Appendix A: Interview Script

A.1 Privacy and consent

For the purpose of this research, this interview will be recorded (both video and audio) and transcribed. No sensitive personal data will be recorded. Participation is voluntary, and you are free to refuse to participate or withdraw from the research at any time. Recording and/or transcriptions will potentially be put online to support the research. Do you consent to this?

A.2 Introduction

- Introduce guest (if not anonymous) and thank them for doing the interview.
- *I will start by briefly explaining the structure of this interview.*
    - Introduction
    - Background information on myself
    - Background information on the guest
    - Explanation of the research
    - First round of questions
    - Showcase
    - Second round of questions
- Introduction of the interviewer
- Background information on the guest.
    - *Could you provide a brief description of who you are and what you have worked on?*
    - *What is your interest in game audio?*
    - *Do you generally prefer experimenting with new methods or using existing proven techniques? And how do you go about deciding which methods to use?*
    - *Have you ever worked with horror games or other quick suspense type of scenarios, and if so, can you speak to this?*

A.3 About the Research

- General explanation of the research, using figures to help demonstrate the subject.
    - Research question
    - Hypothesis
    - The tool

A.4 Questions #1

- *Have you ever come across any of the problems described in the explanation of the research (in general, not just for risers)? Or is it something you have thought about before? And do you even see it as a problem?*
    - *If you have, how did you address it?*
- *How would you approach a build-up type of goal for audio right now? For the specific context and in general.*
- Procedural audio
    - *How would you define procedural audio and what makes it different from other nonlinear audio design techniques?*
    - *Do you have experience using any form of procedural techniques?*

    - *If so, what type? And why was it used?*
  - *When should and when shouldn't procedural methods be used and why? What are some of the limitations of procedural audio?*
- *What is your initial opinion on the research's approach to addressing the stated issues?*

A.5 Showcase

- Demonstration of the current prototype. Most of it is subject to change. Please feel free to ask any questions.
- *Do you have any experience with UE4?*
- Showcase the tool.

A.6 Questions #2

- *What is your first impression?*
- *Do you still think the stated issues are a problem or not a problem?*
- *Do you think this method has potential? If it were more worked out, would you want to use it over existing techniques? Could making more types of audio with this technique be used more in the future?*
- *Are there any cases in the past where you would have used this?*
- *What do you think about the chosen audio parameters to modulate and how they are modulated based on the game data? How would you improve or adapt the current system?*
- *Are there any changes you would make? Future developments*
- *Would this tool fit into your current pipeline and/or workflow?*
- *Is the tool's interface easy (enough to) understand?*

A.7 Follow up

- *Would you be interested in me sending you the final paper or an update at the end of the project?*

Appendix B: Test Cases

Case Chase/Escape

Parameters

- Player speed
- Movement direction
- Proximity to goal
- Time passed
- Start and stop
- (Optional for finite level)Distance start and stop

Case task in time

Parameters

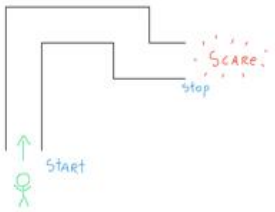
- Progress to goal (amount of enemies)
- Health (enemy progress)
- Time passed
- Start and stop

Case Health

Parameters

- current position
- (Optional) amount of risk (if there are no enemies, no need for heavy tension)
- (Optional) speed
- (Optional) Movement direction
- Time passed
- Start and stop
- Distance start and stop

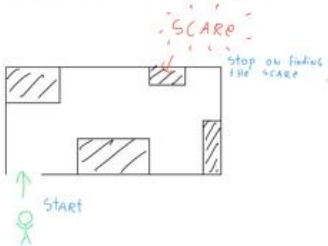
Case Horror 1



Parameters

- Player speed
- Player position / proximity to goal
- Movement direction
- Time passed
- Start and stop
- Distance start and stop

Case Horror 2



Parameters

- Player position / proximiy to goal
- Movement direction
- Time passed
- Start and stop
- Distance start and stop

Appendix C: Tools Development Approaches Overview

Approach	**Advantages**	**Disadvantages**
Audio middleware plugin	• Common approach • Integrated in most engines • Well documented	• Plugins are mostly focussed on DSP, not on audio adaption • Limited by middleware's limitations • Still obstructed by having to switch between software
Middleware-based	• Able to integrate in any engine. • Complete control and freedom • Same workflow as middleware, and therefore easier to learn • Modular	• Costs more time and effort
Custom UE4 editor	• Everything in 1 location • Quick • GUI corresponds with engine interface	• Specific to one engine • Limited control
JUCE audio framework Unity plugin	• Easily convertible code	• Specific to one engine • Limited control • Plugins are mostly focussed on DSP, not on audio adaption
Using node-based audio languages Max MSP/Pure Data and OSC	• Quickest prototyping option	• Limiting • Not optimised • Programs always needs to run simultaneously

Appendix D: Edited Interview Script

Edited interview script of adaptions made after the first interview with Clément Duquesne.

