immersion (Sensory Challenge-based Imaginative immersion) to explain its subjective effects on gameplay.⁷¹

⁶⁷ Sweetser, P.; Wyeth, P., supra, p. 6

⁶⁸ Sweetser, P.; Wyeth, P., supra, p. 6

⁶⁹ cf. Zhang, J.; Fu X., supra, p. 1

⁷⁰ Zhang, J.; Fu X., supra, p. 2

⁷¹ Ermi, L.; Mayra, F.: Fundamental Components of the Gameplay Experience: Analyzing Immersion, Finland 2007 p. 8

These subjective experiences of immersion have been put to experimentation in earlier studies.⁷² The participants were presented with a 2 min gameplay of The Lord of the Rings – Two Towers. Later studies state that this is too little time for immersion⁷³ to take place but nevertheless results were of that; three different levels of immersion; sensory, challenge based and imaginative were observed from the participants' subjective reflections.

5.7. Immersion Test

A method to test immersive effects of game music in players have been constructed in earlier studies.⁷⁴ A group is represented with a game with least bit of challenges and levels of engagement (in the case of the study this is Half-life 1 tutorial level). After 10 minutes of gameplay, subjects are put through a test of a tangram puzzle and were asked to estimate the time spent playing the game. In order to get also a subjective perception of the immersion, subjects rated their experiences via the Immersion Questionnaire, to provide information about SCI models of immersion at players.

Time distortion is an important indication when exploring immersion. When a certain activity is immersive, people tend to lose track of time. Depending on the nature of the activity, if it is absorbing an immersive, the perception of time becomes distorted. So, when someone is playing a particularly immersive video game, the perception of time by the individual may be altered and distorted.⁷⁵

Another aspect of game music inducing immersion in games have been observed with involvement of self-selected music. In a study, the game Project Gotham Racing, was used on participants and subjects were given option to select their own music to play while they played the game. The results show that when selecting their own preferred music, subjects over-estimated the time spent with the game and the number of collisions they had in the game. This was also significantly higher than those who played the same game with the experimenter's choice of music.⁷⁶

Another way to observe immersion in game-players was the conduction of a Stroop Task.⁷⁷ A Stroop task is defined as a test that involves asking the participants to

⁷² cf. Zehnder, S. M., Lipscomb, S. D.; The Role of Music in Video Games 2006

⁷³ cf. Boetch, I; Georgi, R. ; Bullerjahn, C., supra, p. 75

⁷⁴ Jennett, C. et al.: Measuring and Defining the Experience of Immersion, London 2008, p. 10 et seq.

⁷⁵ cf. Zhang, J.; Fu X., supra, p. 3

⁷⁶ cf. Cassidy, G. G., Macdonald, R. A. R.: Scandanavian Journal of Psychology Vol. 51 Issue. 6: The effects of music on time perception and performance of a driving game, London 2010, p. 18 et seq.

⁷⁷ Jennett, C. et al.: Measuring and Defining the Experience of Immersion, London 2008, p. 11 f.

perform a task that is irrelevant to the game and outside the reality of the game. The testing aspect of this task will be that if the participants were immersed in the game, they would take longer times completing these irrelevant tasks. As the immersion of the game will interfere with the players consciousness even after the game related content is over.

Regarding studies that tested immersion, existence of background music was observed to significantly improve immersion levels. Also, this significant effect will be on less experienced gamers than experienced, since an experienced player is likely to be desensitized to subliminal effects, such as audio, of games.⁷⁸ Other studies also, did experiments regarding the subjective perception by comparing self-selected music to original or silent games and also subjectively measuring their distraction levels according to game genre preferences.⁷⁹

It is noted in an earlier research that 70% of 3500 subjects listen to other self-selected media while gaming.⁸⁰ Also 81% of 130 adolescents stated self-selected music is very important and 94% of them stated that it depended on the game. A more recent experiment concludes that self-selected music is deemed less distractive and a very effective instrument of subjective immersion of gaming experience.⁸¹ The study also shows that when players prefer Action/Shooter or Skill games, subjective effects were more intensely perceived. Study relates this to the established Awareness of Status and Score functions defined by the GameFlow concept of music in Action/shooter games, especially in Survival/Horror games. The study also concludes that for those players who like Strategy games better, the function of music was less visible. It also concludes that in line with **Bullerjahn (2001)** theory of music and its differentiating functions, Strategy games usually have Hollywood style lush orchestral music, compared to Simulation games where popular music is more prevalent.

Conclusion of results for a study show that in action-oriented game music's effects on players are subjectively non-distractively intensifies. The same didn't apply to Strategy or Simulation games. The study also concludes that when players choose the music

⁷⁸ cf. Zhang, J.; Fu X., supra, p. 5

⁷⁹ cf. Wharton, A., Collins, K.: Game Studies; The Journal of computer game research; Vol. 11, Issue. 2; Subjective Measures of the Influence of Music Customization on the Video Game Play Experience: A Pilot Study, 2011 p.8. Available at: http://gamestudies.org/1102/articles/wharton_collins. Available on: 26/09/2020

⁸⁰ Pratchett, R.: Gamers in the UK - Digital Play, Digital Lifestyles 2005, p. 9 et seq.

⁸¹ cf. Boetch, I; Georgi, R. ; Bullerjahn, C., supra, p. 86

they want (can include silence or the original music), the perceived effect of music also amplifies.⁸²

⁸² cf. Boetch, I; Georgi, R. ; Bullerjahn, C., *supra*, p. 86

6. Empirical Method

In this paper, the purpose of the empirical method is designed to provide insight what game music with improved adaptiveness would be and to test its effects on voluntary participants.

Whilst many studies so far have experimented with varying ways music affects players during gameplay, it is also stated that more research regarding the specific effects of adaptive music compared to static background music is needed.

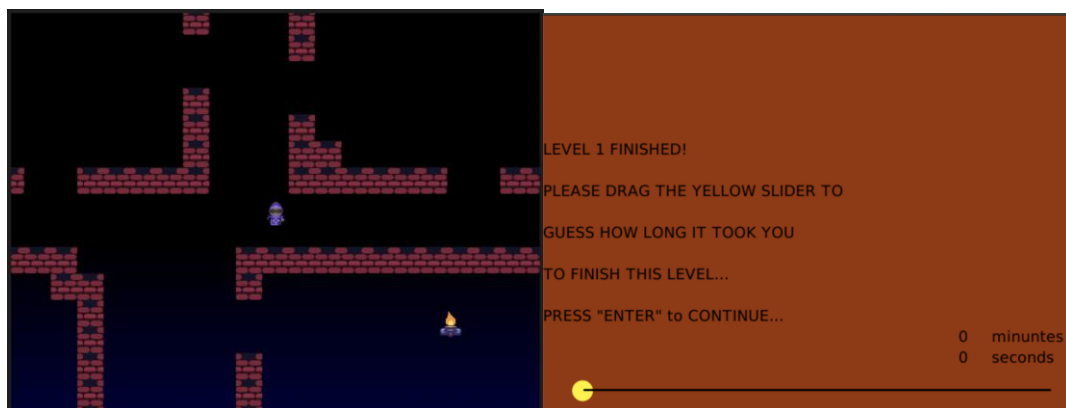
In the experiment conducted for this paper, observations were made to understand the difference in immersion, if a game's static background music were turned into serve adaptive functions. Whilst the sounds that played were not changed, their behaviors were.

For this experiment, a game "Purple Guy" has been programmed via using open-source casual game engine Stencyl.

6.1. Purple Guy

Purple guy is a Legend of Zelda style adventure game combined with interruptive multiple choice basic maths quiz levels.⁸³

It consists of 7 levels. The purpose of the player is to find and collect the 15 objects in the adventure with no time restriction (but measured still). In maths quiz the purpose is to click on the answer to basic mathematical operations as quickly as possible.



⁸³ Game can be played at the following link:
<https://gamejolt.net/?token=budE7QT2DR2r47tMNe8xs4faDx3Aff>
Available on: 26/09/2020

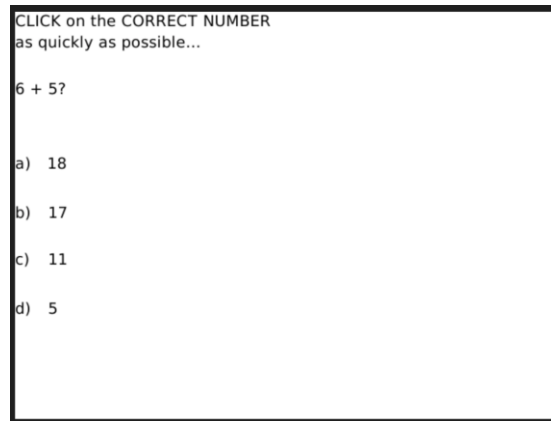


Figure 7 – Different stages of Purple guy

The adventure game's premise is a 4-screen square are enclosed by walls. The interior of the environment separated into 9 different arbitrary areas. There is no maze or problem solving involved, only navigating in the environment via the use of "W, S, A, D" keys.

Once an object gets collected, another appears at another area of the game space. Once the 15th object is collected the level ends abruptly and player is asked to estimate the time spent playing the level using a slider. The adventure levels were designed specifically to at least last 3 minutes.

The adventure game is played three times during the course of the gameplay each with different design for sound and music. Maths quiz and estimations sections have no music or sounds. The course of the gameplay is as summarized below:

- a. Maths quiz 0 (control test)
- b. Adventure 1 (completely silent) + Time estimation
- c. Maths quiz 1
- d. Adventure 2 (with background music) + Time estimation
- e. Maths quiz 2
- f. Adventure 3 (with same music and sound but adaptive) + Time estimation
- g. Maths quiz 3

After the game finishes, the results are printed on the screen and the experimentation is over. The results consisted of estimations of the player, along with how long it took the player to finish each level.

18.47	
3minutes10seconds	
3minutes30seconds	
4minutes0seconds	
THANK YOU FOR PLAYING!	
PLEASE TAKE A PHOTO OF THIS SCREEN...	
YOUR SCORES ARE	
20.42	133.39
20.74	151.12
27.23	163.42

Figure 8 – Example score chart for purple guy

The music sounds added to the adventure game consisted of a looping rain ambient and two different types of beeping sounds. In addition, the maths questions were the same questions only in different orders. The right answers were always the same choice and the wrong answers were different numbers each time.

The third adventure has a complex music to test the effects of adaptive music. The rain sounds according to the vertical movement of the character varies in volume only slightly, giving a subtle sense of reality. But the beeping sound only starts playing when the player is at a certain distance to the object to be collected.

The game asks the player in the beginning to use earphones. Depending on the horizontal location of the object according to the player, the beeping comes from right or left in different degrees. As the player comes closer to the object the beeping volume increases and the sound comes more and more from the center. Once the object is collected the other sound beeps to reward the player.

It is important to note that during gameplay none of the information such as time or the number of objects collected were revealed to player. What is intended with this is to facilitate further loss in player's track of time.

6.2. Method

The purpose of all the data collected in the game is to measure the immersive effects of the game on the player based on earlier tests done to observe different aspects of gaming.

The approach of this test was to focus on objective observations. The immersion test established by **Jennett et al. (2008)** -which is what the other studies also used- had surveys in order to measure the different types of immersion that were established by the SCI models as well as to profile the participants. This part of the immersion test was excluded from this experiment. In the experiment done for this paper, the game used was specifically designed to cause and test immersion. The consecutive nature of the level proceedings was designed specially to induce disorientation in players. It was the level of this disorientation that was measured. The differences between the time spent in each level were the variables.

Furthermore, the immersion in earlier studies⁸⁴ consisted of gaming activity, a Stroop test and a time distortion analysis. In this experiment, the estimation of time after the adventure level is compared with the actual time spent in the level is designed to measure the time distortion of players in the adventure level. The better the immersion, the higher the time distortion and higher the difference between the estimate and the actual time.

The maths quiz levels were a replacement Stroop tests which were traditionally Tangram tests. A Stroop test is defined by being more tactile, being in real physical life and based on using the logical processing capabilities of the brain and its impairment due to game immersion. If immersion was better, the time it takes to complete the Stroop tasks take longer. In earlier studies used basic Tangram puzzles to take the player out of the game reality into physical reality.⁸⁵

In this experiment, the Stroop task is included in the game as maths quizzes. The limitation of this experiment that the player after the game does not fully exit the game's reality. In order to maximize the disorientation at the maths quiz levels, the control has been switched to mouse from keyboard serving the tactile nature of the Stroop test.

⁸⁴ cf. Zhang, J.; Fu X., supra, p. 4

⁸⁵ Jennett, C. et al.: Measuring and Defining the Experience of Immersion, London 2008, p. 11 f.

The graphics for the maths quiz levels were also designed to be minimum like a maths exam to minimize the in-game construction of the Stroop test.

The difference of estimates made by the player and timing measured of the adventure levels were calculated. Also, the time measurements taken for the maths quizzes were recorded as results. The control maths quiz at the beginning were excluded from the results.

6.3. Analysis

In order to measure and calculate the time distortion effects of immersion and Stroop Task impairment, a number of variables have been set, such as ΔT and ΔS . These variables will be calculated from the data collected from the players during game play and revealed on the final scene of the game as scores.

ΔT stands for the time difference regarding time distortion. To calculate this T_{est} (time estimated) and T_{mea} (time measured) will be used. For each level of the game the difference between the estimated and time measured will be calculated, T_1 , T_2 and T_3 . The differences between T_1 and T_2 will be represented as ΔT_1 and the differences between T_1 and T_3 will be represented as ΔT_2 . Contextually, ΔT_1 is the difference in time distortion when music is introduced to the game and ΔT_2 is the difference in time distortion when music is made adaptive to gameplay.

Within the theory researched in this paper, it is hypothesized that ΔT_2 will be equal or greater than ΔT_1 . It is important to note that time distortion values T_1 , T_2 and T_3 are set to be in absolute value. The players can predict the time to be less than the measured or more, the difference will be recorded positively.

ΔS represents the differences in Stroop task timings measured. S_1 , S_2 and S_3 represents the time measured in the game for each level of maths quizzes played. ΔS_1 represents the difference between S_1 and S_2 while ΔS_2 represents the difference between S_2 and S_3 . ΔS_1 will be the Stroop task impairment when music is introduced and ΔS_2 will be the Stroop task impairment when music is made adaptive to gameplay. Since Stroop task is the measurement of performance, the value of it is not set in absolute value. It is hypothesized that the results will be that $S_1 < S_2 < S_3$. For this reason, ΔS values are not expected to be in negative value. Mean values and standard deviations for both ΔT and ΔS values have been calculated.

6.4. Sampling

The participants were not selected by a criterion of gender, experience of gaming or preference of gaming. No preference of music was profiled as well. The game, graphics and sounds were kept to minimal to standardize these variables. The rain sounds, beeping sounds, the controls and the graphics were all kept minimalistic to be comprehensive to anyone who uses computers. Only age was taken into account and participants were taken to experimentation were selected from age groups 25 to 40.

7. Results

An example chart for one of the participant's data is as given below. Charts such as the one below has been prepared for each participant's gameplay.

Estimate Time (T_{est})	180	150	238
Measured time (T_{mea})	167,64	120,77	157,02
Time difference ($T_{1,2,3}$)	12,36	29,23	80,98
Stroop Task ($S_{1,2,3}$)	24,46	23,51	42,18

The compiled results of the participants' performance were listed as following;

	ΔT_1	ΔT_2	ΔS_1	ΔS_2
Participant 1	16,87	51,75	-0,95	18,67
Participant 2	109,61	39,97	6,75	-4,72
Participant 3	2,27	17,7	0,32	6,49
Participant 4	54,86	10,64	7,63	-7,54
Participant 5	20,67	31,75	4,44	-3,47
Participant 6	8,99	25,5	0,56	0,33
Participant 7	118,75	255,51	-2,93	1,09
Participant 8	96,5	8,88	4,35	-6,06
Mean (μ)	53,6	55,2	2,5	0,6

As well as the mean values of the data collected, the results were plotted in comparison to the differences in levels regarding time distortion and Stroop test.

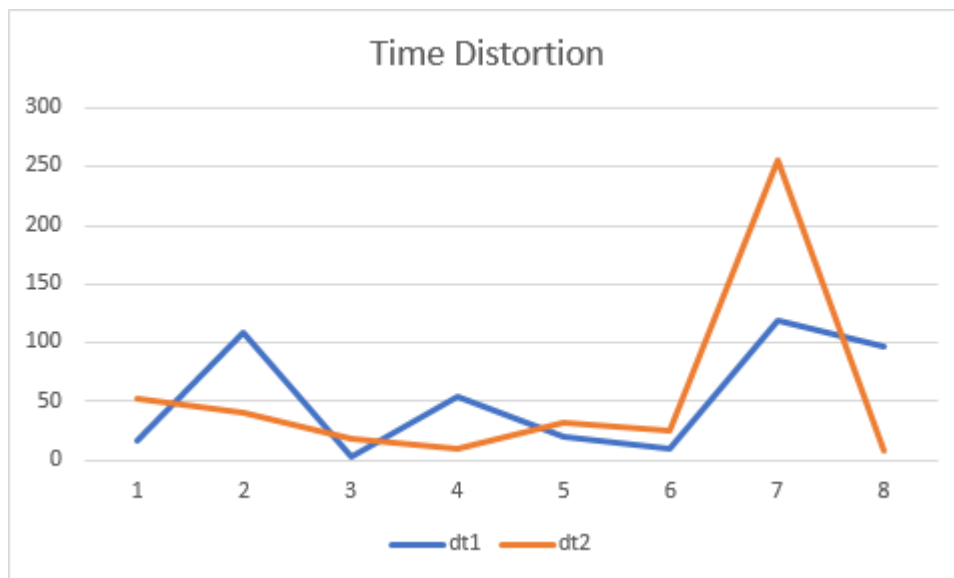


Figure 9 – Time distortion differences of participants

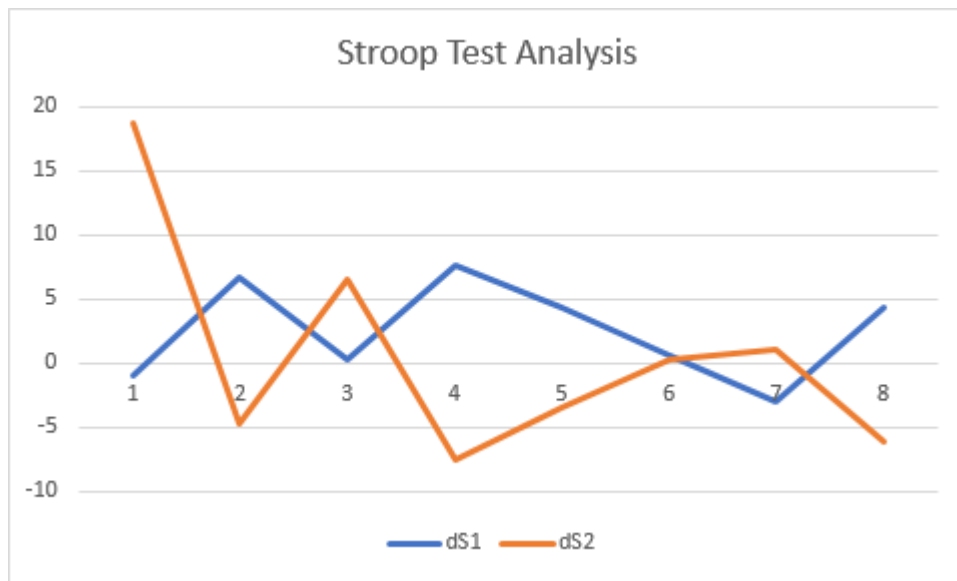


Figure 10 – Stroop task time-differences of participants

Whilst the mean values calculated for the differences in time distortion values show the desired value, the graphical presentation of the source data show that this is not necessarily an accurate result. There is much fluctuation of values. It suggests that participants experienced the time distortion effects of game immersion more when playing adaptive music levels, but this is not reliable data due to restrictions of the experiment.