D.1 Privacy and consent

For the purpose of this research, this interview will be recorded (both video and audio) and transcribed. No sensitive personal data will be recorded. Participation is voluntary, and you are free to refuse to participate or withdraw from the research at any time. Do you consent to this?

D.2 Introduction

- Introduce guest (if not anonymous) and thank them for doing the interview.
- *I will start by briefly explaining the structure of this interview.*
    - Introduction
    - Background information on myself
    - Background information on the guest
    - Explanation of the research
    - First round of questions
    - Showcase
    - Second round of questions
- Introduction of the interviewer
- Background information on the guest.
    - *Could you provide a brief description of who you are and what you have worked on?*
    - *What is your interest in game audio?*
    - *Do you generally prefer experimenting with new methods or using existing proven techniques? And how do you go about deciding which methods to use?*
    - **Optional:** *Have you ever worked with horror games or other quick suspense type of scenarios, and if so, can you speak to this?*

D.3 About the Research

- General explanation of the research, using figures to help demonstrate the subject.
    - Research question
    - Hypothesis
    - The tool

D.4 Questions #1

- *Have you ever come across any of the problems described in the explanation of the research (in general, not just for risers)? Or is it something you have thought about before? And do you even see it as a problem?*
    - *If you have, how did you address it?*
- **Optional:** *How would you approach a build-up type of goal for audio right now? For the specific context and in general.*
- Procedural audio

    - *How would you define procedural audio and what makes it different from other nonlinear audio design techniques?*
    - **Optional:** *Do you have experience using any form of procedural techniques?*
        - *If so, what type? And why was it used?*
    - *When should and when shouldn't procedural methods be used and why? What are some of the limitations of procedural audio?*
- *What is your initial opinion on the research's approach to addressing the stated issues?*

D.5 Showcase

- Demonstration of the current prototype. Most of it is subject to change. Please feel free to ask any questions.
- *The prototype serves as a proof of concept.*
- *Do you have any experience with UE4?*
- Showcase the tool.

D.6 Questions #2

- *What is your first impression?*
- *Do you think this method has potential? If it were more worked out, would you want to use it over existing techniques? Could making more types of audio with this technique be used more in the future?*
- *Are there any cases in the past where you would have used this?*
- *What do you think about the chosen audio parameters to modulate and how they are modulated based on the game data? How would you improve or adapt the current system?*
- *Are there any changes you would make? Future developments*
- **For audio designers:** *Would this tool fit into your current pipeline and/or workflow?*
- **For audio programmers or leads/directors:** *Would this tool fit into the general audio design pipeline and/or workflow?*
- **Optional:** *Is the tool's interface easy (enough to) understand?*

D.7 Follow up

- *Would you be interested in me sending you the final paper or an update at the end of the project?*

Appendix E: Interviewees Background Information

E.1 Interviewee Experience Table

Interviewee	Time in game development	Role
Davis, Will	20 <	Audio lead/director designer
Duquesne, Clément	5 - 10	Audio designer
Fournel, Nicolas	20 <	Audio lead / director programmer
Fuesslin, Florian	15 - 20	Audio lead/director designer
Hays, Tom	20 <	Audio lead/director designer
Huguenard, Charlie	10 -15	Audio programmer
Smit, Tom de	> 5	Audio designer
Vera, Bogdan	5- 10	Audio programmer
Wijngaarden, Jonathan van den	10 -15	Audio lead/director designer

E.2 Interviewee Descriptions and Interest in the Field

Interviewee	Description	Interest in the field
Davis, Will	*Okay. I started doing audio for games with a bit of a programming background. Because back then you had to write your own drivers. To do that old chip stuff. Ended up head of audio for Codemasters. Over at EA. A senior audio director for Ubisoft at a head office in Paris. I have done, I stopped counting at 498 games. So, I have done a few. Most recently, I was head of production for NeoBards. […] Currently working on real-time audio implementation for movie work using Unreal.*	*I suppose I like that interaction between the various elements that make a final result. It is incredibly easy to get good audio. For a game, a film, it does not matter. You just give it to some people who have got a basic talent and you will have a good result with some time and some effort. But so, hiring good audio people does not actually mean you will get good audio, particularly in games or 'nonlinear' workflows. Because you have got to have the rest of the team also wanting it. It is far more important that everybody else wants good audio, or good visuals, or good gameplay, or whatever it is. The end result is the combination of everything else combined.*
Duquesne, Clément	*I am Clément Duquesne. I am a game audio designer and do a bit of programming also. And a bit of music also, but some. And I studied musicology at the beginning but with an interest in programming. Then I did a video game school in France called ENJMIN. I entered Ubisoft where I worked on the game audio systems of Ghost Recon Wildlands with Twan (referring to Twan de Graaf). What did I do other than that? Oh, yeah, I joined a small indie studio called Swing Swing Submarine for a while, then another one called the Pixel Reef, where I worked on the VR game Paper Beasts. And then I worked with friends at a small studio La Poule Noire, where I am still there. And now I do some freelance jobs on top of that.*	*Game audio is really the thing that makes the games alive. And that is what I love. And it is really the best of feelings when there is a game that exists for a few months, people are playing the prototype, it is fun, it works well and then you add audio. And then it is magic, and everything comes to life. And it is so great. So, that is what I love about this. And I also love the encounter between the creative artistic side and the technical constraints and possibilities of programming and runtime real-time environments. That does something really unique and captivating.*

Fournel, Nicolas	*My name is Nicolas Fournel, and I am mostly kind of audio programmer, or researcher, or something like that. I have worked pretty much all my life in the audio software industry. Before more for music, at the beginning of my career. Well actually, that is not even true. Mostly for sound effects, actually. And mostly for the gaming industry. So, I worked a little bit in France, where I am from, in a small company. Then I moved to California to work for Factor 5, which was a company working for Nintendo GameCube. So, I worked on video system of GameCube console. Then I moved to Konami, and then Electronic Arts, then Sony. And at all that time, I was working more or less on what could be called procedural audio. At different levels, but I was doing a lot of other things like AI, UI, whatever. And then, about nine years ago, I moved to Japan and I created Tsugi, which is a company which is really dedicated to procedural audio. So, until now, we were focusing mostly on the gaming industry. And now we are trying to derive that a little bit for all industries.*	*I think I have an interest in generative technologies, in general. But also in audio. That is why the two combined together. When I was a working at Sony, I was working on quite a few things. But the two main things I was working on were, in addition to the regular audio engine, where procedural audio and audio feature extraction. Which I found, can combine themselves pretty nicely if you want to do some synthesis, but you want to have some kind of feeling which is rooted in reality of more interesting sounds.*
Fuesslin, Florian	*Yes, I am Florian Fuesslin. I am audio director at Ubisoft Blue Byte in Dusseldorf. I started my career like 15 plus years ago, as an audio intern at the company Crytek. Before that, I had a 10-year background in producing and making music. So, piano and drums are my instruments, and I went to the school of audio engineering to get a diploma degree there. And on the way to the bachelor, I decided to do that internship, which turned out to be/ Yeah, I never went back to university. And then I went through all the ranks, like different design positions, then became lead and eventually director. And that was all at Crytek in Frankfurt. And then after this 15 years, I decided to 'new challenge new opportunity'. And to join Ubisoft. I think the cycle closes as well, when I am teaching at various universities and of course writing this chapter (referring to chapter written for a book on game audio programming).*	*I think it was really making music and sound effects and all that was a really big time of my youth that I spend on that. And yeah, producing various bands and playing in bands. And the other part was always playing computer games. Being born in the 80s means you had both worlds still right? The analogue telephone and then suddenly, digital stuff coming around, or the first home consoles. […] And part of my youth was really playing a lot of games as well. And then I always was interested in the sounds as well, I think with Warcraft 3, there was a map editor. And that is where I started to record and implement my first sound. It was a pretty simple like area trigger, like if the player passes that gate, then play like 'death to all humans', or whatever. […] You start with nothing. And you have an idea in your head, how the world could look like and how it could sound as well. And then you have to build everything from scratch. […] We start with nothing. We really have to imagine all these things and come up with all the details.*
Hays, Tom	*I was a musician as a kid and then got into turning knobs as soon as we got effects boxes. […] And went to audio engineering school then detoured off and got a degree in history at UC Berkeley because I cannot just think about one thing all the time. […] I got a job in […] it turned out that this job was for a dialogue editor. And we were editing dialogue on a super low level to fit it into data compression. [„„] And then this is mostly for talking watches and toys. But we wound up doing some work for Disney and Sega on some video games. So, I kind of got into that world and got hooked. And after a few detours, I*	*I definitely fell into it. But the thing is, I was developing an interest in computers. I came kind of late. I was not the guy like Will Davis, people like that, where I did everything I could to get my hands on whatever computer existed when I was 12. I was way more interested in playing guitar. But when I was in, in college later in my 20s, and when I got to an Atari 1040 and a Dr. T's KCS sequencer. Yeah, it has probably went up the market before you are born. So, that that really hooked me,*