Furthermore, the Stroop test differences of time are even more unstable and suggest that the difference between the non-music level of the game to non-adaptive background music level has been greater, disproving the hypothesis. This is also not reliable since the levels of fluctuation in this data set are even higher than that of the time distortion values.

8. Discussion

In this paper, the following points have been made:

- The diverse group of people that the game music professionals represent, do not yet show significant signs of becoming more diverse. Contemporary and future technologies making use of AI tools such as big data enable providing valuable tools for bringing in more people to the industry from different backgrounds, but this was not observable from the sampled data used in this paper.
- AI-curated music services such as Spotify offer valuable insights regarding the music preferences of gamers according to geographical locations. This is currently in use by large companies and is likely to gain more importance in the future. This is also likely to shape the decision making done by game developers when implementing music in their games and localizing the audio content.
- As AI among other technologies are influencing the sophistication of games being made, the necessity to provide more sophisticated audio design is increasing and adaptive music is becoming more important. While objective observation of adaptive music compared to background music in games have not been fully achieved in the experiment conducted for this paper, further research is needed to understand how music and audio can be intelligently used and its effects on immersive effects of games.

For future research

Whilst the mean values of time distortion and Stroop task impairment measurements reveal there is some observable effect of deeper immersion, the range at which the values fluctuate have been recorded to be quite high. During experiments, some anecdotal and subjective observations have been recorded to reflect on for further improvement of the experiment.

One of these observations was that some participants, while supervised, did not read the instructions of the game or did not pay much attention to them. As they tried to figure out the gameplay, valuable time and attention was wasted. Furthermore, in some cases language difficulties also played a role. Not all the participants spoke English.

In its unique way the test could show more accurate and readable results, but due to pandemic measures, the experiment was conducted in discreet settings. This made it difficult to obtain a larger and more curated group of participants. Furthermore, there has been some exceptional cases where one participant got so bored with the first non-music/sound level that he predicted 20 mins whereas the measured time was much less. A larger group of samples would solve this problem as a clearer trend would be visible and anomalies such as this would be excluded.

Another systematic limitation of the experiment was the game fatigue aspect. As the variables of all elements of the game were at their bare minimum (such as number of sound types, task types, visual variations...etc.) the immediate differences in subsequent levels were compared. This meant that the experiment would have to do the experiment in one sitting. This is likely to affect the game immersion effects since the features of the game were minimalized, the participants were more likely to get bored as the game progressed. Most participants had the most trouble finishing the first level with no sounds and this is likely to have affected the results of the proceeding levels.

9. Conclusion

Within its limitations, in this thesis it was hypothesized that much like the entrance of CDs had an impact over games of its era, the progressive data driven technologies today would have an effect on interactive music industry.

The prospects of this have been handled quantitatively with referring to global industry data and qualitatively via case studies and experimentation via game design based on literature that the thesis was based on.

The quantitative analysis showed that there is no significant change in the quantitative analysis. Game music is written and produced professionally by a very few individuals with very diverse backgrounds and make income in very pragmatic ways fitting to their level of experience in the field. They also make income from variety of sources, some of them non-gaming related and are dominantly male. It is a small closed group and whatever effects technology might have in business practices of this industry, it has been observed to be non-consequential and incidental.

AI is likely to have an effect in providing curated consumer music to play in games but this is primarily a concern of local consumer music artists and not necessarily to the benefit or loss of game music professionals. Yet the games in the future can be expected to be more curated to users and game types and specially to improve localized appeal of games.

Finally, it has been observed that many game music professionals are very keen to explore the possibilities of what can be done with music and sounds in games in more cerebral dimensions. The effects of sound and music on human perception have been researched through literature and an experiment was setup to test the findings as well as setting an example for what adaptive music is.

In conclusion, being the subliminal values, it adds to the game, it is very difficult to make substantial claims for the future of interactive music. While the industry is unlikely to experience a change, the effects of the ingenuity that goes into it behind the walls of game graphics and gameplay will certainly be felt by the players.

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<https://gamejolt.net/?token=BMd56r93cULUBPucMBW4cXPHXTKr9>
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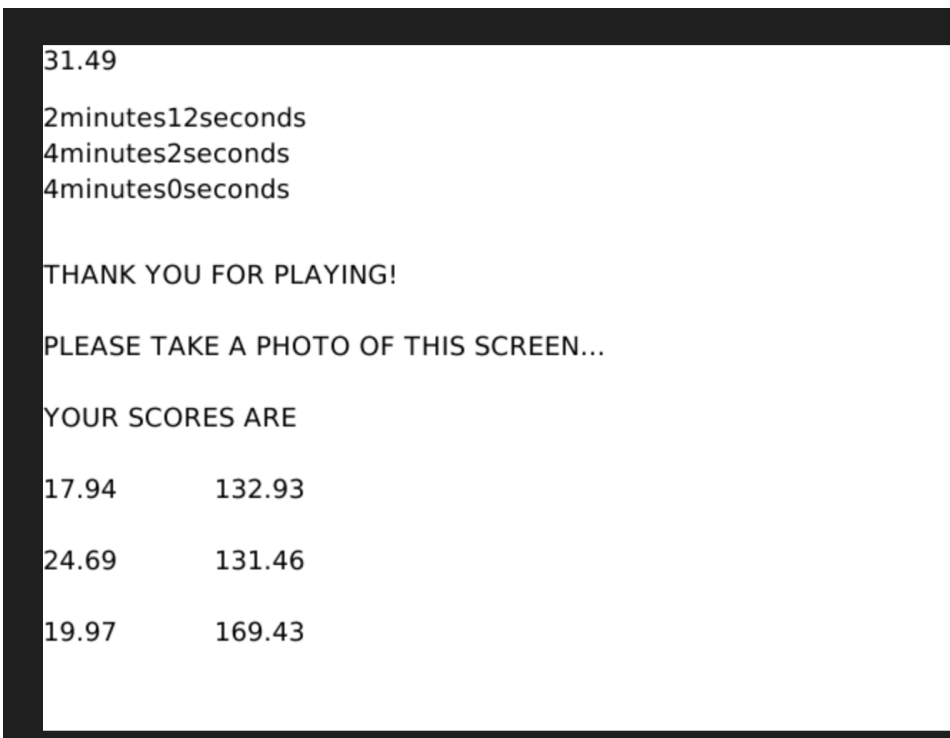
11. Appendices

11.1. A1– Results

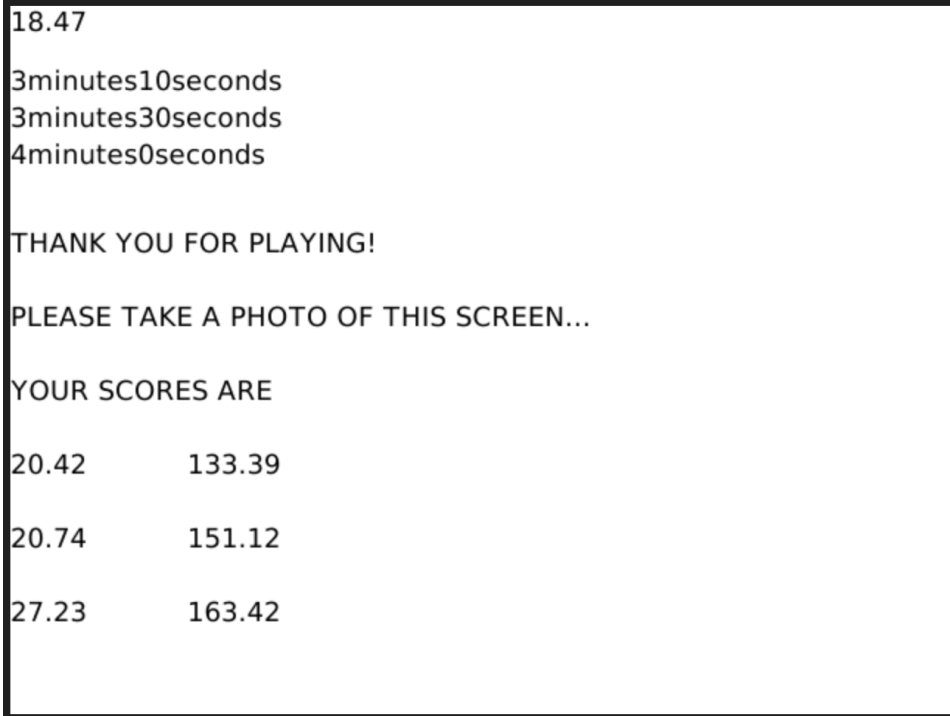
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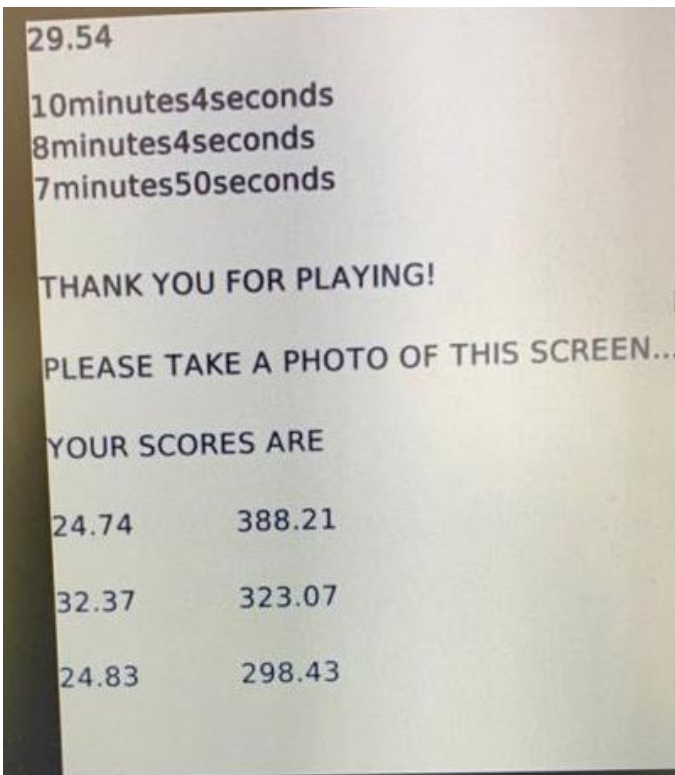
- Participant 2



- Participant 3



- Participant 4



- Participant 5

58.26

4minutes0seconds

2minutes30seconds

3minutes36seconds

THANK YOU FOR PLAYING!

PLEASE TAKE A PHOTO OF THIS SCREEN...

YOUR SCORES ARE

25.52	199.71
29.96	130.38
26.49	164.63

- Participant 6

35.32

5minutes2seconds

3minutes2seconds

3minutes56seconds

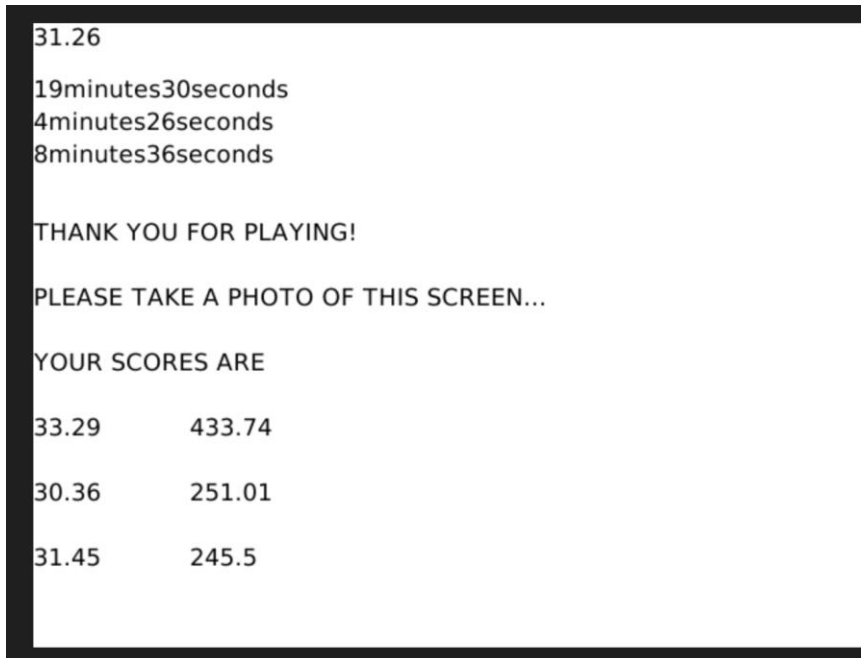
THANK YOU FOR PLAYING!

PLEASE TAKE A PHOTO OF THIS SCREEN...

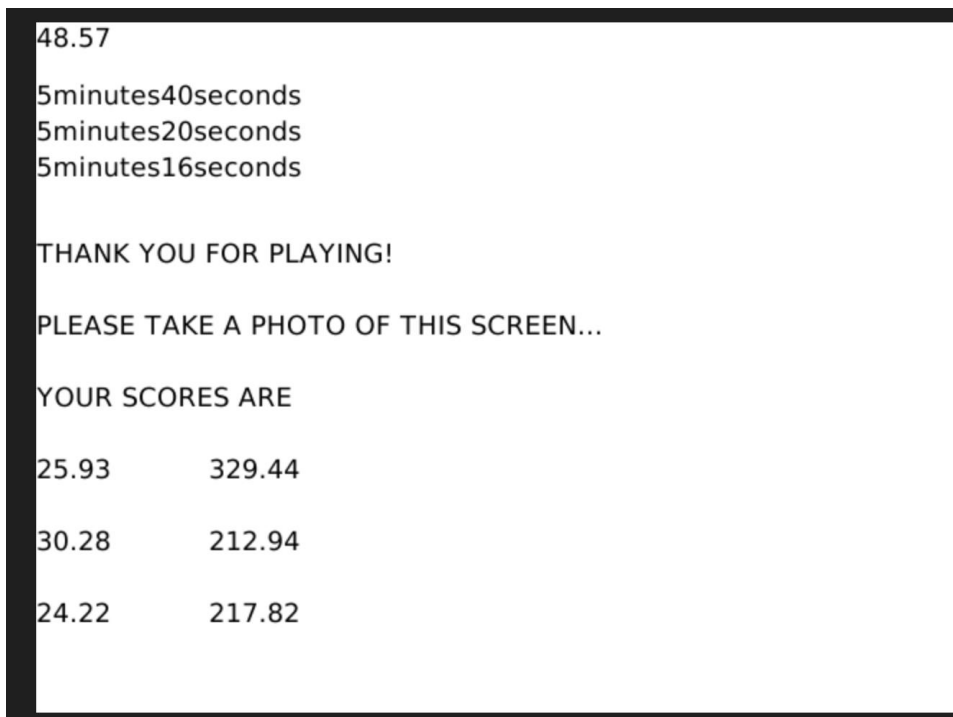
YOUR SCORES ARE

30.49	282.44
31.05	153.45
31.38	181.95

- Participant 7

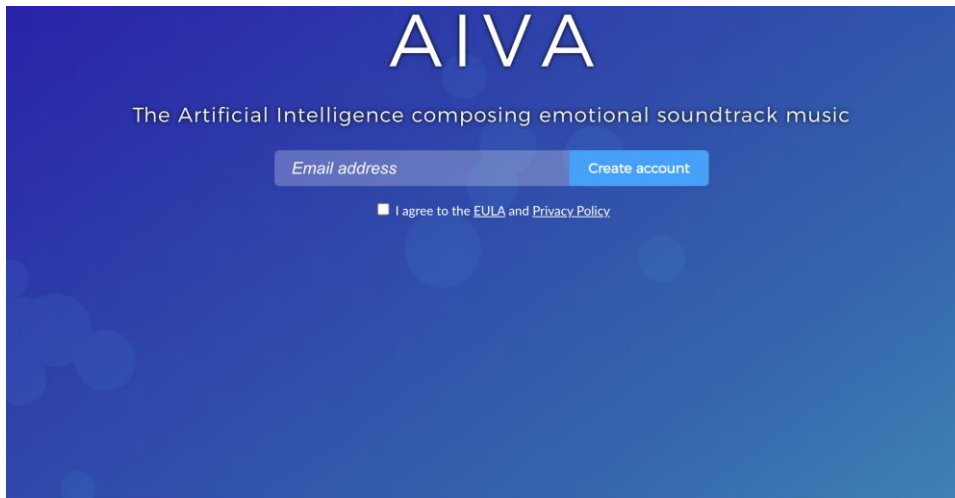


- Participant 8



11.2. A2 – Online Software

- AIVA



A Creative Assistant for Creative People

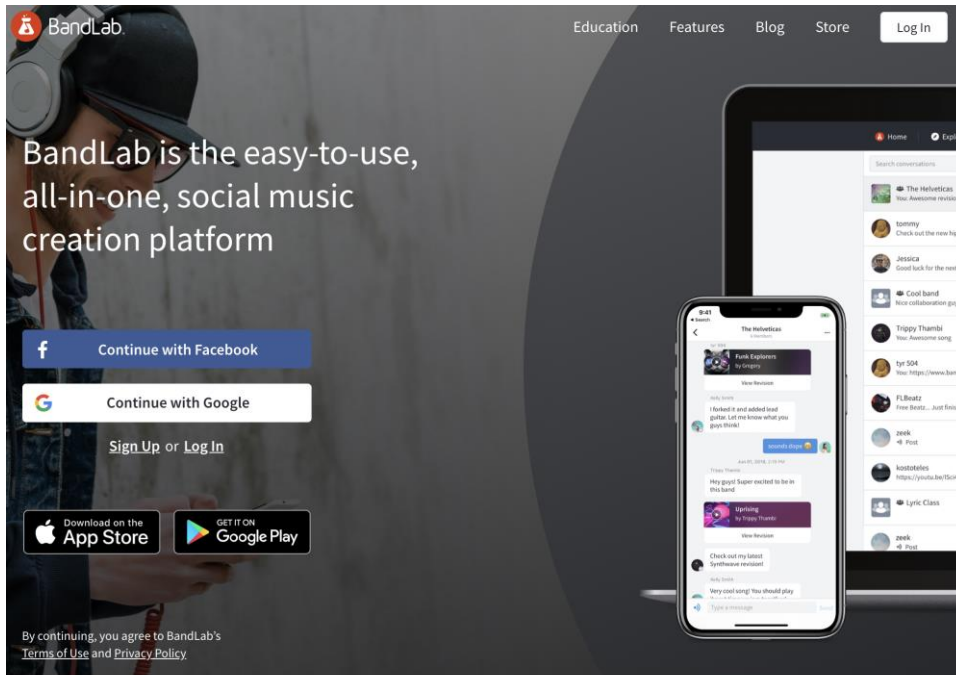
Whether you are an independent game developer, a complete novice in music, or a seasoned professional composer, AIVA assists you in your creative process. Create compelling themes for your projects faster than ever before, by leveraging the power of AI-generated music.