	started freelancing and started a small business in 92. I got to do a lot of work at Broderbund. I did the sound editing for the PC port of Mist back in 93. And then worked on a bunch of stuff for a company called Rocket Science Games in San Francisco wound up as their audio director of 95-97. They went out of business, I got the first job I could find, which was audio director at Novalogic. Moved down to Southern California and worked on a bunch of war games and learned how to record weapons and tanks and stuff like that, which is a lot of fun. […] And beginning of 92 got an offer at Treyarch and went over there. Worked on the end of Spider Man, and then some less known games, shall we say. […] And yeah, then did Spider Man 2, Call of Duty two, Ultimate Spider Man. […] And then I got an offer to work the vendor side, building up the department at Technicolor. […] I did that until 2013, at which point I basically took our core team and started Rockets Sound, the company that I am running now. Like 90% of our work is, is voice stuff	*and I really enjoyed it. And so when, when I started to see these crossovers between, essentially computer science and audio and music, that that really sparked my interest. That is kind of what drew me into it. And the thing is, I love music, I love playing music, but I also kind of like tinkering. And I do have, I am not necessarily a math guy, but I have an engineering kind of mindset. Like fixing things and figuring out how to make things happen. And so, game audio just covered a lot of different areas in terms of things that I find interesting.*
Huguenard, Charlie	*So, I am Charlie Huguenard. My background is in computer music but I work in video games, or have worked in video games, and recently VR, for about 13 years. I started off as a note tracker, and a sort of audio designer for music games. And then, through that, kind of learned a bit more about game design, and a little bit more programming, and started working as a gameplay programmer or a game designer sometimes. And I spent about half of my career working as a gameplay programmer. But because my background was in computer music and sound, eventually I started finding opportunities to do more audio programming. And in the process as on, the chapters I have written for the Game Audio Programming books, I kind of found that I can combine the computer music background with the audio programming with the gameplay programming. And the sort of like the game design aspects of things to push forward a little bit more of the procedural sound and generative interactive music, nonlinear music, composition, sort of areas of things. So, that has my main kind of area of interest nowadays.*	*My background in music is actually jazz music. And then also, some punk and ska music and that kind of thing. But mostly jazz music, which is very improvisational. So, it was a lot of thinking on your feet, a lot of rewriting things. Or writing things and rewriting them, and then changing your mind and playing the wrong note and playing it again. All of that. And so, that is really what I bring to the sort of computer music area and the computer sound or interactive sound areas as well.*
Smit, Tom de	*I am Tom, I graduated from the […] University of the Arts Utrecht. I had a bachelor in sound design and received a masters that focused on nonlinear audio. And games as well, but specifically horror games and providing tension and in what ways you could go about that. After that, I have been freelancing, or actually, during my program at School of Fine Arts, I was already freelancing. Shortly after my graduation, I started working at Bohemia Interactive, for almost four years in Amsterdam as a senior sound designer on the Arma 3 Contact expansion. And as a sound designer on some DLCs, and the main product line of Arma 3 and all the trailers and advertisements that concern the production of a game. And after that, I started at PUBG, which I am now little*	*I did not play game one day and was like 'wow, this sounds so cool, I want to be a game audio designer'. No, I probably, at first, I noticed that the music industry was terrible in the Netherlands. So, I moved to media. Then I noticed that television media and the film industry is also, well a film industry is nearly non-existent in the Netherlands, and the media world is very difficult to get a foot in the door. Because many agencies have their people already. So, that takes a long time. So, what kind of was left at that point was game audio, games basically. And when I started looking into that, I noticed that that really interested me.*

	less than a year, in three weeks, I will be working a year, again as a senior sound designer. And for me, game audio, I have quite a specific view on that, which might not be shared in the same way by everyone. But I think it is very important and it is something that I took from the academy with me. And that is that game audio is really, the purpose of it is to support a storyline or a narrative, or the enforcement of emotions in players.	*The way how something creatively has so many connections into all these other disciplines. And the nonlinearity of it, obviously, is very important to my interest in the field.*
Vera, Bogdan	*My name is Bogdan Vera, and I did a couple of degrees in music tech at Bournemouth in the University of New York. Then I tried doing a PhD in electronic engineering at Queen Mary University. But I left that two years in, because I was really interested more in the industry stuff and less so in research. So, I have like a little bit of a background in machine learning from there as well, which I never really get to use. But then I ended up working at Media Molecule to basically develop a music and audio creation system for the game Dreams that we released last year. Which is basically this game where you can, inside the game, create other games, and also make music sculpt things, animations, make characters effectively. It is like a game engine within the game. And as part of that, I developed the sound engine, and the music and audio creation and editing tools. Mostly on the UI side.*	*I like game audio in general. Obviously, I have a have an interest in UX and tools, and interactivity. So, I am really big into like worlds where the player has an impact on the sound experience in some way.*
Wijngaarden, Jonathan van den	*I have been working in the games industry for 17 years, starting out as a composer. Then moving from only composition to also doing composition and sound design. And then being an audio lead and audio director. So, I have sort of had all of these roles in the past over the past decades. […] Right now, I am working with the Arizona team on After the Fall, which is going to be the spiritual successor to Arizona sunshine. And I have also been doing a lot of smaller projects. Doing a couple of mobile games as well as doing several national things for stuff like Rabobank. So, really a diversity of all kinds of projects. And as of recent also, because of working very closely with Vertigo, I have been branching more and more into VR audio and doing a lot more VR games.*	*It started with just being a gamer. I grew up on video games very early on. We would always have PCs in our household from a very early age. I remember being one of the only persons who actually had a dedicated PC in the household. So, I would start playing arcade rip-offs, like Pac Man on PC and Dig Dug and all those early games. And that sort of grew as a hobby and later on passion. […] I was listening to the soundtrack to Command and Conquer, which had, hip hop, heavy metal, orchestral music, all sorts of cool music. And I thought, wow, this is this is really cool. […] And then I started an educational course towards this direction.*

E.3 Interviewee Procedural Audio Definition Table

Definition of procedural audio	**Interviewees**
Adaptive audio	Will Davis, Florian Fuesslin, Tom Hays
High amount of adaptivity	Charlie Huguenard, Tom de Smit
Real-time (granular) synthesis	Clément Duquesne, Nicolas Fournel, Jonathan van den Wijngaarden
High amount of adaptivity or real-time synthesis	Bogdan Vera

Appendix F: Exerts from the Interviews

Exerts from the interviews quoted or mentioned in Chapter 4.