▶ Discover how

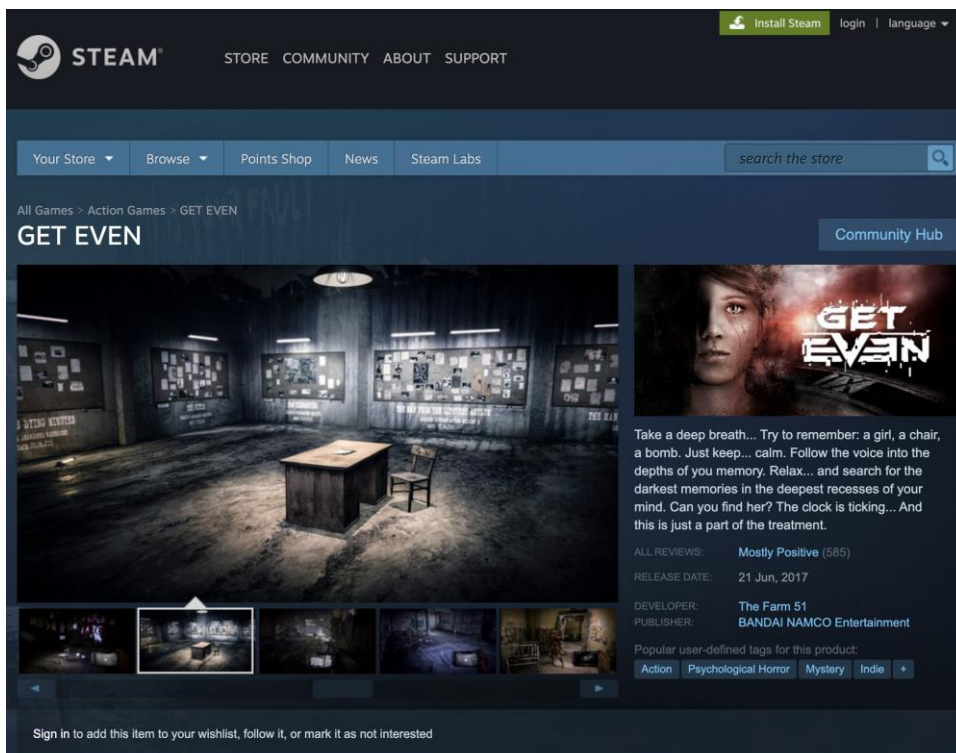
- Band in a Box

The image shows a banner for the PG Music website. The top navigation bar includes the PG Music logo, the date "Thu Sep 24, 2020 5:03 AM PDT", and contact information: "Open today 6am-6pm (PT) Customer Service", "CLOSED 1-800-268-6272 • 1-250-475-2874", "CLOSED Live Chat", and "OPEN Online Ordering". The main navigation menu includes "Band-in-a-Box® Windows", "RealBand", "Band-in-a-Box® Mac", "Band-in-a-Box® VST DAW Plugin", "Other Products", "Support", and "Forums". The banner itself has a dark background with a large white "B" on the left. The text "Band-in-a-Box® 2020 for Windows® & Mac®!" is prominently displayed. Below this, a yellow box contains the text "Band-in-a-Box® 2020 & New Add-ons!" followed by a list of features: "✓ 50+ New Features! Learn more: Windows | Mac", "✓ 202 New RealTracks! Listen to demos: Windows | Mac", "✓ NEW! Xtra Styles PAK 9 for Windows and Mac 2020 and higher.", "✓ NEW! Loops-with-Style PAK 2 for Windows and Mac 2020 and higher.", "✓ Xtra Styles PAK 8 for Windows and Mac 2019 and higher.", and "✓ Loops-with-Style PAK 1 for Windows and Mac 2019 and higher.". Below the yellow box, the text "Windows Packages | Mac Packages" is displayed. The bottom right of the banner contains a paragraph: "Band-in-a-Box® is so easy to use! Just type in the chords for any song using standard chord symbols (like C, Fm7, or C13b9), choose the style you'd like, and Band-in-a-Box® does the rest... Band-in-a-Box® automatically generates a complete professional-quality arrangement of piano, bass, drums, guitar, and strings or horns."

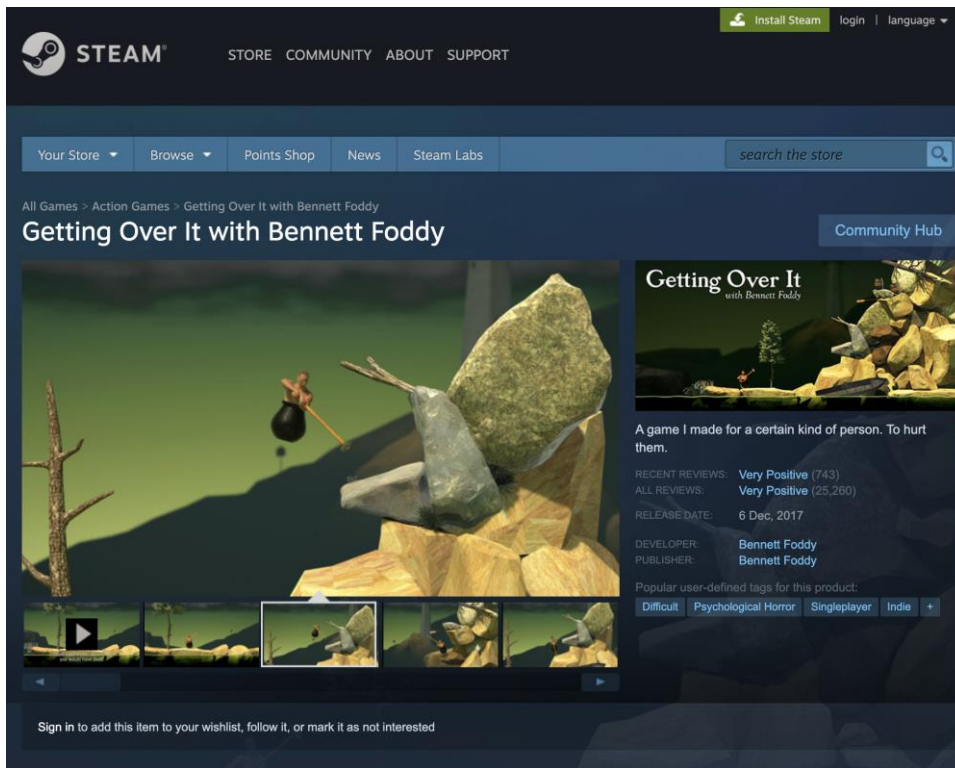
- BandLab



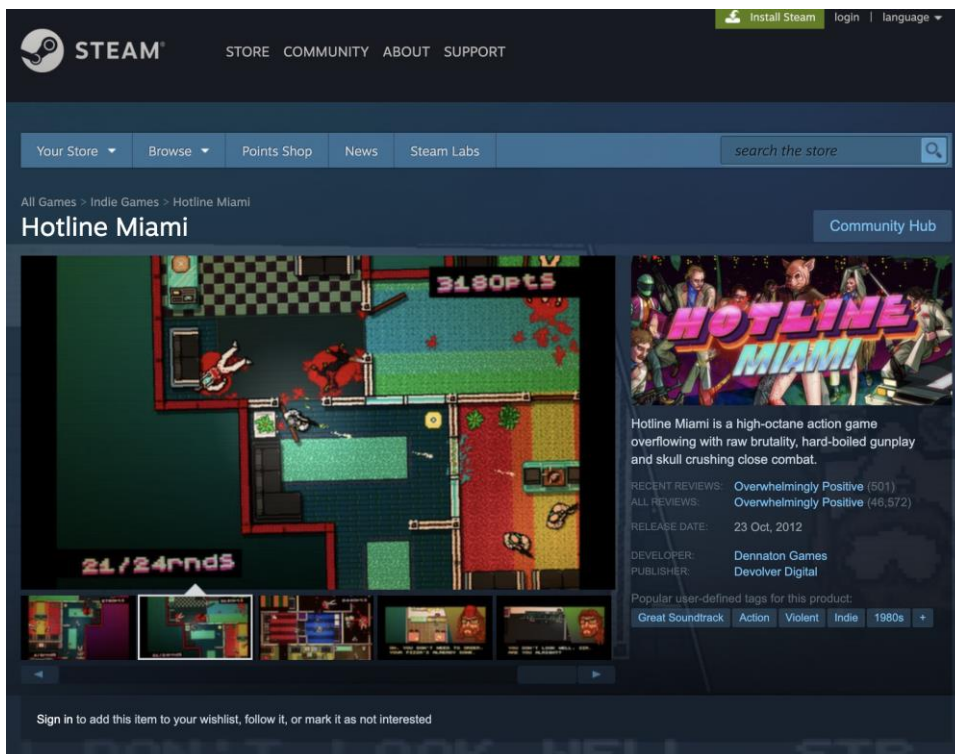
- Get Even



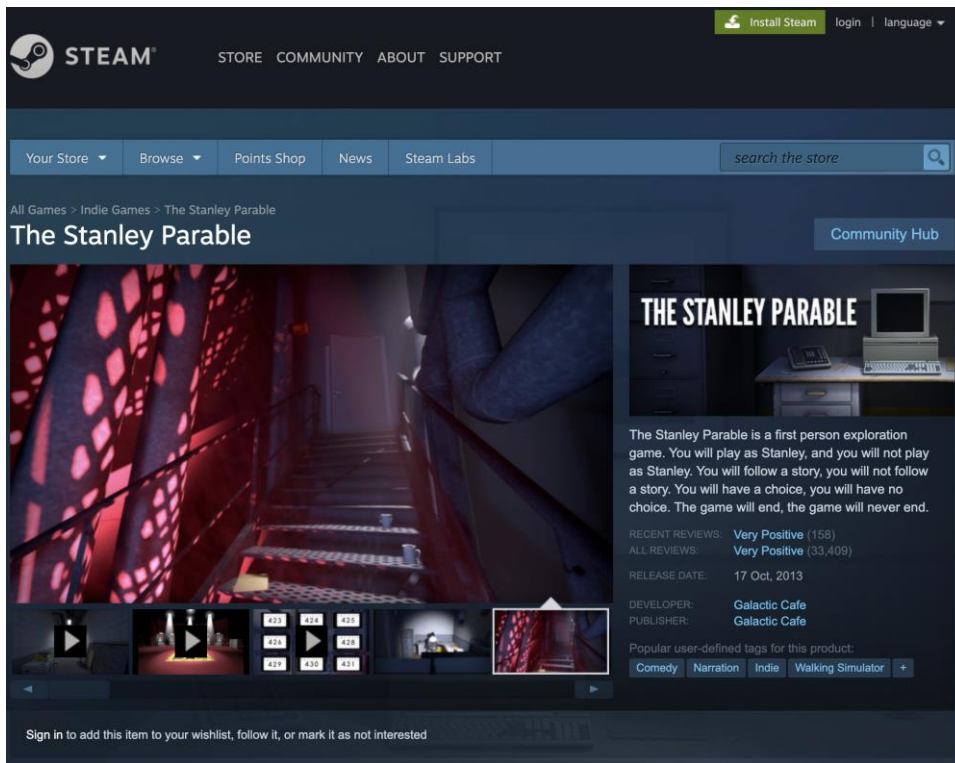
- Getting Over It with Bennett Foddy



- Hotline Miami




- The Stanley Parable



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- Wwise



Wwise is the most advanced, feature-rich interactive audio solution for games. Whether you're an indie or a multi-million dollar production, Wwise will work for you. The Wwise audio solution has made its mark in the gaming industry and is now facilitating the advancement of interactive audio across multiple sectors.



11.3. A3 – Online Sources

11.3.1. Spotify

Find the Perfect Gaming Music on Spotify

AUGUST 24, 2018

When you're gaming, you're in the zone—and you need the music to match. Sometimes the game's soundtrack is on point (we're looking at you, [Dan Romer](#) and ["Far Cry 5"](#)), and other times you wish it could be anything else. That's why we partner with some of the biggest streaming gaming companies like Twitch and Blizzard, and why we've made Spotify available on some of your favorite consoles, including [Xbox One](#). This year, we're also deepening our partnership with Xbox and fans by returning to [Gamescom](#) with an even bigger presence.

Read on to learn about our partnership, playlists, and even the beats per minute behind gaming streaming.

All Fun and Games at Gamescom

Gamescom is Europe's largest annual gaming convention, and it's being held in Cologne, Germany, this week (August 22-25). The four-day event showcases demos of the latest top games, innovative accessories, and most current gaming software. The biggest names in gaming brands (Sony, Microsoft, Nintendo), developers (Ubisoft, Activision), publishers, influencers, distributors, and media are in attendance.

PWN the Gaming Playlists

Gamescom is the ideal platform to launch [Xbox's Spotify profile](#) and first playlists, featuring the biggest gaming titles of the year. Check 'em out:

- [PlayerUnknown's Battleground](#): Pan yourself a chicken dinner with this heart-pumping playlist.
- [Forza Horizon 4](#): Live full-throttle with this electric mix of faves from Forza.
- [State of Decay 2](#): End the undead with this mix of melodic and metal music.
- [Ori and the Blind Forest](#): Dip into the surreal world of Ori with this original soundtrack.

[Metro Exodus](#): Climb aboard and take a stand with these futuristic tracks.

With [Spotify on Xbox One](#) and [Spotify on Playstation](#), you can stay in the game while playing Spotify in the background, as well as control playback with Spotify Connect, allowing you to stay linked to game play. Plenty of gamers are already embracing the streaming/playing combo—and using the beat to drive their fun.

The Beat Behind the Game

Since Gamescom attracts gamers from all over the world, we took a look at the median beats per minute (BPM)—the measurement that denotes tempo, or speed—of the most popular songs from Spotify being streamed on gaming consoles across a few countries. The higher the BPM, the faster the song. Check it out:

United States – 140 bpm

Germany – 115 bpm

Belgium – 130 bpm

Brazil – 130 bpm

Canada – 137 bpm

Spain – 113 bpm

France – 130 bpm

Great Britain – 129 bpm

Finland – 121 bpm

Italy – 124 bpm

Japan – 135 bpm

Sweden – 116 bpm

We found that American, Canadian, and Japanese gamers listen to faster music while gaming, around 140 bpm. This could include a song like Preme and Post Malone’s “Jackie Chan.”

Swedish, Spanish, and German gamers, however, listen to the slower music while gaming, as low as 113 bpm – so something like Khea, Bad Bunny, and Duki’s “Loca Remix.”

Whether you're racing hedgehogs, exploring a new world, or killing zombies, level up with the perfect soundtrack to match your playing.

11.3.2. High, A.: Is Games Music All It Can Be?, 2012

This is a love song. A love song to video game music. A love song to video game music that spends a lot of time pointing out that video game music would do well to iron its shirt, shower every day, and would it kill it to maybe shave every once in a while?

This piece is directed toward those who make, compose for, and/or enjoy a cinematic game experience common to most triple-A and an increasing number of indie titles. It touches on elements common to all video games in many places, but the purpose is not to play the nagging Jewish mother to two-man developers about how they should be more like their big brother who graduated summa cum laude and landed a big contract with Activision and will probably cure cancer someday.

The purpose is to help producers communicate with their composers, help composers hone their craft, and help the end consumer become more educated about the potential value of game music.

Why Take a Cinematic Approach to Game Music?

Too long has video game music been relegated to a dusty corner of gamers' minds. Sure, we all have fond memories of chip-tunes and our favorite melodies, but video game music has typically been viewed as a background soundtrack, not something that plays directly into the visual elements. Just look at all the games that allow you to import or stream your own music while you play.

This is a shame. Music can have a tremendous impact on the mood, feel, and emotion of any visual elements a game can try to convey. A shift in the music can take the exact same visual scene in two completely different directions. (I've always liked this example to show how a different score can change things up:)

Video games come in many forms and serve many purposes as far as the type of entertainment -- *Ninja Gaiden* in hard mode clearly scratches a different itch than *FarmVille* -- but I think it is safe to say that the majority of triple-A and otherwise popular games are trying to take a more cinematic, story-focused approach. What was the last FPS you played that didn't have a story component, regardless of how preposterous the premise? The visual techniques reflect this -- effects that emulate real camera

patterns like light bloom, lens flare, focal shift and even film grit are all very common in the modern game.