F.1 Davis, Will

F.1.1 Player predictability

The biggest problem in the game, and you mentioned it, is 'do not do what you want to do'. You start the trigger, and then they go 'oh look, shiny squirrel' and wander off in a completely different direction.

F.1.2 Tool integration

That is a that is a tricky one. Because if you were at Ubisoft, the first thing that you would do would be rebuild that tool inside of Anvil, or whichever game engine they wanted to use, and make it part of the larger toolset. Or actually, probably, you would be putting it on the list the tools group to do it. And then you would be a liaison from the game team and the tools group. Every company is completely different. Can I see individual sound designers using it? Absolutely. Because it can speed it up. It is simple. And actually, it does not require any effort to learn if you have already got a basic understanding of these things anyway. And most sound designers do. One would hope. Saying that, your tool is simple enough that you can just whack it on 'oh, I got some layers, whack in some sounds, change these things'. In five minutes of just playing with it, you would have a basic understanding of how it works. So, that is really nice. It is slightly faster than using blueprints or code or, a lot of work from a lot of sound designers would still be in their DAW. That is a quick way of hearing sounds together and how it is going to work. That is cool.

F.2 Duquesne, Clément

F.2.1 Description

I am Clément Duquesne. I am a game audio designer and I do a bit of programming also. And a bit of music also, but some. I studied musicology at the beginning but with an interest in programming.

F.2.2 Experimentation

Well, it really depends on the context of the developments, because sometimes you just do not have the time to experiment. And you have to find things that are already there. And you have to make with what exists. But I had the luck to work on several projects that had the time to find new solutions, and the resources to find them. So, on Ghost Recon and Paper Beasts it was the case. And so, I had the time to search for stuff, to test things. And yeah, I guess when I have the time, I try to find new solutions that work well with what we were trying to do. Because we are always trying to do new things.

F.2.3 Audio control

Just something else that I was thinking about is that as a sound designer, what would maybe prevent me from wanting to use this solution is, but it is maybe just something that is to come, it is that it is not open enough. It does only one kind of riser. When you are a sound designer and you are looking for ways to do something, you mostly want to control how it will sound, what sounds you will use. That is one of one of the things I would change.

F.2.4 Riser modulation

For a riser I find that in the last seconds it does not rise enough. […] Because I guess the moment where your risers stops is really entirely distance base

F.2.5 Viability

I am so familiar with Wwise that I think I would still go to Wwise for something like that. And also, I did not have many risers in my games. So, I am not thinking, 'Oh I could have used this at this moment or this moment'. In my personal experience, I would not have used it, I think.

F.2.6 Programming competence

It was done by me (referring to the audio integration in code for Paper Beasts). I had the responsibility of the programming as well. That is also one of the reasons that I am not very attracted to specific audio middleware, is that I have the competence to do audio tools that answer to specific needs. I am tempted to do this myself if I have to.

F.2.7 Viability

…I am not sure risers, I mean apart from horror games, I am not sure it is a thing that will happen a lot in terms of quantity. I think you can still find the time when you need to. It is a

thing I often find with small procedural tools like this, is that if it is not important for your game, then you do it in another more simple way or you just do not do it if it is not that important. And if it is really important, you want to do it your way.

F.3 Fournel, Nicolas

F.3.1 Procedural Audio

Well, I guess that is real-time synthesis. Real-time sound synthesis based on input from the player or the game. So, something that reacts in real-time and generate audio from that. […] In my work, it is always synthesis. Then, my definition of procedural audio is really straight and limited to generating something from scratch. Most of the time. I totally understand that other people call procedural audio some kind of rules that you follow to create interactive music, or some kind of scripting and they call procedural techniques. I am totally fine with that (laughs). I do not mind. But my definition in my work and for when I talk about procedural audio, that is sound synthesis. And now I am a bit less strict. But even before, I really use no samples at all and totally generated.

F.3.2 When should procedural audio be used?

Well, I think in a lot of cases, you might want to use both. First its limited, again, by the CPU usage you can have. So, in most cases, you probably want to use procedural audio, maybe if you want more interactivity for your sound. Let us say you have a fight between dragons, and your dragon is just in front of the screen, in the middle of the screen, just in front of the player. Obviously, you want the roar to follow the movement of the throat of the dragon and everything. You will want that to have like, full control, full procedural audio. If there is another player's dragon very far away, you do not need procedural audio for that, you do not even see very well the thing. You can play a sample or a couple of fundamental samples. So, that is one thing. I think there are cases where you do not necessarily need procedural audio, which are/ I am not even sure how to say this in English. Citations, like when you refer to something which is very well known. A very typical sound for example, you have a fighting game, and you have a very well known, I am really bad at weapons, very well know AK or something. So, in that case, usually players really like to observe the exact sound of that weapon. And in that case, it is a short sound, there is not so much control. You really want that particular sound. So let us go with samples right. Again, I am talking about sound effects right. If you cannot obviously, because of CPU reasons, then you have to choose your battles. Pick up where you can use it. And if you really need some kind

of station effect something like really/ Well some people will say also, for something realistic, but I do not necessarily/ Yeah, depends on what the level of the procedural audio modal you have, right of what levels they have. Of course, if you need something very realistic and you do not have access to very good models, then obviously you should use samples.