Video games are unique to this A/V field in a number of ways -- one of the most obvious being that the pacing and even the order of events can be dictated by the player. Writing for this sort of uncertainty definitely present problems that any video game developer needs to consider. However, as games become more scripted, planned, and emotionally impactful, game composers would do well to study the centuries of experience other mediums can provide them. Re-inventing the wheel is not something we want to do here.

The focus on cinematic visuals and storytelling becomes increasingly obvious as we look into just how much straight-up non-interactive cinematic storytelling can be found in games. Oh sure, there might be a "press X to not die" moment sprinkled here or there, but when you strip out the real gameplay you are often left with a long sequence of cut-scenes that rivals the length of major movies.

For instance, The *Batman: Arkham City* cutscene [playlist](#) on YouTube is just north of 2 hours and 30 minutes long, longer than the majority of motion pictures. *Gears of War 3* is 1:43 in duration. *Xenoblade Chronicles*? [North of five hours](#), beating even the extended edition of *Return of the King* in length. Even completely disregarding player-driven gameplay, there are entire movies contained inside today's games.

Unfortunately, video game developers and the players themselves don't often see this connection. Corners are cut, sacrifices made, flat-out wrong practices are repeated time and again, and the gaming media looks upon it and proclaims it good. Games have made great strides lately with a more cinematic approach to storytelling, but it's sad to see a crucial piece of that puzzle so often neglected. The *Final Fantasy* series, *Dragon Age*, and *Mass Effect* have managed to start to understand lighting, blocking, cinematography, and the like, and utilized them to great effect -- but what about the music?

All visual media is more closely related than some would think. Film, TV, advertising, and games all share many similar traits, and music publishers often treat them in a very similar way. Though each presents unique advantages and challenges, all can be summed up with two simple, tiny words:

"TO PICTURE"

This is the essence of all visually-oriented music. Video games have long been a valid medium for telling an intriguing story, and the "to picture" approach has been proven over the centuries to be the best companion, as such. Our reaction to the music is often more subconscious and deeper than our visual analysis. At best it enhances and deepens our understanding of what our eyes tell us -- sometimes directly adding, sometimes showing another facet or wrinkle that we didn't see.

With all the cinematic focus on visual elements, why *wouldn't* we take a cinematic approach to game music?

Before we discuss using musically nerdy cerebral philosophies to guide game scoring, perhaps a quick overview of some basic techniques are in order. Frankly, many games fail to get even these right. The essential problem is that you can't just *write music* and expect it to work.

Understanding Your Place

Our ears are specifically tuned to speech frequencies, and working around that can be difficult. Guess where melodies (and music in general) sound best to our ears? That's right -- the exact same range as speech. Think about the last time you were trying to hold a conversation when you had the radio tuned to a pop station. Did you notice how much you had to turn it down to be able to hear the other person? Now try talking with about the first 90 seconds of this on in the background:

This piece was scored specifically written to accommodate human voice. Can you keep the volume much louder than the pop music example? You should be able to quite well. It's about space.

For the purposes of visual media discussion, [diegesis](#) is anything that is directly represented on-screen as "of the world". So if there's a scene in a smoky cabaret and the music of the scene is being played by a jazz band contained therein, that's diegetic. "Bohemian Rhapsody" is diegetic within *Wayne's World*, as the characters are obviously aware that the music is coming out of their radio and are reacting to it. ([This article](#) talks a bit more about that and other important concepts.) Most all film and video game music is [mimetic](#), not diegetic, meaning that it's not music that is in the world with the characters but has instead been added for the sake of the audience. It's important to understand why that matters: because diegesis is king.

If you ever study opera you will quickly see that the entire orchestra basically exists to support the singer(s). The vocalist is diegetic, or in the world, and must be skirted around carefully by the music, which is mimetic, or outside of the world. Therefore, any composer worth their salt must write around the diegetic part of the story because that's the part that's actually telling the story. In more traditional musical settings like opera this is quite easy to accomplish, as the melody lines are clearly written out in musical notation. In other mediums, it may not be as obvious. This doesn't mean that the concept can be ignored, however.

Even simple conversations have pitch. Great stage actors can have up to a three-octave speaking range; it is how emotion is carried through the voice. Try speaking in a monotone and see how much you are able to convey. Erich Korngold, one of the great early composers of film, was famous for writing diegetic film dialogue out in musical notation and then scoring around that, as he did earlier with opera librettos. While this may not be a necessary step, a basic understanding of the frequency ranges used by male and female speakers and how to avoid writing scores in the same range is not out of the realm of any composer's understanding. As an example, take this clip from *The Adventures of Robin Hood*, one of Korngold's most famous scores.

Notice that the instrumentation takes up the entire spectrum of sound at the beginning, but then right as the vocals enter at 18 seconds in, they part. The strings become higher, the bass gets a bit lower, and everything that was in between the two drops out. It's a virtual parting of the waters to make room for the voices in their proper register. Just to show it's not a fluke, it does the same thing at 0:43.

I can't think of a single game that really nails this concept, which surprises me. It's not necessarily *difficult*, one just has to be aware of it. It's sad commentary that the first thing I typically do when I load up a video game is turn the "voice" slider to maximum and the SFX and music sliders down considerably, because they have no concept of how to write and mix *around* the vocals, instead of barreling over them.

In addition to keeping the frequency range in mind, the composer must also consider other ways they can muddy the text, and avoid them. In the gaming world this most often manifests itself as a score that is so busy it's distracting. Too many notes, too fast a tempo, too much of everything. An expert composer can properly choose the

time for the score to become prominent and the time for it to fade into the background, back and forth between the natural breaths of the narrative.

An excellent example of this comes from the trailer for *Conan* -- a film that was rather terrible from a cinematography and plot standpoint, but had an absolutely outstanding score composed by Basil Poledouris. Watch the whole thing:

Notice how Poledouris actually alters the music for the lines of text? And it works even on its own as a song? Pull out the high strings and choir, throw in some low brass to punch up James Earl Jones' dialogue, it works very well. The actual instrumentation lends itself to the interplay of dialogue and action scenes.

Now for the ugly side of that coin. Sometimes people opt for the lazy way out and dump this on the mixing engineer, who accomplishes such by "ducking" the music when a vocal track is present -- ducking being pulling back the music volume to make room for the vocal to be heard. An example of constant ducking is, well, a lot of trailers, as they tend to have busier, more "intense" music. We'll use *Uncharted 3* as a recent example:

Starting at about 40 seconds into the launch trailer, notice the up-down-up-down-up-down as the speech pops in and out. It's distracting and annoying.

Creating audio space is like arranging a bunch of 3D bubbles. Whatever is in the center on the X- and Y-axes and at the front of the Z (depth) axis is going to grab the most attention, and that should always be the vocals. Ducking is a cheap way of pushing the music back on the Z-axis, but that constant shifting is noticeable; the much preferable method is to make space on the front plane of X and Y around the dialogue. It is quite possible to write around dialogue, as thousands upon thousands of hours of Opera and film scoring will attest. Why shouldn't video games do this, as well?

Just Beat It

A beat, in scoring terms, refers to a particular visual point of action that should be accented. This can be a hard cut in the footage, a punch, just about anything. This can be accented in the music in many ways, typically depending on the requirements of the visuals. Here's a quick example that runs the gamut:

The low percussion (likely an udu) as the dragonfly lands on her nose is a beat. The sitar note as it flies away is another. The harp gliss for the reveal of Wonderland is

another. The cymbal roll for discovering the caterpillar is yet another; the harsh low brass almost immediately after as his expression sours another still. 25 seconds in and we've hit five beats already. This is a fairly common pace for higher-energy sections and trailers. Notice that each of these has a different effect, but all come together to add interest and impact to what's happening on screen.

It is possible to create music for a beat-heavy visual without using beats, but then it's up to the foley and sound designers to pick up your slack. See [here](#) for a quintessential example:

The opposite effect, hard transitions and visual beats without any aural punch at all, feels so unnatural that I can't even find good examples of it, because no one does it.

I've used the example of a trailer here because this is something not really seen in games much, despite having many cut-scenes proliferate in the modern game. Occasionally one can find a use of a single beat, say a cue that build to a big crescendo, but considering many scenes can have potential beats that number well into the double-digits it is a woefully under-utilized idea.

Painting the Picture

The most important thing the score is there to provide is an enhancement and complement to the visual cues on-screen. This means, as an example, that bombastic brass in the middle of a tender love scene would not be particularly appropriate.

A good score can also act as another tool for the director (or game designer), adding subtext that may not otherwise be available, or shifting the perspective of a scene. The latter is a very important concept, but not necessarily appropriate for all situations.

Most movies, games, etc. are pretty straightforward, and usually demand a straightforward accompaniment. Nevertheless, it is important enough that we will discuss it in-depth later.

As to the players themselves, well, they would do well to think about what they really enjoy about game music. Are they just looking for some tunes to chill to while they game, as a great many game soundtracks show? Or are they willing to take the step to become a more active audience in a game's audio-visual synergy, to invest themselves more into the experience, and reap the greater rewards?

11.3.3. Collins, K., Game Studies 2011

Subjective Measures of the Influence of Music Customization on the Video Game Play Experience: A Pilot Study

by Alexander Wharton, Karen Collins

Abstract

Many games and consoles today allow for a player to substitute a personal music playlist into the video game. We examined the influence that a player's choice of music has on the player's experience in one particular game, *Fallout 3: Operation Anchorage*. Players specifically chose music for the purpose of relieving anxiety, improving tactics and to experience immersion. Results showed that players were unable to predict what music would improve their immersion, but were able to choose appropriate music to influence game playing tactics and anxiety levels.

Introduction

Digital technology allows for wide-scale personalization and customization of our media content, from interactive music formats like MXP4 that allow us to choose what instruments we want to hear in a song, to personal video recorders (PVRs) that let us select which programs we want to watch and when. On the Internet, the notion of Web 2.0 and user-driven content has grown in a single decade to the point where it is now taken for granted. Participation is one of the hallmarks of new media, and video games are no exception. As Marshall McLuhan and Barrington Nevitt had predicted as early as 1972 (p. 4), the consumer/producer dichotomy blurs with new technologies, as consumers - through appropriation, customization and personalization - change the end product to suit their own needs and desires. Today we often refer to 'co-creative media' to describe these producer-consumer relations, in which neither the game developers nor the game players are the sole creators and mediators of a game, but that players, through customization and personalization, bring their own content, meanings and ideas into the game (see, e.g. Morris 2003). The customization and personalization of games through the advent of computer game modifications or "mods" has been one aspect of this drive towards user-customizable game components. Modding describes a number of activities that can overlap, depending on the abilities and desires of the person (or persons) modding the game. This can range from simple changes in graphics or characters, to more advanced level mapping, to entirely new versions of a game based on the original

game's engine. Modification communities or "modders" have become a significant marketing factor for computer game developers, especially in first person shooter, role-playing, and real time strategy games (such as *Call of Duty 4: Modern Warfare* [Infinity Ward 2007], and *Dragon Age* [Bioware 2009]). But modding, like other customization and personalization activities, exists in a grey area between fans and the corporate world, which has led to some criticism of the game industry as taking advantage of the free labour of fans to extend shelf life, create brand loyalty, and reduce R&D and training costs (Sotamaa 2007). It has been suggested, for instance, that up to 90 percent of *The Sims* (Maxis, 2000) content was produced by the players (in Sihvonen 2009, p. 52). And, if your customers are willing to create nearly all of your content, where is the motivation to release a finished product, or to treat a game as a *gesamtkunstwerk*, a 'total work of art,' where the end result is more than the sum of its parts?

It is clear, then, that music can not only change the meanings of the game for the player and alter the level of perceived immersion, but it can actually impact the playing ability and tactics of the player. This is particularly interesting as players can consciously select songs that they know will raise or lower their heart rate to alter not only their experience of the game, but also alter their perceived skill in the game. An interesting future study would test whether the music chosen actually does improve the gameplay of the participants, or whether this is just a perception based on the increased involvement with the game (i.e. immersion in the game) created by the multimodal interactions between music and imagery.

Conclusions

We have presented a pilot study to examine the role of the customization of musical soundtracks in video games. As this functionality becomes more commonplace, further understandings of how music functions in media will be important in order to determine the effects that this has on the experience of the games. In particular, more quantitative methods or a larger group of participants will be necessary in order to determine differences amongst genders, amongst participants with different listening habits, amongst experienced and inexperienced gamers, and amongst a variety of game genres. It is likely, for instance, that the role of music in a match-three puzzle game is less important than in the game studied here.

There were many important theoretical findings that came out of the study that will warrant further research and exploration with a larger group of participants. An important (if unsurprising) finding of the study is that altering the music in a game changes meanings, actions, effects, and emotional response to the game. By varying the songs or altering the order of the songs, players not only experienced different immersive and emotional states, but also considerably changed how they play the game. New meanings were created through juxtaposition and counterpoint of music and game. Songs that were chosen at times took on an ironic level juxtaposed with the violence of the game, meaning that the music could be used to heighten awareness and alter meanings. In other words, the overall semiotic meaning(s) of the game can change considerably from what the game's designers intended.

The fundamental nature of music as a part of games implies that incorporating or accounting for significant player customizability of music is a factor to consider in the design process. Game designers who wish to deliver a more cinematic experience to the player may wish to retain more control over or disable music customization features. Game composers may wish to inextricably tie their music to the visual and haptic gameplay elements in order to create a singular gaming experience that cannot be replicated with customized music. Alternatively, there could be a shift away from a cinematic or narratological focus of video game music that strictly maps composed music with in-game settings, events or scenes. Instead there could be a refocusing on gameplay elements that allow for greater player control over the music heard in-game, as was seen with the *Grand Theft Auto* example discussed earlier. Games could also be created with a recommended playlist that could be interchanged and manipulated by the player: in essence, the player would be able to customize the game-space within a limited window. It may also be possible to improve the customization experience by using audio "intelligence", such as beat-mapping or using music file meta-data to match fast-paced music to high-action scenes in the game. *Little Big Planet 2* (Media Molecule 2010) for instance includes a music sequencer that lets players arrange a variety of instrument samples into songs, and then share these with other players online. More interesting, however, is the game's ability to then synchronize the player's created music to in-game events (Orland 2009). In this sense, *Little Big Planet 2* recognizes the importance of the integration of the music with the game content, and provides a (albeit limited) means of customizing music while still

maintaining some control over the game.

The music chosen in the game had a variety of impacts on the players' emotional state and their immersion, but it is worth distinguishing here that some players found themselves immersed in the game, or the music based on their musical selection sometimes at different times. In these instances, players disconnected the musical experience from the game experience and enjoyed the game as different kinds of experiences: sometimes the music influenced the game, and sometimes the game influenced the music. Moreover, while studies have shown clearly that music can influence affective state, anxiety and emotion, this was, to our knowledge, the first study to show how music can influence the player's actual actions. This is an important finding that requires significant further research, as the pacing of songs in particular had an important effect on how players played the game.

One interesting consideration here is that the Xbox360 console designer (Microsoft), in building in the ability to customize music, has implied that game music is peripheral to the game. The players in the study, however, consciously or subconsciously attempted to make connections between the music that they chose and the game's narrative, events, imagery and playing tactics. Players found coincidences between elements of the music and actions on-screen, and chose music that they felt would increase their enjoyment of the game. Those players that were experienced with interactive game music scoring were particularly disappointed that the music that they selected (as well as the actual game music) was not more closely tied to the game action. Indeed, when music was incongruent, players reported less ability to play, less ability to concentrate, and less immersion in the game. In other words, music is *not* a peripheral part of games, but is, rather, an integral part of the overall experience.

Although perhaps an obvious point, it is worth highlighting the fact that players want to customize music in games - as is evidenced by the growing music modding community and the fact that Microsoft built this feature into its console. But more than merely wanting choice over the music, players want to choose music that will help create meanings, produce a dynamic range of emotion, reduce anxiety, increase immersion and aid in their gameplay experience. However, what was interesting in our findings was that while players could predict the effect of selected music on perceived

anxiety, and to some extent predict what music would impact their tactical play, players could not predict which music would aid in their perceived immersion in the game. It is possible that, over time, players will gain experience in choosing songs and will become more adept at making these predictions. Just as a composer learns to compose music for specific affect, players may become music supervisors of a sort in selecting songs.⁵ We may wish, therefore, to consider the notion of musical customization itself as a form of co-creativity, because with a selection as broad as the entire musical repertoire available in digital format, the customization of music is a skill, in that the music is being consciously chosen for a desired effect. We may also wish to consider customization itself as a form of interactivity in games. With the sharing of customized musical content through VoIP and social network gaming, the selection of musical content is, in a sense, a form of interaction between both the game and the player, and between players. The sense of fun and pleasure in the serendipitous moments created by chance suggest that customization can even become a form of play.

11.3.4. Deriviere, O., 2018

Is Hybrid Interactive Music the Future? PART I - How I used Get Even as an R&D platform for Interactive Music

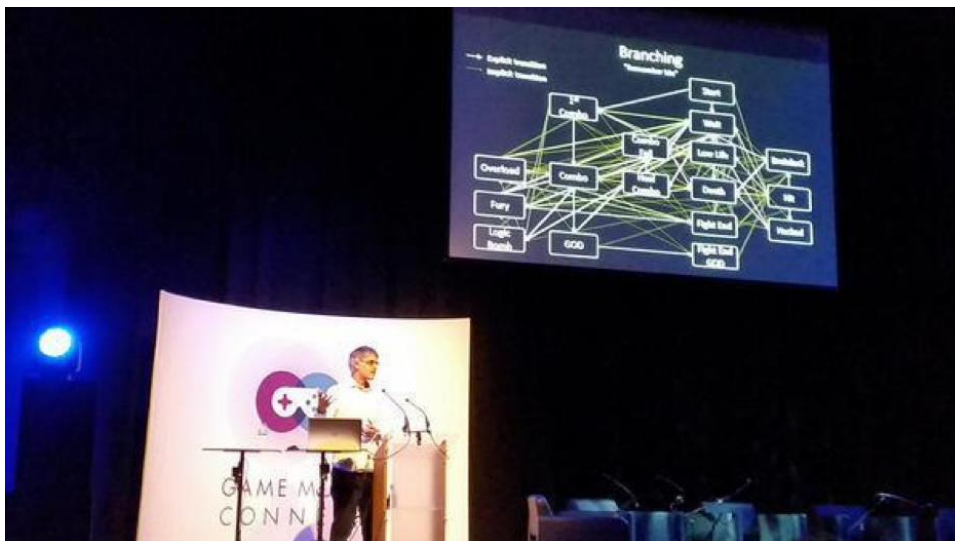
GAME AUDIO / INTERACTIVE MUSIC

OLIVIER DERIVIÈRE | MARCH 27, 2018

When I write music for video games, I always wonder about how I can make it more meaningful for the players. As a composer, you typically discuss the story, the emotions, thematics, colors, and other creative elements related to projects you work on, with the Creative Director and Audio Director. I also tend to ask questions about how music will interact with the players.

I am a classically trained composer who loves electronic music. I love to blend live musicians with digital processing in unique ways, and one of my previous soundtracks, [Remember Me](#), got me a lot of awards for its 'groundbreaking musical approach'. However, one thing that was equally important to me as the composition in itself, was the interactive approach.

In short, for Remember Me, we recorded a 70-piece orchestra in London and had the musicians follow the player's actions at 140 bpm on the next beat. If you are a Composer or Audio Director, or have any experience in music for games, you should know that this is not easy. And, although the result was amazing, I swore to myself that I would never ever do something as complex as this...until I was introduced to [Get Even](#).



*Simon Ashby, VP Products at Audiokinetic - sharing Remember Me Interactive
Music Branching at Game Music Connect (London)*

Get Even

Get Even was developed by [The Farm 51](#), a Polish developer, and published by [Bandai Namco](#). When they explained to me the concept of the game, I was very surprised. They wanted to make a VR game that is not in VR. They wanted to make a shooter / walking simulator / detective / story-driven game. They wanted players to cry when they ended the game. This to me sounded so amazing, so I embraced the work with all my heart and passion.

Get Even : Real-Time Generated Interactive Music Introduction

What is Interactive Music?

I've been travelling the whole world advocating interactive music to composers, developers, and publishers, and sharing my vision while enhancing it from the experiences of industry professionals I meet. Most of my exchanges showed me that as long as the music can change depending on the player's actions, it becomes 'interactive'. Fair enough, writing and producing some (amazing) music, and delivering stems towards creating layers seems enough, and while it may certainly seem very efficient, should we stop here, forever?! I doubt it. Our medium is in constant evolution. We have improved on it so much: AI, lighting, physics, shaders, and more. Yet, not much when it comes to music. Interactive music is at its beginning and I am hopeful that in the next 10 years, we will have a much wider range of use for music.

Video games happen in real-time, why not music?

I've always had a fascination for video games because the pixel that is moving on my screen is rendered as I'm watching it. It is alive only here and now because of my actions. The best analogy for this in music would be electronic music. When you are composing using synths (analog) or computers (digital), the sound is generated in real-time by electricity, CPU, or DSP. This is as fascinating to me as the moving pixel. We were used to music generated in real-time in the very first games. With the use of the chipset included in the console systems, it would follow the action bit by bit if needed. When [PlayStation came out with the CD drive](#), we lost something. Music became a passive track played in the background, yet it was now performed by live musicians

and it sounded amazing. Years later, we started to create layers of music that could change in real-time according to the player's actions, mostly using volume. Today, I am happy to say that we can do both interactive live recording and real-time generated music. I will call this Hybrid Interactive Music (HIM).



Jerobeam Fenderson - Reconstruct - the audiovisual album Oscilloscope Music

Hybrid Interactive Music (HIM)?

Today, we digitize music. A live performance, a synth or sample libraries become a waveform in a file (such as an MP3 or WAV). Over the years, we gained more control and started to edit these files to create multiple sections (horizontal) and layering (vertical), such as an 'introduction', a 'loop', and an 'end loop' to gain more flexibility and musicality for games. This horizontal and/or vertical approach is still the general approach for interactive music, and, if you are curious, I can easily say that Wwise allows you to get incredible results like in Remember Me, Get Even, and many more games out there.

Wwise introduced MIDI to its engine a few years ago and thanks to its incredible versatility we can use it in two different ways. The first one is for playing sounds generated by Wwise. Audiokinetic provides you with some basic synths that allows you to create music in real-time (nothing is recorded, rather generated by the

processor). The second way is equally interesting, you can use Wwise as a sampler triggered by MIDI with a lot of control (ADSR, velocity, key mapping). This is really amazing!

Now, what is groundbreaking in Wwise is the relationship between the prerecorded files and the MIDI. You can blend them freely in the Music Editor. This means that you can record an orchestra and create an instrument based on a synth that would play a bass line in MIDI, and a drum kit created as a sampler and triggered in MIDI along with the orchestra. This is what I call Hybrid Interactive Music, when real-time generated music plays alongside prerecorded music segments.

11.3.5. Hotline Miami Artists

M|O|O|N

M|O|O|N was a burgeoning Boston-based teenage electronic artist when he provided the majority of *Hotline Miami*'s main level tracks. The four tracks ("Paris," "Crystals," "Hydrogen," and "Release") are collected on his 2011 *MOON* EP.

In *Hotline Miami 2: Wrong Number*, he provided "Delay" over the Ambush scene used to introduce the Hawaiian Conflict, as well as the immensely popular scoring and credits track "Dust," both from his 2012 *Particles* EP. He also provided his 2013 single *Quixotic* to be played over Jake's ill-fated raid of a meth lab in Withdrawal.

<http://music.musicofthemoon.com/>

Jasper Byrne / Space Recordings

A UK-based electronic musician and indie developer of the 2012 game *Lone Survivor*. In the first game he provided the main level track "Hotline" and the scoring screen track "Miami." Both tracks are collected on his *Hotline Miami* EP, along with "Voyager," which would appear slightly adjusted in two of *Hotline Miami 2*'s Fan levels, essentially setting up the 1991 Setting and Gang enemies and locations.

Byrne's "Decade Dance" was used to sell the Pig Butcher's brutal assault on a police station in Final Cut, and was featured in many early showings and demos of the game. Its title is possibly also a reference to the decade shift between *Hotline Miami* and *Hotline Miami 2*, as well as the media-emphasizing *Hotline Miami* chapter Decadence which serves as an origin for the Pig Butcher.

<http://spacerecordings.bandcamp.com/>

Perturbator

James Kent is a prolific and well known French synthwave and electronic artist, formerly a black metal guitarist. He provides "Miami Disco" and "Electric Dreams," each of which are only used once in *Hotline Miami*'s main campaign ("Miami Disco" would later be set over Highball); "Miami Disco" appears in Push It and "Electric Dreams" plays over the first set of credits, ending Jacket's story. An unused track, "Vengeance" was planned to go over the eponymous chapter before it was ultimately replaced with Scattle's "Inner Animal."

Hotline Miami 2 pillages his discography, using "Tech Noir" from *I Am the Night* to introduce the character of Manny Pardo. "Sexualizer" from the *Sexualizer* EP is Dennis Wedin's stated favorite song in *Hotline Miami 2* and goes over the plot-pivotal scene and death of a player character in Execution. Finally, "Future Club" from his 2014 album *Dangerous Days* is set over the game's climactic final assault on an affluent Colombian drug fortress. Welcome Back, also from *Dangerous Days*, is sampled for Hotline Miami 3.

<http://perturbator.bandcamp.com/>

El Huervo

Niklas Åkerblad is a Swedish musician and artist and a personal friend of Dennis Wedin and Jonatan Soderstrom. He serves as the basis for Beard. His *Do Not Lay Waste to Homes* provides the calming metropolitan outro track "Daisuke" to the vast majority of *Hotline Miami*'s level outros. His "Crush" plays over the corpse-filled areas the player navigates through on their way back to their vehicles. He finally provides the intense "Turf," which is split into "Turf Intro" and "Turf Main" to bookend the final Part of Jacket's story in the first game.

Rust/Ghost

El Huervo returned to score the military camp in *Hotline Miami 2: Wrong Number*. His "Rust" track being a jungle war themed borderline remix of "Daisuke." He also provides "Ghost," the Akira Yamaoka-inspired track in the camp before Beard's final assault on the power plant. In addition he drew the essential self portrait that serves as the game's cover art.

El Huervo is also one of the main soundtrack contributors to the Swedish indie programmer game, *else Heart.Break()*. One of the tracks from his *World's End* album, "Hunger," is a collaboration with Nounverber.

<http://elhuervo.bandcamp.com/>

Scattle

Coming in as *Hotline Miami* grew from a small flash game into a bigger project, Scattle is the California-based synthwave artist that scores the near totality of the final two Parts of the first game. "Flatline" drastically shifts and slows the game's tone and pace for the somber Trauma level. The pounding "Knock Knock" plays over Jacket's

homicidal assault on a police station as well as Biker's assault on Phone Hom. "Inner Animal" is the climactic theme to both Jacket's final mission, Vengeance, and Biker's uncovering of The Janitors in Resolution. After Jacket's story, Scattle introduces Biker as a player character with the relaxed and assured apartment theme "It's Safe Now" and the fast-paced main level song "To the Top."

Scattle returns in *Hotline Miami 2: Wrong Number* where he provides "Remorse" for the retiring Henchman's final raid on a low level chop shop in No Mercy, the game relying immensely on the song to characterize and establish player with the exhausted and aging Henchman. Scattle also scores Manny Pardo's desperate pursuit of fame in Dead Ahead with is "Bloodline."

Scattle's often depicted as having an electrical outlet for a face, though in Down Under he's shown hitting on girls by spinning a butterfly knife. His *LVL. 2* remix album features both El Huervo and Magic Sword, in addition to Dan Terminus and Make Up and Vanity Set.

<http://scattle.bandcamp.com/>

Sun Araw

A neopsychedelic performer who provided "Horse Steppin'" from his 2008 *Beach Head* album and "Deep Cover" from his 2010 album *On Patrol*. They play over the main menu and Jacket's apartment respectively.

Though *Hotline Miami* has no marijuana peripherals or explicit drug usage, his music casts the majority of Jacket's lifestyle and the game's general tone as sun-baked, hazy and disconnected, effectively implying it through atmosphere. The sequel plays up explicit drug usage, but he does not return for it.

<http://www.sunaraw.com>

<http://sunaraw.bandcamp.com/>

CoConuts

CoConuts is an obscure psychedelic and noise rock group with a self-titled CoConuts EP from 2010. Their "Silver Lights" is iconically paired with the Animal Room appearances of Richard, Don Juan, and Rasmus. They are former members of the punk band Bird Blobs.

CoConuts has no bandcamp, but their EP can be purchased [here](#).

https://en.wikipedia.org/wiki/Bird_Blobs

<http://myspace.com/coconutsnoise>

Elliott Berlin

Elliott Berlin is the bass player in Dennis Wedin's band Fucking Werewolf. He provides the electronic disco single track "Musikk per automatikk." Musikk is a frantic and high pitched Euro tune which plays over Biker getting fed up with doing jobs in [Fun & Games](#).

<https://fwamusic.bandcamp.com>

Eirik Suhrke

Eirik Suhrke is a Norwegian synth and chiptune artist who composed "A New Morning," which plays over Biker leaving Miami at the very end of the game. He does indie game music for a variety of titles, including *Spelunky*. "A New Morning" is collected on his - (*Hyphen*) EP.

<http://strotch.net>

<https://phlogiston.bandcamp.com/album/->

The Green Kingdom

Michael Cottone is a Michigan-based electronic ambient artist and graphic designer. He provides the slow Untitled menu theme from his 2014 *Expanses* EP, being paired with a slow motion background of the Miami skyline being obliterated. The Green Kingdom describes the EP as being "meant to evoke vast and expansive environments, either real or imagined," and that it can "provide a sense of calm and wonder at our relative insignificance."

<http://thegreenkingdom.bandcamp.com>

Sean Evans / Prey Growl

A UK based electronic ambient artist, Sean Evans provided the opening credits theme "Detection" to [Midnight Animal](#), and is actually credited in-game as providing music for the film. Prey Growl has taken down much of his music from his bandcamp, but his 2014 "Detection" track remains along with "Stalker."

<http://preygrowl.bandcamp.com>

Coco Bryce

Light Club is a collaboration between Dutch electronic artist Coco Bryce and Canadian DJ and beat musician Motëm. Their 2012 *Feelings* EP provides the atmospheric and heavily used "Blizzard" and "She Meditates" to the Fans' intros and outros respectively. Fahkeet from the same EP is used over the Son's overdose on Pills in Apocalypse. A Remix of "Apropros" called "Jungle3" was at one point meant to be used over some intros and outros in Hawaii.

Motëm

Coco Bryce is a fan of *Trainspotting* star Ewen Bremner and often uses his likeness. The release of his "Club Tropicana" is paired with an ad declaring: "the Dutch producer indulges in the sort of musical alchemy that on paper sounds like a recipe for disaster, and yet as the album unfolds the concoction Bryce brews proves potent and addictive. Tapping into his own self-confessed omnivorous musical interests, Club Tropicana echoes Coco Bryce's musical career from the Hardcore days of the mid-90s, tekno and electro through to the new school of electronic hip hop, the funk of Skweee and the melodic synth styles of dubstep and trap."

<http://soundcloud.com/motem>

<https://myor.bandcamp.com/album/feelings>

Endless

Endless is a French Canadian ambient electronic artist who contributes much of the remorseful and exhausted intro and outro music to Manny Pardo and Richter's levels in his "Keep Calm" and "Disturbance" tracks from *Glitch*. In addition to a bandcamp, Endless has a Youtube Channel where he uploads videos of his songs (two for *Hotline Miami 2* and one inspired by *Dark Souls*).

<http://endless3.bandcamp.com>

Noir Deco

Noir Deco is a fairly well known synthwave artist who collaborated with Perturbator on his "Tech Noir" track from *I Am the Night*. Noir Deco is most famous for his cyberpunk

and *Blade Runner* inspired tracks such as "Sentient Love." He also has some songs inspired by the 80's Miami aesthetics in "A Cruise with Crockett."

<http://www.cdbaby.com/cd/noirdeco>

OFFG

Old Future Fox Gang is a tongue in cheek alias of Coco Bryce, under which he released the 2011 pseudo hip hop album Love Them All. The album is used in *Hotline Miami 2*, with "Guided Meditation" going over Manny Pardo's exhausted crime scene outros and "Java" casting a bizarre jungle mood over the tiki bar in Ambush. "Don't Cry For Me" was at one point intended to play over Beard's intros, but was ultimately cut from the soundtrack.

Their album has been removed by MYOR music, making it unavailable for purchase.

Riddarna

Riddarna is a Swedish pop rock group whose "Simma Hem" (Swimming Home) is sampled and slowed to make "Miami Jam," Jake's apartment theme. The Riddarna logo can be found on several T Shirt sprites throughout the game, and Riddarna themselves are shown counting money and selling merchandise out front of the party in Down Under.

<http://soundcloud.com/riddarna/sets>

Magna

Magna is a Philadelphia based rave music artist who created "Divide," an energetic dubstep remix with regular strikes and samples to punctuate Jake's lethal throws on Hard News. "Divide" is one of the most popular songs on the OST, and Magna has several remixes of it on his soundcloud.

<http://soundcloud.com/magna>

The *Current Events* album, featuring US and USSR military satellites.

Mitch Murder

Johan Bengtsson is a Swedish chillwave electro artist based in Stockholm. His 2010 album *Burning Chrome* is a reference to William Gibson's sprawl short story and cyberpunk anthology of the same name, and provides the track "Hollywood Heights,"

playing over both Martin Brown's dream interview and the intro Fan hallucinatory delivery sequence in *Death Wish*. "Frantic Aerobics" from his 2011 album *Current Events* goes over both The Henchman's dream of driving off in a red semi convertible, as well as the 50 Blessings headquarters Jake visits in *Withdrawal*.

His music plays up the bliss of the 1980's while recognizing the horrific political fears of the times, and *Hotline Miami 2* appropriately uses it for moments of happiness before the carpet's pulled out from underneath as underlying violent, political or nationalist sentiments rear their heads. *Current Events* is very explicitly about consumerism, technology, and nuclear threats. In 2015 Mitch Murder also contributed to the soundtrack of the 80's-themed short comedy *Kung Fury*.

<http://rossocorsarecords.bandcamp.com/album/burning-chrome>

<http://rossocorsarecords.bandcamp.com/album/current-events>

Life Companions

Life Companions is a psychedelic ambient artist from Gothenburg, Sweden who contributes the track "Richard" from their 2015 *Soft Curses*. "Richard" famously accompanies Richard's appearances as well as other disturbing events. Their "We're Sorry" track puts an unnerving edge on the sewer section of Into the Pit. The mixer for Life Companions is Benjamin Söderström, Cactus' twin brother.

<http://lifecompanions.bandcamp.com>

Sjellos

A German electronic, black metal, and ambient group, Sjellos contributes "Chamber of Reflections" from their 2013 album *Transmission Lost* to the Butcher apartment seen in Final Cut's intro. The track sets the tone of the Butcher as markedly different than the rest of the characters in game, strongly playing up the idea that he's always imposing and terrifying as a matter of course.

<http://cryochamber.bandcamp.com/album/transmission-lost>

<https://sjellos.bandcamp.com>

Chromacle

Chromacle is an ambient chillwave artist from Philadelphia whose "Interlude" from their 2012 *Interlude* EP goes over many level intros. The song has a melodic section

two minutes in that most players will only hear as Writer at the courthouse in First Trial. The opening is reused much more frequently as a calm before the storm in Blood Money, Caught and Apocalypse. The band is highly experimental and often uses chip-tunes and bass in a variety of ways. Chromacle describes their Interlude EP as "meant to act as a palette cleanser between the barrage that has previously been witnessed and the onslaught that is still yet to come."

<http://chromacle.bandcamp.com>

Vestron Vulture

Dante Diaz is a synthpop artist based in Monterrey, Mexico. From his 2012 *WAXWORK* EP he provides the popular "New Wave Hookers" as an uncharacteristically slow main level theme for Evan Wright's panicked nonlethal "raid" on a Russian Mafia bath house in *First Trial*. Italo-disco and pulp media inspire much of his work. More recently he's undergone a drastic tonal shift to goth synth and witch house.

<http://vestronvulture.bandcamp.com>

Modulogeek

Joon Guillen's a synth and ambient artist from Manila, Philippines. His melancholy ambient track "Around" adds genuine moments of sentimentality to *Hotline Miami 2*. The track adds a tone of genuine exhaustion and loss in the hopeless and innocent downtime between Richter's levels where he both cares for and lies to his chronically ill mother, as well as to Beard giving the picture to a critically wounded Jacket in Hawaii while they wait for rescue in the disastrous aftermath of a power plant assault.