F.3.3 Tool integration

Interviewer: *So, this type of tool, do you think it could fit in the current pipeline and workflow of audio design?*
Fournel: *Yeah, I think so. If it saves time to people. People do not have a lot of time. After that, if you decide to make several, then you kind of need to send something over that, so you do not ask people 'okay, this is this one and this one does that' As long as there is a uniform user experience, way to set things up. Yeah, I think that is interesting.*

F.3.4 User control

I think where you want to give options is more on the creative side and less on the implementation side. If you can have the implementation go very quickly, easily like, just dropping a box, attaching something. That is great. And nobody will ever complain, because they have more creative options.

F.4 Fuesslin, Florian

F.4.1 Issues regarding game audio development

I do not think it is a problem, it is just the reality we work in. Without the players we do not have a job. And the player is the disturbing factor in our world. There is nothing we can do about it, rather than in the end, it is a lot of psychology. Using old tricks to steer players' attention where we want it to have it. To design the levels that the player will most likely use that path. And then maybe using that, let us say golden path as it is usually mentioned in games, to use that golden path, and design around that. Of course, if there is the most important emotional cutscene, where your mom dies, and the player decides to look at the feet or totally away from the explosion. Cool guys never look at explosions, right? So, in the end, we cannot do anything about it. But we can do the setup that it is very, very likely that the player will not miss out that scene. Or you have to do a cutscene. But again, if you are in the interactive medium, the last thing you want to do is taking away the controls or the camera, especially if you talk virtual reality games and with a headset.

F.4.2 Simplicity of sound design

Sound design is sometimes pretty simple. It is time, frequency is very important. And if you design sound, people always say 'more plugins'. But in the end, it is like 'I use pitch, volume, maybe reverb'. The standard feature set EQ compression that is way more than you usually need. So, I agree let us not make it overly complicated. Especially as it seems to work and you achieve the feeling or the emotional point you wanted to make.

F.4.3 Parameters & modulation

I think it is a good start. Same like, I send you the link, they also use a lot of distance and that works fine. Because what you know, you know the max speed of the player, you know the angle the player's turning. And by this you always know 'oh, okay, it will definitely, I do not know, 10 meters per second is max speed'. The player will always take two seconds from this position to hit the impact moment. And that is cool, because you can well, you can even choose the right piece then. If you want to play a different audio based on this. But I think distance already works perfectly fine.

F.4.4 Player predictability

I think it is project based. But in this situation, it works really well. Like you basically come around the corner and you see that point of interest That is guiding. Well, okay, there is nowhere else to really go right. You could turn around now and walk to the end of the street, but there is an invisible wall, that is blocked. You will eventually turn and go towards the church. But as you do, the riser will give you direct feedback about 'something is about to happen'. This is a psychology thing, but I guess you would not stop pushing forward with the controller. Because you will continue. The building is interesting, how it is burning, it triggers all these questions. And then the riser is basically supporting your approach to the impact moment. And that is perfect.

F.4.5 Tool integration

It is a standalone thing, right? It connects with the different engines. And I think this is where the beauty is, this is where the middleware have really proven that they worth getting. And they all have a plugin pipeline and architecture. So, you could easily make a Wwise plugin out of that, right? It is not a big deal. Then it is just a matter of, let us say, good software design.

F.5 Hays, Tom

F.5.1 Procedural audio

I actually see it as a continuum. I do not think there is one or the other, I think that well executed triggering of individual, one shots and stereo sounds and music streaming, it is procedural. It is almost like granularity is a continuum where on the one end you might have a single sound for a gunshot or for a rock fall, and then at the other end you might have sounds that tie into every little, tiny interaction of the rock as it rolls down the hill. Because it is one of those things where you can drive yourself crazy thinking about how many different sounds are being made when rock rolls down the hill. And so, it is all procedural in that way. Now, of course, if you are synthesising the sounds, and the end result, or the hundreds or 1000s of sound grains that go into the rock rolling down the hill, then/ I guess that there is a line that you are crossing when you are going from sample based into truly synthesised, but I do not know. I tend to see the whole thing as a continuum. And it may be that there is some kind of point where there is just a paradigm shift, and it is completely unlike anything you have seen before, but I guess I do not know where that is. I have been surprised before.

F.5.2 Tool integration

There is a sort of philosophy and mindset behind it, it has a little different from the tools that you might have right now. Say we are trying to exactly what you are doing, but using say existing Wwise, or whatever else. I think you could come close, but its underlying intent is different.

F.6 Huguenard, Charlie

F.6.1 When should procedural audio be used?