<http://soundcloud.com/modulogeek/>

Magic Sword

Magic Sword is a trio of LED-helmeted synth artists very attached to the video game and fantasy aesthetic. They provided the glowing endorsement of vigilantism "In the Face of Evil" to the Fans' assault on a dilapidated junkie hang out to "rescue" a friend's sister and bring her home. "The Way Home" is similarly about heroism but with a connotation of sacrifice that goes extremely well with the suicidal final assault by Beard's Unit it plays over. Both tracks are collected in their *Magic Sword Volume 1*. The group has several remixes with Scattle on his *LVL. 2* EP.

<http://www.magicswordmusic.com>

<http://soundcloud.com/magic-sword>

<http://www.youtube.com/user/magicswordmusic>

Dag Unenge

Known to Dennaton for scoring the 1984 Swedish action movie *The Ninja Mission*, Dag Unenge provides a then-untitled track now referred to as "The Winding Theme #1" to the players introduction to Russian player characters in *No Mercy*. The theme has the capacity to feel both relaxed, affluent and assured as well as exhausted and meandering, managing to capture both *The Son* and *The Henchman's* personalities and tones.

http://www.imdb.com/name/nm0881066/?ref=tt_trv_snd

<http://www.youtube.com/channel/UCse3jotacdXzsScEyEzLBgg>

Carpenter Brut

French electro and horror synth artist Carpenter Brut is a very popular synthwave musician who provides some of the heaviest sounds and most intense moments to the franchise. The "Dial Tone" trailer for *Hotline Miami 2* was framed around the drop in his "Escape from Midwich Valley." "Roller Mobster" is a top contender for most popular track for its playing over the Fans' return to Russian killing in *Death Wish*, providing sheer energy and playing up in the inherent appeal of firefights in gorgeously expensive office complexes. His "Le Perv" is similarly straining against the confines of composition to push a melody to the utmost adrenaline high possible and gives an unforgettable send off to Richter's act in *Release*. All his contributions are collected on his *Trilogy* album.

<http://carpenterbrut.bandcamp.com>

iamthekidyouknowwhatimean

Swedish electronic artist iamthekidyouknowwhatimean composed "Run," a comparatively slow-paced track that characterizes the gang-cluttered urban decadence on full display in Evan's *Subway* level, calming incoherent vocals slowly emerging from apparently disjointed noise. The original version of the song is run backwards and forwards like a tape. It and three other tracks are collected on their lone *S/T EP*.

<http://iamthekidyouknowwhatimean.bandcamp.com>

Benny Smiles

Ross Fortune is an Irish electronic musician who submitted both the "Hotline Miami Theme" and an unused, faster-paced track called "Bad Ending." The "Hotline Miami Theme" goes over the stylistic "origin" of the series in Stronghold, where for the "first" time Russians are fought in gorgeous and trashed living locations. The theme is strangely light hearted and innocent for a military assault, but matches well with the sun baked jungle resort visuals. Smiles' music is often described as playful and tonally varied.

<http://www.youtube.com/channel/UCOtlnmpklSGYjPb3WeQG-FQ>

http://www.youtube.com/channel/UC6GQ3GnonBpULTLcgDR8b_Q/

<http://soundcloud.com/bennysmiles>

Dubmood

A Swedish synth and chiptune artist, Dubmood provides a fast paced remix of the Escape From the Police Station track from the *Terminator* OST, titled "Richard." The song introduces Richter during his frantic assault on a small Russian Mafia owned bar in First Blood. Dubmood is almost entirely oriented around extremely fast and energetic electronic beats.

<http://soundcloud.com/dubmood>

Mega Drive

Mega Drive is a very well known synthwave artist out of Dallas, Texas whose 2014 album *198XAD* provides Perturbator and Carpenter Brut's biggest competition in intensity. His three extremely action-oriented tracks are all given large, challenging late game set pieces. "NARC" lends a dark, nightmarish tone to Richter's incursion into a derelict building used to store smuggled military grade weaponry in Demolition. The Son's bank heist in Blood Money is memorably set to a sudden burst of "Acid Spit" interrupting Chromacle's "Interlude." Finally, the rapid "Slum Lord" sets the mood in Manny Pardo's panicked and claustrophobic nightmare sequence, Caught.

<http://megadrive.bandcamp.com>

CiniMod

A Canadian electronic artist, CiniMod provides the playful but strangely remorseful beat "The Rumble" to Richter's afternoon raid on a small affluent villa in House Call. CiniMod has several remixes of "The Rumble" on their *DUELux* EP.

<http://cinimod.bandcamp.com>

Auto Delta Time

Auto ΔT is a electronic techno artist based in Houston, Texas. They have two small EPs from 2010 and 2011: the Ecco-inspired *Way of the Dolphin* and *Inception*. The latter provides The Son's headquarters theme and Colombian-Mafia War prep song "Ms. Minnie."

<http://soundcloud.com/auto>

<http://autodeltatime.bandcamp.com>

El Tigr3

El Tigr3 is a small Texan electric artist who has produced a handful of tracks. His "She Swallowed Burning Coals" is the colorful, loud and chaotic song featured in the Son's assault on a Colombian strip club in Seizure. His symbol is a tiger spewing streams of colors from its mouth. Several of his tracks are collected on an forthcoming album, *¡ROAR!*.

<http://www.youtube.com/user/ElTigre0161/videos>

<http://eltigre.bandcamp.com/music>

<http://soundcloud.com/el-tigr3>

LipPi Sound

Stefan Lindvall and Simon Ohlsson are new electronic artists from Göteborg, Sweden, who provided their lone track "The Abyss" (coupled with an ambient "Abyss Intro") to the dark, dilapidated former 50 Blessings headquarters that Evan must escape from in his bonus scene, The Abyss.

<http://www.youtube.com/channel/UCgohwkCt9c8H89Igl4QKXzg>

<http://lippisounds.bandcamp.com/releases>

Nounverber

David Scott is a music producer from New Orleans who makes electronic and ambient music under the moniker of Nounverber. His unsettling and exhausted "Black Tar" plays over surreal gatherings of the *Hotline Miami* series cast of characters in the Broken Bar and the Table Sequence. He collaborated with El Huervo on the track "Hunger" for El Huervo's *World's End* album.

<http://www.nounverber.com>

<http://nounverber.bandcamp.com/music>

<http://www.youtube.com/user/soundverber>

Castanets

Castanets is an American west coast experimental music project headed by Ray Raposa. Their chilling, calming and ultimately chaotic "You Are the Blood" from their 2004 album *Cathedral* rounds out the Hotline franchise once and for all in *Hotline Miami 2*'s strangely beautiful final credits sequence.

<http://asthmatickitty.com/artists/castanets/>

[http://en.wikipedia.org/wiki/Castanets_\(band\)](http://en.wikipedia.org/wiki/Castanets_(band))

<http://castanets.bandcamp.com>

11.3.6. Glenn MacDonald

1993

Sonic CD Ups the Ante

Breaking new ground in home gaming sound fidelity, Sonic CD for the Sega CD system boasts what is perhaps the first truly CD-quality soundtrack. The music credits read like a professional commercial release, with multiple composers, arrangers, and mixers, as well as individual musician credits for guitar, drums, bass, and synthesizer.

1993

Jaguar Pounces

Atari leaps over its competition by introducing the 64-bit Jaguar Atari, bypassing the 32-bit arena altogether. It's actually two 32-bit coprocessors, affectionately named "Tom" and "Jerry." Jerry, a 32-bit digital signal processor, handles sound duties and is able to produce CD-quality sound with full stereo effects

11.3.7. Schmidt, B.: GameSoundCon; Game Audio Industry Survey 2014

Compensation: Salaried Employees:

Mean Yearly Salary: \$70,532

Median Yearly Salary: \$63,000

Mean Years in Industry: 8.6

Median Years in Industry: 7

Mean # of games worked on in past year: 3.8

Salaries have two main peaks, one at around 50,000, and one around 100,000.

Higher salaries tended to be correlated with descriptions such as “management” or “direction.” This latter peak may explain the Gamasutra numbers.

Compensation: Freelance under Work for Hire: All Games

Mean Project Fee: 28,091

Median Project Fee: 5,918

Mean Years in Industry: 8.1

Median Years in Industry: 6

Mean # of games worked on in past year: 4.6

Per project fees varied tremendously, from a low of zero, to a high of over 250,000.

Large budget games of course dominate at the higher end.

Compensation: Freelance under Work For Hire: Large-budget Game

Mean Project Fee: \$76,822

Median Project Fee: \$64,000

Mean Years in Industry: 10.9

Median Years in Industry: 10

Mean # of games worked on in past year: 3.4

Compensation: Freelance under Work for Hire: Indy or Casual Game

Mean Project Fee: \$9,830

Median Project Fee: \$3,000

Mean Years in Industry: 6.2

Median Years in Industry: 4

Mean # of games worked on in past year: 5.2

Compensation: Freelance under License Agreement (Contractor retains rights):

Mean Project Fee: 4,481

Median Project Fee: 1,500

Mean Years in Industry: 4.7

Median Years in Industry: 3

Mean # of games worked on in past year: 5.5

As with the freelance Work for Hire, there is a large discrepancy, but the highest amount for the project was significantly less than for the work for hire case. A large number of very low guaranteed payment games drove the mean project compensation down to under \$5,000 and median to \$1,500. Note that the “0” bar indicates games for between 0 and 250 (not games done for \$0)

2/ Work and Environment

Game Audio professionals are predominantly freelance

Almost 60% of respondents replied they were freelance or contractors, with 37% salaried employees of a company.

Most game composers also deliver SFX

65% of composers who delivered music for a game also delivered at least some sound effects. Even after eliminating salaried positions, freelance composers delivered SFX 56% of the time. For “large budget” games, that number drops to 20%, a reflection of the specialization of larger budget projects.

At least some “Integration” is done by 1 in 5 composers

22% of freelance composers who delivered music for a game also did some integration, helping put the sounds into the game. Programming/scripting was not so common among freelance composers (4%)

1 in 8 game audio jobs is hourly

12% percent of respondents said they were paid by the hour/day or week.

Game Audio professionals are predominantly male

96% of all respondents were male

3/ Additional Compensation

“Per unit royalties” are very rare for the big titles

Only 2% of composers of large-budget games reported receiving payment based on unit sales. For casual or indy games, this number increases significantly to a still slim 17%

Additional payments “per sku” are very rare

Less than 2% reported additional compensation for additional ‘skus’ (Porting the same game to another platform).

Soundtrack clauses remain rare among large games, more common in smaller games

Only 5% of large-budget games provided a composer with payments for soundtracks. However, 18% of small games provide for composer compensation for game soundtracks.

4/ Music Recording & Use of Live Musicians & Audio Middleware

Most game music is performed & recorded by the composer alone

Among all respondents who delivered music, the overwhelming majority of the music was created by the composer alone. Over 70% of music was delivered either as completely virtual (41%) or as virtual with any real instruments played by only the composer (29%).

Even for professionally developed, large budget games, only 46% of music was predominantly performed by live musicians or hybrid with 5 or more live musicians. That leaves 54% of “large budget” games as mostly “virtual” with 4 or less non-composer players.

Indy/Casual games are dominated (91%) by virtual with 4 or less non-composer players

Use of 3rd party Middleware more likely to be used in large-budget games, but is by no means ubiquitous

Although use of 3rd party middleware such as FMOD or Wwise was more common in large-budget games, half of all large-budget games either used internal tools or no 3rd party middleware. For casual and indy games, well over half used custom tools or no middleware.

Contract Terms

Big Companies require “Work for Hire”

95% of music for large-budget games is created under Work for Hire, either by a company employee or as a freelance composer working under a Work for Hire contract. Only 3% worked as a freelancer and licensed their music to large-budget games.

Small game companies somewhat more likely to let composers keep music rights

Although 72% of casual or indy games are done as Work for Hire, more than 1 in 5 (22%) composers licensed their music for their project, keeping publishing rights. That number drops to 12% when looking at professionally produced small scale games.

4 in 10 composers stated that there is a specific clause in their

agreement allowing the score to be registered with a PRO

The ability for a game composer to register their work with a PRO varies with game size. For large-budget games, around 40% of composers have contract clauses that let them register their Work for Hire compositions (36%), or can have their work registered because they maintained ownership (4%).

For small games 40% of composers either have contract clauses that let them register their Work for Hire compositions (14%) or can have their work registered because they maintained ownership (24%)

It should be noted that all game publishers are able to register the game score with appropriate PROs at their discretion.

11.3.8. Schmidt, B.: GameSoundCon; Game Audio Industry Survey 2015

Compensation: Salaried Employees:

Mean Yearly Salary: \$80,546

Median Yearly Salary: \$65,000

Mean Years in Industry: 9.2

Median Years in Industry: 8

Mean # of games worked on in past year: 3.5

Salaries have two main peaks, one at around 60,000, and one around 150,000.

Higher salaries tended to be correlated with descriptions such as “management” or “Audio Director” This latter peak may explain why the Gamasutra Salary survey generally reports a relatively high average “game audio” salary (\$95,682 for 2014).

Compensation: Freelance under Work for Hire: All Games

Mean Project Fee: 24,298

Median Project Fee: 5000

Mean Years in Industry: 7.9

Median Years in Industry: 5

Mean # of games worked on in past year: 5.2

Per project fees varied tremendously, from a low of zero, to a high of over 250,000.

Large budget games of course dominate at the higher end.

Compensation: Freelance under Work For Hire: Large-budget Game

Mean Project Fee: \$73,493

Median Project Fee: \$60,000

Mean Years in Industry: 11.5

Median Years in Industry: 11

Mean # of games worked on in past year: 5.6

Compensation: Freelance under Work For Hire: Professionally Produced Casual Game

Mean Project Fee: \$18,177

Median Project Fee: \$5,000

Mean Years in Industry: 9.7

Median Years in Industry: 8

Mean # of games worked on in past year: 6.9

Compensation: Freelance under Work For Hire: Indy/Other

Mean Project Fee: \$8,399

Median Project Fee: \$2,000

Mean Years in Industry: 5.3

Median Years in Industry: 3

Mean # of games worked on in past year: 3.6

Compensation: Freelance under License Agreement (Contractor retains rights, All Games):

Mean Project Fee: 29,616

Median Project Fee: 3,000

Mean Years in Industry: 5.3

Median Years in Industry: 3

Mean # of games worked on in past year: 3.1

As with the freelance Work for Hire, there is a large discrepancy. A couple very large (>200,000) license fees skewed the mean up. Removing the three highest reduces the mean to \$12,889. Note that the "0" bar indicates games for between 0 and 250 (not games done for \$0)

Compensation: Hourly employees

Hourly employees are non-salaried employees either of a game developer/publisher or (more frequently) for a contract service provider.

Mean Hourly wage: \$36.79/hour Median Project Fee: \$32/hour

2/ Work and Environment

Game Audio professionals are split between freelancers and employees

Almost 46% of respondents replied they were freelance or contractors, with 46% salaried employees of a company.

Most game composers also deliver SFX

80% of all composers who delivered music for a game also delivered at least some sound effects.

70% of “AAA” composers also did some sound design

83% of non-AAA composers also did sound design

Integration, programming, by freelancers

45% of freelancers also did either integration work or some programming or both.

21% of freelancers also provided scripting or programming to the project.

Almost 1 in 4 game composers also do scripting

23% of all composers also provided scripting or programming services.

At least some “Integration” is done by 1 in 2 composers

48% of composers also reported doing integration.

1 in 8 game audio jobs is hourly

13% percent of respondents said they were paid by the hour.

Game Audio professionals are predominantly male

93% of all respondents were male (down from 96% in 2014)

2a/ Work: Getting Gigs

Like many other music/sound jobs, networking and referrals is one the largest ways game composers and sound designers found either their job with their employer or their last freelance gig. That said, more than one in five (22%) sound/music employees of a game company got their job through a job posting. Another 28% were recruited by the company or employer.

Among freelancers, almost 2/3 of composers and sound designers got the last gig either through someone they had worked with before, or via a referral.

Important for freelancers, almost one in five (18%) answered “other.” In the detail of “other” the most frequent details were directly related to networking: meeting at conferences, game jams, networking events, “GANG event”, “GDC”, etc.

3/ Additional Compensation

“Per unit royalties” are very rare for the big titles

Only 3.8% of composers of large-budget games reported receiving payment based on unit sales. For casual or indie games, this number increases significantly to 17.3%

Additional payments “per sku” are very rare

Only 1.7% of composers of large-budget games reported receiving payment based on unit sales. For casual or indie games, this number increases slightly to 3.6%

Soundtrack clauses remain rare among large games, more common in smaller games

Only 5% of large-budget games provided a composer with payments for soundtracks. However, 23% of small games provide for composer compensation for game soundtracks.

4/ Music Recording & Use of Live Musicians & Audio Middleware

Most game music is performed by the composer alone, although slightly more than half large budget games are predominantly recorded by live musicians.

Among all respondents who delivered music, the overwhelming majority of the music was created by the composer alone. 63% of music was delivered either as completely virtual or as virtual with any real instruments played by the composer personally.

Among professionally developed large titles (AAA), 54% music is fully live or hybrid score. 30% of the music was created by the composer alone, 16% being created by the composer “virtually” with 4 or fewer live musicians to sweeten the score.

Live Musician Budgets (>\$100)

21% of games where music was delivered had a budget specifically to hire live musicians. The mean budget was \$61,586, with a median budget of \$5,000.

Live Musician Budget 2015 (>100)

Use of 3rd party Middleware more likely to be used in large-budget games, but is by no means ubiquitous

5/ Contract Terms

Big Companies require “Work for Hire”

97% of music for large-budget games is created under Work for Hire, either by a company employee or as a freelance composer working under a Work for Hire contract. Only 3% worked as a freelancer and licensed their music to large-budget games.

Small game companies somewhat more likely to let composers keep music rights

Although 72% of casual or indy games are done as Work for Hire, more than 1 in 5 (18%) composers licensed their music for their project, keeping publishing rights. That number drops to 8% when looking at professionally produced small scale games.

Large games more likely to register music with a PRO than smaller games

For large budget games, 45% of music was registered with a PRO.

For indy and professionally produced casual games, that drops to 21% of music registered with a PRO.

Note that any game music may registered with the PRO, if the publisher (typically the game developer or publisher) so desires.

6/ Education

Approximately half of respondents reported having a bachelor’s degree, approximately 1/4 reported having had some college or an associate’s degree; 19% reported one or more graduate degrees

7/ Percentage of Income

We also asked respondents what percentage of their annual income they make directly from working in the game industry. Of the respondents, 65% reported games as their only source of income, with another 15% reporting it is at least half. Less than 5% of respondents reported that games represented less than 1/4 of their income.

This information is provided primarily to inform you of the makeup of the survey respondents.

11.3.9. Schmidt, B.: GameSoundCon; Game Audio Industry Survey 2016

Annual Income: Salaried Employees (non-freelancer):

Average (Mean) Yearly Salary: \$71,838

Median Yearly Salary: \$64,434

Average (Mean) Years in Industry: 8.6

Median Years in Industry: 10

Salaries again in 2016 have two main peaks, one at around 60,000, and one around 150,000. Higher salaries tended to be correlated with descriptions such as “management” or “Audio Director.”

Annual Income vs Experience for Salaried Employees

As expected, those working in the industry longer generally receive a higher total income, with the highest salaries (> \$150,000) going to those with at least 8-12 years experience in the industry.

Salaried Employees with Freelance Income on the side

Almost 25% of Salaried employees reported earning additional freelance income on the side

Average “On the side” income: \$9,430

Median “On the side” income: \$4,309

Note that “On the side” income is NOT included in the graphs above

Annual Income: Freelancers:

Average Yearly Salary: \$42,117 (58,291 > 50%)

Median Yearly Salary: \$9000 (20,000 > 50%)

Average Years in Industry: 7.25

Median Years in Industry: 5

Freelancers reported a lower average and median annual income than salaried employees. However, the very highest salaries were obtained by freelancers.

Average annual income from a game audio freelancer was \$42,117; \$58,291 when excluding people who made more than half their income from non-audio activities (“day job”).

Annual Income vs Experience for Freelancers

As with salaried employees, freelancers working in the industry longer generally receive a higher total income. However the range of income varies much more than for salaried employees. The highest annual incomes were reported by freelancers.

Salaried Employees by Gender

The average and median salaries reported overall different by gender significantly. For salaried game audio professionals, average salaries for women were 73% that of mens' salaries; the median was 69% that of mens'. It should be noted, however that the average and median number of years in the industry also differed. As noted earlier, there is a clear correlation between compensation and number of years in the industry. It should also be noted that women represented approximately 10% of those reporting; the smaller sampling of women's salaries may cause less accurate results. ***However, those issues notwithstanding, these results prompted us to look into the data more deeply, which will be presented in a followup posting.***

Salaries (Employees of Companies) for Game Audio by Gender

Compensation: Freelance “Per Project” fee

Per project fees varied tremendously, from a low of zero, to a high of over 250,000. Large budget games of course dominate at the higher end, with Indie games clustered toward the low end. However, there are significant number of Indie games (self-funded, kickstarter, etc.) with per project fees rivaling those of Professionally Produced small scale/casual games.

Freelance Per Project Fee (USD) by game type

Compensation: “Per Minute” rates for Composers:

62% of respondents who provided income information also provided their “most typical” per-minute rate for music. Many of the respondents said they did not charge or calculate on a ‘per minute’ basis, or declined to provide their rate.

As seen below, “per minute” music composition rates by freelancers varied with the scope of the game developed:

2/ Work and Environment

Game Audio professionals are evenly split between freelancers and employees

41% replied that they were pure freelancers. However, 16% of those who worked as employees (either at a game company or an audio production house) reported earning additional freelance income on the side.

3/4 of game composers also do sound design

The chart below shows what percentage of people who compose also provide other services for games.

Integration & Programming by Composers

47% of composers also did either integration work or some programming or both.

15% of composers also provided scripting or programming work

30% of composers also filled the role of “Audio Director”

At least some “Integration” is done by 1 in 2 composers

47% of composers also reported using game audio Middleware; 40% reported doing Game Engine integration (Unity, UE4, etc.)

Game Audio professionals are predominantly male

10.4% of all respondents were female (up from 3.5% in 2014)

34% of game audio professionals are currently working on a Virtual Reality Title

Platforms include, Oculus Rift, HTC Vive, Playstation VR, Gear VR, Hololens and others

2a/ Work: Getting Gigs

Like many other music/sound jobs, networking and referrals is one the largest ways game composers and sound designers found either their job with their employer or their last freelance gig. 17% obtained their job or most recent freelance gig through a job posting. 47% were recruited or referred.

Referrals and previous contacts remain significant ways to find new work. Important for freelancers, networking (via conferences, local events, and on social media) were frequently listed as the way they got their last contract or position.

3/ Contract Terms

“Per unit royalties” are uncommon for the big titles

7% of composers of large-budget games reported receiving payment based on unit sales. For professionally produced casual, it increases to 10%, for Indie games it increases to 28%

Soundtrack clauses are becoming more common, though still relatively low

18% of large-budget composers reported being eligible to receive some share of game soundtrack sales (from 5% in 2015). For indie games, this number is 27%. Professionally produced casual games report only 8% of composers eligible for revenue from soundtrack sales.

Sales Milestone Bonuses

Sales milestone bonuses are fixed payments paid when game sales exceed a certain amount; they may be tiered.

- 5% of large budget games have bonuses for sales milestones
- 11% of professionally produced small games have sales milestone bonuses
- 14% of indie composers receive sales milestones bonuses

“Work for Hire” for Freelancers**

AAA Games Require “Work for Hire”

97% of music for large-budget, freelance games is created under Work for Hire. Only 3% worked as a freelancer and licensed their music to large-budget games.

Professional Casual “Work for Hire”

85% of freelance composers reported music for professionally produced non-AAA games was composed under Work for Hire.

Indie “Work for Hire”

Freelance composers for “Indie” games reported 45% of music was done under a Work for Hire agreement, while 55% reported licensing their music to the Indie developer.

******(Note that salaried employees who compose music or otherwise create content are, by definition, working under "Work for Hire", so their numbers are NOT included above)

Large budget games more likely to register music with a PRO than smaller games

- For large budget games, 35% of music was registered with a PRO.
- For Professionally Produced casual games, 23% of music was registered with a PRO.
- For Indie games, 28% of music was registered with a PRO.

Note that any game music may registered with the PRO, if the publisher (typically the game developer or publisher) so desires.

4/ Music Recording & Use of Live Musicians, Union & Audio Middleware

Most game music is performed by the composer alone, although slightly more than half large budget games are predominantly recorded by live musicians.

Among all respondents who delivered music, the overwhelming majority of the music was created by the composer alone. 63% of music was delivered either as completely virtual or as virtual with any real instruments played by the composer personally.

Among professionally developed large titles (AAA), 38% music is fully live or hybrid score. 41% of the music was created by the composer alone, 21% being created by the composer “virtually” with 4 or fewer live musicians to sweeten the score.

Live Musician Budgets

20% of games where music was delivered had a budget specifically to hire live musicians. The mean budget was \$44,961 with a median budget of \$7,500.

Use of Unions in Game Audio

The use of members of SAG/AFTRA for Voice Over work in games is significant, but not totally ubiquitous. 30% of games reported using SAG/AFTRA Voice Over talent in their projects

The use of members of the American Federation of Musicians (AFM) is rare. 1.8% of all respondents who delivered music reported they used AFM musicians. Counting only games which used live (non-composer) musicians, 3.8% used AFM musicians. The average budget for live musicians for AFM recorded games was \$154,166.

Use of 3rd party Middleware

FMOD and Wwise remain the most popular audio middleware, although other solutions such as Fabric, Elias and CRI are growing in popularity

5/ Education

Almost $\frac{3}{4}$ of respondents reported having a bachelor's degree or higher, just under $\frac{1}{4}$ reported having had some college or an associate's degree; 19% reported one or more graduate degrees. (note: The chart below does not count those who reported <25% income from audio).

Education effect on Income

It is difficult to draw conclusions on formal education's impact on income. We report in two ways: first a simple average/median analysis, and then graphically.

It should be noted that when looking at the above numbers, the relatively small sample sizes for HighSchool/GED and "Associates Degree" make it easy for a small number of outlier points to have an outsized impact on the average and median results.

To give a better picture of income as a function of education, we have charted income against education and years in the industry. The very highest incomes are generally achieved by those with Bachelor's degrees or higher (red circles), but not exclusively so. In addition, all "High income" (>\$150,000) individuals had at least some college.

It should be noted that when looking at the above numbers, the relatively small sample sizes for HighSchool/GED and "Associates Degree" make it easy for a small

number of outlier points to have an outsize impact on the average and median results.

Of note is that those reporting "Bachelor's Degree or higher" tend to have the highest total income, although there is a significant clumping of lower-income Bachelor's degree holders as well; this may be due to the large percentage (72%) with Bachelors+.

11.3.10. Schmidt, B.: GameSoundCon; Game Audio Industry Survey 2017

Annual Income: Salaried Employees (non-freelancer):

Average (Mean) Yearly Salary: \$74,732 (\$71,838 in 2016)

Median Yearly Salary: \$64,000 (\$64,434 in 2016)

Average (Mean) Years in Industry: 8.5 (8.6 in 2016)

Median Years in Industry: 10 (10 in 2016)

Salaried jobs in game audio again in 2017 have two main peaks, one at around 60,000, and one around 150,000. Higher salaries tended to be correlated with descriptions such as “management” or “Audio Director.”

Annual Income vs Experience for Salaried Employees

As expected, those working in the industry longer generally receive a higher total income, with the highest salaries (> \$150,000) going to those with at least 8-12 years experience in the industry.

Salaried Employees with Freelance Income on the side

About 15% of Salaried employees reported earning additional freelance income on the side

Average “On the side” income: \$15,604

Median “On the side” income: \$4,000

Note that “On the side” income is NOT included in the graphs above or in the average/mean salary numbers

Annual Income: Freelancers:

Average Yearly Salary: \$69,848 (85,687 > 50% income from audio)

Median Yearly Salary: \$25,000 (43,520 > 50% income from audio)

Average Years in Industry: 7.25

Median Years in Industry: 5

Full-time freelancer game composers and sound designers in general had greater annual incomes than salaried employees. The very highest salaries were obtained by freelancers.

Average annual income from a game audio freelancer was \$69,848; \$85,687 when excluding people who made more than half their income from non-audio activities (more than half income from a non-audio “day job”).

As with salaried employees, freelancers working in the industry longer generally receive a higher total income. However the range of income varies much more than for salaried employees. The highest annual incomes were reported by freelancers.

Because a few high-income freelancers make it difficult to see more typical incomes, we have included the graph above, but zoomed in to exclude incomes > \$200,000. Note that the graph below SHOULD NOT be used when reporting on this survey, since it is only partially representative. It is provided simply to show greater detail in the sub-200,000 composer/sound designer income range.

Salaried Employees by Gender

The average and median salaries reported overall different by gender significantly. It should also be noted that women represented approximately 12.7% of those reporting; the smaller sample size may cause less accurate results. Numbers in parenthesis represent the 2016 numbers

Salaries (Employees of Companies) for Game Audio by Gender

Compensation: Freelance “Per Project” fee

Per project fees charged for game music and sound design varied tremendously, from a low of zero, to a high of over 300,000. Large budget games of course dominate at the higher end, with Indie games clustered toward the low end. However, there are significant number of Indie games (self-funded, kickstarter, etc.) with per project fees rivaling those of Professionally Produced small scale/casual games (“casual core”).

Compensation: “Per Minute” rates for Composers:

62% of respondents who provided income information also provided their “most typical” per-minute rate for music. Many of the respondents said they did not charge or calculate on a ‘per minute’ basis, or declined to provide their rate.

As seen below, “per minute” music composition rates by freelancers varied with the scope of the game developed:

2/ Work and Environment

Game Audio professionals are evenly split between freelancers and employees

41% replied that they were pure freelancers. However, 15% of those who worked as employees (either at a game company or an audio production house) reported earning additional freelance income on the side. These numbers are very similar to previous years.

Almost 3/4 of game composers also do sound design

The chart below shows what percentage of people who compose music for games also provide other services for games.

Integration & Programming by Composers

54% (47% in 2016) of composers also did either integration work or some programming or both.

17% (15% in 2016) of composers also provided scripting or programming work

26% (30% in 2016) of composers also filled the role of “Audio Director”

At least some “Integration” is done by 1 in 2 composers

54% (47% in 2016) of composers also reported using game audio Middleware; 40% reported doing Game Engine integration (Unity, UE4, etc.)

Game Audio professionals are predominantly male

12.7% of all respondents were female (up from 10.4% in 2016)

36% of game audio professionals are currently working on a Virtual Reality Title

Platforms include, Oculus Rift, HTC Vive, Playstation VR, Gear VR, Hololens and others

2a/ Work: Getting Gigs

Like many other music/sound jobs, networking and referrals is one the largest ways game composers and sound designers found either their job with their employer or their last freelance gig. 19% obtained their job or most recent freelance gig through a job posting. 50.8 % were recruited or referred.

Referrals and previous contacts remain significant ways to find new work. Important for freelancers, networking (via conferences, local events, and on social media) were frequently listed as the way they got their last contract or position. Other responses included: "Joined Q/A team," "random Craigslist Ad," "Agent," and "Just found them and asked if needed help."

3/ Contract Terms

“Per unit royalties” are uncommon for the big titles

2.5% of composers of large-budget games reported receiving payment based on unit sales. For professionally produced casual, it increases to 6.2%, for Indie games it increases to 26%

Soundtrack clauses are becoming more common, though still relatively low

Only 6.7% of large-budget composers reported being eligible to receive some share of game soundtrack sales (from 5% in 2015). For indie games, this number is 37% (27% in 2016). Professionally produced casual games report only 8.7% of composers eligible for revenue from soundtrack sales.

Sales Milestone Bonuses

Sales milestone bonuses are fixed payments paid when game sales exceed a certain amount; they may be tiered.

- 16.5% of large budget games have bonuses for sales milestones
- 11% of professionally produced small games have sales milestone bonuses
- 13% of indie composers receive sales milestones bonuses

“Work for Hire” for Freelancers**

AAA Games Require “Work for Hire”

95% of music for large-budget, freelance games is created under Work for Hire. Only 5% worked as a freelancer and licensed their music to large-budget games.

Professional Casual “Work for Hire”

81% of freelance composers reported music for professionally produced non-AAA games was composed under Work for Hire.

Indie “Work for Hire”

Freelance composers for “Indie” games reported 45% of music was done under a Work for Hire agreement, while 49% reported licensing their music to the Indie developer.

******(Note that salaried employees who compose music or otherwise create content are, by definition, working under "Work for Hire", so their numbers are NOT included above)

Large budget games more likely to register music with a PRO than smaller games

- For large budget games, 49% (35% in 2016) of music was registered with a PRO.
- For Professionally Produced casual games, 18% (23% in 2016) of music was registered with a PRO.
- For Indie games, 28% (unchanged from 2016) of music was registered with a PRO.

Note that any game music may registered with the PRO, if the publisher (typically the game developer or publisher) so desires.

4/ Music Recording & Use of Live Musicians & Audio Middleware

Most game music is performed by the composer alone, although slightly more than half large budget games are predominantly recorded by live musicians.

Among all respondents who delivered music, the overwhelming majority of the music was created by the composer alone. 63% of music was delivered either as completely virtual or as virtual with any real instruments played by the composer personally.

Among professionally developed large titles (AAA), 38% music is fully live or hybrid score. 41% of the music was created by the composer alone, 21% being created by the composer “virtually” with 4 or fewer live musicians to sweeten the score.

Use of 3rd party Middleware

FMOD and Wwise remain the most popular audio middleware, although other solutions such as Fabric, Elias and CRI are growing in popularity.

Although Middleware usage was common in large budget AAA games, many AAA games use their own customized audio engine, rather than commercial game audio middleware. Indie games are as likely to use no audio engine at all as they are to use middleware. Note that "no audio engine" may either refer to the built-in audio engines in larger game engines such as Unity or Unreal, or may refer to low-level systems where the programmer directly plays wav files.

5/ Education

Almost $\frac{3}{4}$ of respondents reported having a bachelor's degree or higher, just under $\frac{1}{4}$ reported having had some college or an associate's degree; 19% reported one or more graduate degrees. (note: The chart below does not count those who reported <25% income from audio).

Among salaried employees working in game audio, 54% have a degree in music or audio-related field; 14% have a computer or technical degree, while 13% received a degree in an area other than music or computer/technical.

Education effect on Income

It is difficult to draw conclusions on formal education's impact on income. We report in two ways: first a simple average/median analysis, and then graphically. In each case, we also report numbers with the highest earner removed, since one or two unusually high earners can affect average numbers significantly.

It should also be noted that when looking at the above numbers, the relatively small sample sizes for HighSchool/GED and “Associates Degree” make it easy for a small number of outlier points to have an outsized impact on the average and median results.

To give a better picture of income as a function of education, we have charted income against education and years in the industry. The very highest incomes are generally achieved by those with Bachelor's degrees or higher (Green and Purple), but not exclusively so. In addition, all "High income" (>\$150,000) individuals had at least some college.

It should be noted that when looking at the above numbers, the relatively small sample sizes for HighSchool/GED and "Associates Degree" make it easy for a small number of outlier points to have an outsize impact on the average and median results.

Of note is that those reporting "Bachelor's Degree or higher" tend to have the highest total income, although there is a significant clumping of lower-income Bachelor's degree holders as well; this may be due to the large percentage (72%) with Bachelors+.

5a/ Entry Level Game Audio Jobs

For those employees new to the industry, which we define as having reported 1 year of experience:

Mean Year One Salary: \$36,852

Median Year One Salary: \$33,276

A high percentage (86%) of first year, salaried employees hold a Bachelors or Masters degree. In addition, almost 4 in 5 first year, salaried employees of game companies hold a degree in music or audio.

6/ Part-time game audio workers

We also asked respondents what percentage of their annual income they make directly from working in the game industry vs traditional media or music production. Of the respondents, 66% reported games as 95% or more of their income, with another 15% reporting it is at least half. 39% of respondents also reported additional income from audio for traditional media.

31% of people reported earning between 25% and 75% of their income from game audio; 11 % reported earning 75% or more of their income from non audio sources (a "day job") whom we (arbitrarily) designate as "people who do game audio part time."