Well, one answer I think I agree with is whenever you want. Do whichever one you feel like doing. Because some people do enjoy working in sort of linear production techniques more than then in designing systems or designing procedural systems and vice versa. And that can have a huge impact on the outcome. Because if somebody is really into their method, and they are good at their method, then it is going to sound better. So, that is one answer. The other answer, though, is that I think that for me, I go for procedural solutions first. And the reason is that they are always more flexible. The downside is that they blow up easily. There are edge cases to deal with and stuff like that. And going with sort of like linear

production techniques, and then applying some interactivity to those resulting sounds can be a lot more stable and predictable.

F.6.2 Parameters & modulation

They all make sense to me. The abstraction of position and in motion or action, that makes sense. As opposed to tying it to like, the 3d position, for instance. Because I could also see some instances where maybe you want to use this system for something that is not actually about player motion. Say you have a relationship meter or a relationship mechanic, and you have some sort of relationship value with another character, and you want that to build. You can apply that to this. So, makes sense to me.

F.6.3 Tool integration

It depends. Sometimes if a project that is using your thing is specialised enough and specialised in favour of the thing that your tool uniquely does, then it can be a conversation about using that instead of Wwise or using that instead of FMOD. Where it starts to get a little difficult to sell, is when the project calls for a lot of things that one of the more widely used tools does really well. Like say, dialog localization, or being able to batch process large numbers of sound effects, or that kind of thing. That is when it gets a little trickier. And running side by side if possible, becomes a good option. Or if it is possible, plugging your tool into that system. And I have definitely considered doing the third option, like plugging one of my music system tools into Wwise, instead of trying to get people to use it instead of Wwise. But you know it is definitely a consideration. And it is not the most interesting part of the work, but it is a huge part of the work.

F.6.4 Viability

It has potential? Yeah of course. Is that a trick question? No, I mean, as you know by now I am a big proponent of procedural sound design and system thinking and sound design. To me this is just a thing that we definitely should do. And we should do more of it. And have more tools like this. Because, I think I kind of alluded to it earlier, the sound designers, the purely design side of the people that I have worked with, they already want this stuff. And they already know how cool it could be. But they do not spend a lot of time thinking about it, or asking for it, because they think that it has too hard. So, if more people are making tools that prove that it has not too hard, then they are going to get used.

F.7 Smit, Tom de

F.7.1 Experimentation

I like to try new things. Provided there is time. There might not always be time. My experience until now is that introducing new technology usually comes with the necessity for extra support. So, this is something that you would want to time in the onset of development. For instance, during preproduction or if there is an allocated period within production that you have discussed with management 'we will take this time just to investigate this specific piece of technology'.

F.7.2 Centralisation to Wwise

Say my workflow currently is Unreal Engine and Wwise. If I were to use this tool, I would have to in Unreal is what I understand. Is that correct? […] I am asking because, what I prefer most is to have most things centralised. I would probably ask if this could be converted into a Wwise plugin. Because I have Unreal on one screen, Wwise on the other, and then my loudness meters on the third one. And I do not know if I would have space for yet another application that would kind of battle with the other applications for focus. Because Windows is really annoying like that. That would be maybe a reason that I would say lets put it either in Unreal, but preferably in Wwise as a plugin. Because that is already compatible with Unreal

F.8 Vera, Bogdan

F.8.1 Procedural Audio

Do you mean procedural audio synthesis or procedural audio arrangement? […] I mean, arrangement would mean generative composition, sort of. You put together segments of music or sounds in some way, procedurally. As in like, according to some rules automatically. Procedural synthesis would be, instead of going to record a sound file, you generate it from some algorithm. I think those things are very different. When it comes to procedural synthesis. I think it is very interesting. And I have tried in the past to propose it to people at Media Molecule for example. And we did we did try for a while. And to some degree, you kind off can do that in Dreams now. But there is a tension when it comes to sound design people not being in control of the same parameters they are used to. They know how to go record the sound they want. You have to teach them a whole new technical

skill when it comes to procedural. It is almost like a procedural sound designer is a different role than a sound designer.

F.8.2 Risers

Think of it like the riser itself does not have to be just the sound that is rising, the sound effect that is applied. It is the gesture of the riser that can be applied to many things. It can be applied to the lighting in the scene. Another team might decide that fog comes in at the same time, you could tie that in the riser. It is the same kind of parameter. If you make it work together with the rest of the game design. Maybe the lights get darker in anticipation. In Dreams, we have often implemented this linkage between sound and the rest of the rest of the tools.

F.8.3 Player predictability

The thing is, players do not really do that (referring to unpredictable player behaviour). It is like, if they are trying hard to break your riser, it is their fault. It is a video game. The average person really will not. Because it is a video game anyway. I can go really close to a texture and look at it and it is going to look like it is low res, because it is a video game. So, it is like 'do not look at it so close'. Same with audio, the experience for you is, even though it is dynamic, it is still going to be a little bit railroaded because there is a planned event. That is fine.