The 2017 survey ran from June 15 to July 30, 2017 and was promoted via social media and other game or music industry web sites. We received 464 usable responses. In addition to compensation numbers, we wanted to see what some of the business terms and creative issues were current in game music and sound design. This year, we provided greater breakdown for professional status, with 3% reporting they were “hobbyist or aspirational.” These results have been excluded from the compensation calculations, except where as noted.

11.3.11. Schmidt, B.: GameSoundCon: Game Audio Industry Survey 2019

Annual Income: Salaried Employees:

Mean Yearly Salary: \$80,837

Median Yearly Salary: \$68,125

Mean Years in Industry: 8.9

[1] “Mean” is the average: the sum of all numbers divided by the number of entries. “Median” is the ‘middle number’. There are as many salaries higher than the median as there are lower. Median is reported because the mean can be skewed by a small number of very high or very low values.

Salaries again in 2019 have two main peaks, one at around 60,000, and one around 125,000. Higher salaries tended to be correlated with descriptions such as “Management” or “Audio Director” and are more likely to be from US based employees.

Annual Income vs Experience for Salaried Employees

As expected, those working in the industry longer generally receive a higher total income, with the highest salaries (> \$150,000) going to those with at least 10 years experience in the industry.

Salaried Employees: Salary by Geographic Region

Reporting only on salaried employees (no freelance income), there is a significant difference between both median and mean (average) salaries between the United States and the rest of the world. NOTE: salaries are not normalized for region-based cost of living. For example, 69% of US respondents live in California or Washington State and include the highest cost of living areas in the country (LA/Orange County & Seattle), which may skew numbers high for US.

Salaried Employees with Freelance Income on the side

Almost 25% of Salaried employees reported earning additional freelance income on the side. Of those who did, their reported freelance income was

Mean “On the side” income: \$13,666

Median “On the side” income: \$7,360

Note that "On the side" income is NOT included in the salary graphs above

Gender Makeup/Salaries

Salaried Employees by Gender

The average and median salaries reported overall different by gender significantly. However, the average and median number of years in the industry also differed; as seen above, there is a clear correlation between compensation and number of years in the industry. It should also be noted that women represented approximately 12.6% of those reporting; the smaller sample size may cause less accurate results.

As in previous years, game audio is heavily male dominated. Men make up 17 in 20 of the industry. Breaking that down further, however, shows that Audio companies are much more likely to have non-male employees than game companies, with "only" 3 in 4 audio company salaried employees reporting as male. (note: no salaried employees taking the survey identified as other/non-binary)

Considering only salaried employees, greaking down gender makeup by region shows that that in the US, the gender imbalance is significantly worse than in UK or the EU (not counting UK). Better than 9 in 10 US employees overall reported they were male.

1a/ Freelancers

Freelancers reported a lower average and median annual income than salaried employees. However, the very highest salaries were obtained by freelancers.

Average annual income from a game audio freelancer was \$63,548.

Mean Yearly Income: \$63,548

Median Yearly Salary: \$28,750

Mean Years in Industry: 9.5

Median Years in Industry: 5

Below, we break down mean and median income by game size/type (AAA, Mid-core, Indie)

AAA:

Mean: \$130,490

Median: \$70,000

MidCore:

Mean: \$46,462

Median: \$26,880

Indie:

Mean: \$22,381

Median: \$8,500

Freelancer: Experience's impact on income

As with salaried employees, freelancers working in the industry longer generally receive a higher total income. However the range of income varies much more than for salaried employees. The highest annual incomes were reported by freelancers.

In order to show more detail at the lower income ranges, the chart below has removed incomes above \$200,000. **It should be noted that the chart below is NOT illustrative of the entirety of the survey respondents.** However, seeing the data while excluding a small number of extremely high earning freelancers is useful

Freelance Compensation/Per Project Fees

Per project fees varied tremendously, from a low of zero, to a high of over 300,000. Large budget games of course dominate at the higher end, with Indie games clustered toward the low end. However, there are significant number of Indie games (self-funded, kickstarter, etc.) with per project fees rivaling those of Professionally Produced small scale/casual games.

Note that in some cases this may refer to music only, while for others it may represent a "full package" (music & sound design)

Freelance Compensation/Per Minute rates for Composers:

55% of responders who provided income information also provided their "most typical" per-minute rate for music. Many of the responders said they did not charge or calculate on a 'per minute' basis, or declined to provide their rate.

As seen below, “per minute” music composition rates by freelancers varied with the scope of the game developed.

Additional Contract Terms

For all composers, additional compensation above and beyond any fees or salaries they receive are listed below.

Note that any game music may be registered with the PRO, if the owner of the music (often the game developer or publisher) so desires.

Work for Hire for Freelance Composers

The majority of work in the game industry is "Work for Hire" where the end product is owned by the game developer or publisher. The smaller the game, the more likely it is for a composer to keep ownership of their music. For large budget games, virtually all freelance composition work is "Work for hire," fully owned by the game developer.

Note that if a composer is a salaried employee, any music they compose for their employer is also considered a "Work for Hire." Those numbers are not represented in the table above.

2/ Work and Environment:

Game Audio professionals are split between freelancers and employees

37% replied that they were pure freelancers, compared with 41% who were employees of either a game company or an audio production house. However, 18% of those who worked as employees (either at a game company or an audio production house) reported earning additional freelance income on the side.

Roles of salaried employees For **employees of game companies**, Sound Design and using Wwise/FMOD (or similar) are the most common job functions.

Approximately one in three employees at game companies compose music.

However, only 1.7 % of game company employees sole job is to compose music; 3.5% compose music and serve as “audio director” as their only roles.

Around 5% of game company employees reported performing dialogue.

Among **employees of audio companies**, sound design and integration using audio middleware such as Wwise/FMOD were the most common roles, as well as

managing and implementing dialogue. Approximately 18% compose music, with 0% having music composition as their only role

Roles of freelancers

Among all freelancers, the most common role is composer, with close to 80% of respondents reporting that they compose music. Of the all composers, approximately 35% report music composition as their only job, or 28% of all freelancers.

More than 4 in 10 freelancers use audio middleware such as Wwise/FMOD, and more than 6 in 10 freelancers do sound design. Just over 20% of freelancers said their roles included dialogue management and implementation.

Audio Middleware usage

The use of 3rd party middleware for games is common, with large budget games more likely to use it than smaller budget games. Of significant note is that many large budget games use their own custom audio engine.

Other responses included SCREAM, Master Audio, Haxe, and SECTR

3/ Education

Almost 8 in 10 of respondents reported having a bachelor's degree or higher, just under 1 in 5 reported having had some college or an associate's degree; Slightly more than 1 in 5 reported one or more graduate degrees.

Comparing all respondents with all respondents, marginally more audio professionals have bachelors degrees (63.4% for salaried employees vs 58.8% for all respondents)

Among salaried employees who have a degree (2 year, 4 year or graduate degree) 3 in 4 have a music degree

Salaries and Education Levels of Recent Hires

We define "recent hire" as an employee with 2 or fewer years experience. Recent hire is an proxy for entry level employees

Recent Hire Salaries:

Mean Salary: \$47,720

Median Salary: \$42,500

Recent Hire Education

A large majority (93%) of recently hired employees in game audio have received a college degree, with the significant majority (81.5%) holding a degree in music or a music-related field. 3.5% of new employees reported having both a music and a computer or other technical degree.

Percentage of Income & “Part time” game audio workers

We also asked respondents what percentage of their annual income they make directly from working in the game industry vs traditional media or music production or other income sources. Of the respondents, 71% reported games as 90% or more of their income, with another 12% reporting it is at least half. 43% of respondents also reported additional income from audio for traditional media.

23% of respondents stated that 25% or more of their income is derived from a non-content audio-related business they own, while 9.6% stated that they derive 25% or more of their income from a non-audio related “day job.”

11.3.12. Schmidt, B.: GameSoundCon; Game Audio Job Skills – How to Get Hired as a Game Sound Designer 2020 Skills Analysis

Below are the most frequently used terms in the job listings we looked at. Each listing was scanned for terms identical or similar to those below. The scan included the entirety of the job posting: the ‘required’ and ‘preferred’ sections of the job skills area as well as introduction and job function description. As noted above, we are leaving out standard sound design skills, such as “DAW” “professional audio tools” and the like, focusing on those most specific to game audio design.

Experience 69%

Not unexpectedly, the most frequently listed requirement was experience. Companies are looking for someone who can hit the ground running and is familiar with what it is like to work on a game project. Of note, however, is that although almost 7 in 10 job descriptions said that “experience” was a qualification, only about half of those specifically mentioned “AAA” experience, 36% in total. (AAA is the term the game industry uses for large-budget, multi-year games such as Red Dead Redemption, GTA and the like.)

Several job listings also implied that education might be a substitute for experience, though not for “AAA” experience (see **education**, below)

Wwise: 63%

More than 6 in 10 game audio job descriptions specifically called out Wwise as a required or preferred skill for their applicants. Wwise is specialized game audio industry software that takes sound and music files that you make in your DAW and puts it into an interactive format that can be integrated into the game itself. Wwise is completely free for the sound designer/composer and can be downloaded from www.audiokinetic.com.

Scripting 48%

The process of putting sound into a video game is more complex than dragging a sound onto the right point in a video timeline. Scripting—a sort of simple, ‘programming-lite’ is used to connect a game sound to a game action or event. Scripting was a skill listed in almost half the job postings that we looked at. Although

no company expects their sound designers to be computer science majors, having a working proficiency in a scripting language such as Blueprints, C#, Python or Lua can be a big plus when applying for game sound design jobs.

In addition to scripting being used to hook sounds up to the game itself, it is common for a game sound designer to be expected to write simple scripts or bat files to facilitate their workflow. An example might be creating a Reaper script to batch export sound effects or reading dialogue file names from a spreadsheet to match the naming convention required by the game programmer.

Unreal: 41%

As we noted above, the act of putting sounds into a video game can be complicated and can vary based on what **game engine** the company is using to make their game. For larger, professionally produced games, the Unreal Engine is among the most popular. Someone familiar with Unreal understands how sound can be added to a game using Unreal's Blueprints or game animations and generally knows how to get around in the Unreal Editor, and may even be fluent in a language like C++.

Formal Education 37%:

One surprising finding was the number of jobs that specifically mentioned that formal education, typically a Degree involving audio or music. 37% of the job listings stated that they preferred or required an applicant with a formal degree, preferably a degree in audio or music. Several of the job openings listed education as a possible alternative to experience, listed above.

ProTools: 38%

For specific audio software, Pro Tools was the most frequently mentioned DAW, with almost 40% saying it was a preferred or required skill. Note, however, that many of job postings listed more than one DAW, with phrases like “.. such as Pro Tools or Reaper...”

Reaper: 31%

Reaper is an increasingly popular DAW for game audio. One of its strengths for game audio production is its extensibility. Through its internal scripting language, it is relatively straightforward to create complex editing or export commands necessary

for game audio. The game audio tools Wwise and FMOD also have taken advantage of Reaper’s scripting language to provide a smoother workflow.

FMOD: 24%

Like Wwise, FMOD—specifically FMOD Studio—is a specialized software tool that lets sound designers/composers create interactive sound effects or music in a format that can be more easily incorporated into the game. FMOD Studio can be freely downloaded at www.fmod.com.

Music Composition 23%

Almost a quarter of the game audio job listings we looked at said that having music composition skills was required or preferred. Note, however, that only 6% of job titles had the word “composer” in them, indicating that music composition was the primary job function. About half of the remaining jobs that listed “composition” as a desired skill said the job involved both sound design and music composition. In smaller studios, an employee may be asked to be able to do both music composition and sound design for a game, either by themselves or as part of a larger audio team.

Of those jobs that had “Composer” in the job title itself, 60% included “Wwise” in their list of required or preferred skills, with one in 5 also saying “Unreal” or “Scripting” was desired.

Unity: 23%

Similar to Unreal, Unity is a stand-alone game engine and editing environment somewhat more popular with smaller studios or indie games. A sound designer with Unity skills will know how to incorporate Wwise or FMOD into a game written with Unity as well as some simple C# (C-Sharp) programming and tagging of animations. Someone with Unity experience also is generally familiar with the Unity game editing environment, and how sound relates to other game components.

Other Skills Listed

Among the other skills listed as required or preferred, but not reaching more than 10% were: **C++** (7%), **Play an Instrument** (6%), **Agile** (3%), **Source Control** (Perforce, SVN) (2%), **Lumberyard** (Amazon’s game engine) (2%) and 3D Art Tools such as **Max/Maya** (1%),

One final note: The skills listed above are generally technical and specific to game audio, and they are an important part of a game audio designer or composer's toolbox. But it's important to keep in mind that the job listings examined were all for content creation roles, where being able to create high quality sound and/or music is the primary skill required, and therefore assumed for *all* the job postings. In the end, it's what comes out of the speakers that counts. Great C# skills won't make up for a poor demo reel.

It is also important to keep in mind that the analysis may be somewhat biased towards larger companies' listings; larger companies are likely to have larger audio staffs, resulting in more job postings. For this reason, some items such as Unity or FMOD Studio that are more common in smaller studios may be under-represented in this analysis

Getting a job in game sound design or game music composition can be extremely competitive. As reflected in the job postings, game companies are looking for qualified sound designers and composers with the specific technical skill sets listed above. If you want your resume to make it onto the 'short list,' when applying for a game audio design job, make sure your skills match what game companies are looking for today.

11.3.13. Taylor, G., 2010

All In The Mix - The Importance Of Real-Time Mixing In Video Games

This a transcript of a talk I did at the Develop Conference in Brighton in July 2010 on audio mixing for video games.

Remember, this was written to accompany a Keynote presentation, but I can't post that here, so you'll have to imagine it. It looked awesome ;-)

Today I'm going to be talking about audio mixing; what's the purpose of mixing over and above getting the levels right, and why a good mix is so important. I'm also going to talk about the stages a mix engineer will go through when working in linear media, and what lessons we can learn, and what techniques we can use from the linear world when working with interactive material.

So, here's what I'm going to talk about today. Firstly, a short introduction. Secondly, I'll ask "what is mixing?" What's the purpose of it, and what's to be gained by good mixing practices.

Thirdly, I'd like to talk about different approaches to mixing systems within interactive entertainment.

Fourth, I want to look at some of the tools and techniques we can use when mixing our games.

And lastly, I want to look at monitoring and mixing standards in our industry.

INTRODUCTION

The industry has come a long way in the last couple of years in terms of the quality of the audio content created for games. Big developers now spend a considerable amount of money recording new audio content, and usually even more money on the writing and recording of original music for their titles.

However, the audio assets that go into a game are only 50% of the complete experience. The other 50% is down to implementation of those assets, with a good mix being a large part of that.

In my view, the mixing process is something that in the past has been overlooked. In my experience, this is usually down to the minimal amount of time scheduled between when a game is content complete and when the game is mastered.

WHAT IS MIXING?

OK, so let's start with the basics. Mixing is the process of bringing together all of your audio assets, sound effects, dialogue and music together and making them sit together nicely so that the whole becomes a coherent audio experience. Technically, it's about achieving clarity. If you've got too many sounds sharing the same sonic characteristics being played at once, the whole thing will just mush together and you won't be able to discern any detail.

Artistically however, mixing is about focus. It's about using all of the audio material that you have put together in your title, and modifying it in real time, in order to manipulate the person playing the game into feeling what you want them to feel, and to make them focus on what you feel is important. By dynamically changing the mix, we have a massive amount of power over how the player perceives the situation they're in.

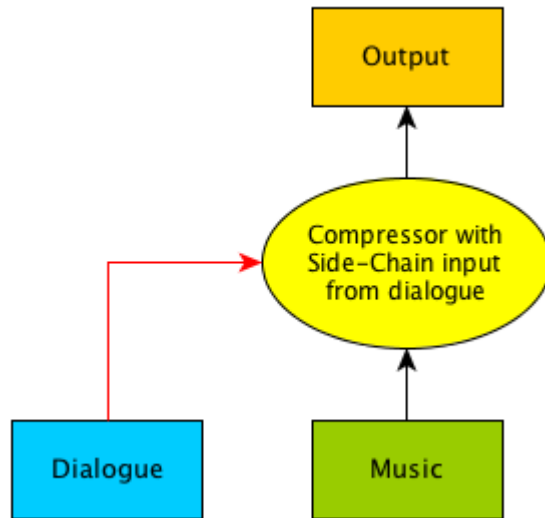
This definition of mixing is the same whether you're mixing a game, film, TV or music. However, when it comes to mixing for games specifically, mixing processes fall into two categories.

Active and Passive mixing

Active Mixing is where event triggers that come directly from within the game itself change the audio mix. An example of this may be the recalling of a set of volumes for a group of sounds, a snapshot, triggered by an in-game event, or for example the tinnitus effect when grenade goes off close to you, in a first person shooter, where all the sound is filtered, except the ringing in your ears effect.

The other category is Passive Mixing. This is a bit more subtle, and is more akin to the way that you would configure a music or film mix in ProTools or Nuendo. Passive mixing is what I would describe as the configuration of dynamics processors, and how they interact with each other.

As an example of passive mixing, here's probably the simplest setup possible.



Here we have a simple routing diagram, detailing how the dialogue and the music interact with each other.

We have a compressor on the music, with a side chain input coming from the dialogue. So, although the compressor is on the music track, it's not actually listening to the music, it's listening to the dialogue.

The louder the dialogue, the more the compressor will attenuate the volume of the music track.

As I've said, this is a very simple setup. I'll go into a bit more detail on routing a bit later.

The key difference between active and passive mixing is that with active mixing the mix changes are triggered by events in the game. The system isn't actually aware what is coming out of the speakers, only that a certain event has been triggered.

With passive mixing the mix system is actually listening to the audio signals themselves and then adjusting levels depending on actual volume levels of the channels or sub-groups. As I said, this is more akin to how you would set up the routing and audio processors on a mixing desk.

So, in my view, a perfect setup would be a combination of both active and passive systems.

Different approaches to mixing

In videogames, developers use a wide variety of different mixing techniques, depending on what technology they have available to them. I'd like to show you a couple of these different approaches.

12. Affidavit

I hereby confirm by means of my signature that I have prepared the submitted work independently and without the help of others, and have not used any sources other than those specified.

All texts taken literally or meaningfully from published and non-published publications are indicated as such.

The work has not been submitted in the same or similar form – not even as excerpts – to any other examination authority, and has not yet been published.

Location, Date, Signature