F.8.4 Procedural audio design

Arrangement would mean generative composition, sort of. You put together segments of music or sounds in some way, procedurally. As in like, according to some rules automatically. Procedural synthesis would be, instead of going to record a sound file, you generate it from some algorithm. I think those things are very different. When it comes to procedural synthesis. I think it is very interesting. And I have tried in the past to propose it to people at Media Molecule for example. And we did we did try for a while. And to some degree, you kind off can do that in Dreams now. There is a tension when it comes to sound design people not being in control of the same parameters they are used to. They know how to go record the sound they want. You have to teach them a whole new technical skill when it comes to procedural. It is almost like a procedural sound designer is a different role than a sound designer.

F.9 Wijngaarden, Jonathan van den

F.9.1 Viability

I think it has potential. It is an interesting idea. It might have to tackle a few hurdles, but I think you are already thinking in the right direction. There are a couple of initial issues that are there that you seem to be aware of.

Appendix G: Coding Handbook

An overview of the coding used to analyse the data, as described in Chapter 4.2.

Code	**Subcode**	**Definition**
Background Information Interviewee		
Career length in games		Amount of time interviewee has been in the game industry (divided in groups of 5)
General description		Description of interviewee of themselves as professional
How to address the stated issues		The interviewee's take on how to address the issues the research states on game audio development
View on stated issues	Agree	Interviewee relates to the stated issues the research states on game audio development
	Would not call it a problem	Interviewee states they would not call the stated issues a problem
View on experimenting		Interviewee's view on experimenting
Interest in the field		Interviewee's interest in the field
Role	Audio programmer	Interviewee is mainly experienced as audio programmer
	Audio designer	Interviewee is mainly experienced as audio designer
	Audio lead/director programmer	Interviewee currently has a leadership role and before this mainly has experience in audio programming
	Audio lead/director designer	Interviewee currently has a leadership role and before this mainly has experience in audio design
Parameters & Modulation		
Modulation	Player predictability	Does and should the method address extremely unpredictable player behavior
	Prototype's modulation does not suffice	The prototype's modulation based on the game's state and events does not suffice
	Prototype's modulation suffices	The prototype's modulation based on the game's state and events suffices
	Pathfinding	The prototype calculates a straight line, and does not account for corners
Parameters	Prototype's parameters suffice	The prototype's parameters are indicated to work well and suffice as the basic parameters.
	Prototype's parameters are not enough	There are more parameters to add for it to suffice.

	High number of possibilities	Interviewee stated that there is a high number of potential parameters to add to the prototype
	Riser can also be adapting other audio	A riser can also be the adaption of already playing sound
Pipeline & Workflow		
Integration approach	Centralise to middleware	Interviewee mentions it would be preferred to have the method integrated in a currently standard middleware.
	Centralise (to middleware or engine)	Interviewee mentions it would be preferred to have the method integrated in a currently standard middleware or game engine.
	Prototype's approach works well	The prototype's approach to integration works well (does not need to necessarily be centralised or adapted in another way)
	Advantages and disadvantages with different approaches	Advantages and disadvantages of different approaches to integrating the prototyped system in the workflow discussed or compared.
Provided controls	Different type of control	The tool provides a different type of approach than sound designers are used to.
	Sound designers prefer traditional control	Full control over the sound design of the audio is preferred
Other future developments		Other future optimalisations to the prototype's approach to workflow.
Procedural Audio		
Advantages and Disadvantages		Advantages and Disadvantages of procedural audio, using the participants definition.
Experience		Experience of participant with procedural audio, using their own definition.
Definition	Adaptive audio	Procedural audio is audio that adapts to the game.
	High amount of adaptivity	Procedural audio is a certain threshold of adaptivity.
	Real-time (granular) synthesis	Procedural audio is real-time generative audio.
	High amount of adaptivity or real-time synthesis	There are two types of procedural audio: a threshold in adaptivity and real-time synthesis.

	Unsatisfied with definition	Interviewee is unsatisfied or unsure of their definition.
Industry Application		Are procedural techniques underused or overused, and why?
User Interface		
Understandability		The understandability of the interface of the prototype.
Improvements		Potential improvements to the UI mentioned.
Viability		
Method potential	Method has potential	The proposed method is stated to have potential to be of practical use in the field.
	Potential is project dependent	The interviewee states that its potential might differ per project.
	Addressing reactiveness allows for more linear-type audio	The interviewee states that by addressing reactiveness the method can allow for more linear audio design type techniques.
	Method does not provide enough to be used over middleware	The proposed method does not provide enough to be used over middleware
	Method gives up too much control	The proposed method gives up too much control
Use cases	Potential future use cases	Interviewee provides example(s) of potential future use cases for the tool
	Use cases in past projects	Interviewee provides example(s) of past use cases for the tool
Requirements		Requirements for the method to be viable
Application of method on other audio effects		Interviewee discusses if the method is applicable to other types of audio effects
Other Relevant Data		
Industry relevance		Industry relevance is discussed
Meaning of 'nonlinear'		The definition of nonlinearity is discussed
Horror genre		The horror genre is discussed and what makes it different, if it is different, from other genres.

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