2021

Developing a music composition practice: Exploring the choreography of cymatics

Joshua Jervis
Edith Cowan University

Follow this and additional works at: https://ro.ecu.edu.au/theses_hons

Part of the Composition Commons, and the Other Physics Commons

Recommended Citation

This Thesis is posted at Research Online. https://ro.ecu.edu.au/theses_hons/1567
Edith Cowan University

Copyright Warning

You may print or download ONE copy of this document for the purpose of your own research or study.

The University does not authorize you to copy, communicate or otherwise make available electronically to any other person any copyright material contained on this site.

You are reminded of the following:

- Copyright owners are entitled to take legal action against persons who infringe their copyright.

- A reproduction of material that is protected by copyright may be a copyright infringement. Where the reproduction of such material is done without attribution of authorship, with false attribution of authorship or the authorship is treated in a derogatory manner, this may be a breach of the author’s moral rights contained in Part IX of the Copyright Act 1968 (Cth).

- Courts have the power to impose a wide range of civil and criminal sanctions for infringement of copyright, infringement of moral rights and other offences under the Copyright Act 1968 (Cth). Higher penalties may apply, and higher damages may be awarded, for offences and infringements involving the conversion of material into digital or electronic form.
Developing a Music Composition Practice
Exploring the Choreography of Cymatics

This dissertation is submitted for the degree of
Bachelor of Music Honours

Joshua Jervis

Western Australian Academy of Performing Arts
Edith Cowan University
2021
COPYRIGHT DECLARATION

I certify that this thesis does not, to the best of my knowledge and belief:

(i) incorporate without acknowledgment any material previously submitted for a degree or diploma in any institution of higher degree or diploma in any institution of higher education;
(ii) contain any material previously published or written by another person except where due reference is made in the text of this thesis;
(iii) contain any defamatory material;
(iv) contain any data that has not been collected in a manner consistent with ethics approval.

Signed: ________________________________ Date: 06/11/2020
ABSTRACT

Cymatics is an area of physics popularised by Hans Jenny that observes the influence of sound but more simply vibration on physical matter. When sound is directly applied to a substance, for example, water, the vibrations create kaleidoscopic movement within the medium. Specific variables primarily of pitch, container size, and water volume contribute to creating a variety of geometric shapes. Without sound cymatics does not exist and is, therefore, a visual characteristic of sound itself.

With an investigation into the behaviour and application of cymatics, this research uses the findings of an investigation to develop a ‘choreographical’ language that can be creatively applied to the practice of music composition. With these techniques applied to two compositions exploring cymatics, the works reveal a convergence of sound and visualisation in an amalgamation of music composition, science and visual music practice. This research serves as a manual of choreography of cymatics in the practice of music composition.
I would first like to acknowledge my supervisor Dr, Stuart James. It was your support that enabled me to pursue this project and your guidance and advice that helped me see it through. Thank you for your investment in my personal growth throughout this research, enabling me to achieve goals that I never thought I could. Secondly, I would like to thank my wife, Jaimee. Without your support, I never would have begun the journey that led me here, and without your wisdom, I would have never arrived.
# TABLE OF CONTENTS

COPYRIGHT DECLARATION........................................................................................................ III

ABSTRACT........................................................................................................................................ IV

ACKNOWLEDGEMENTS.................................................................................................................. V

TABLE OF CONTENTS ................................................................................................................ VI

INDEX OF FIGURES .................................................................................................................... VII

INDEX OF TABLES ........................................................................................................................ VIII

1. CYMATICS, FROM SCIENCE TO ART .................................................................................. 1

   (1.1) INTRODUCTION .................................................................................................................. 1

   (1.2) LITERATURE REVIEW ........................................................................................................ 5

   (1.3) RESEARCH QUESTION, AIMS AND RATIONALE .............................................................. 8

   (1.4) METHODOLOGY ............................................................................................................... 9

2. EMPIRICAL INVESTIGATION ............................................................................................. 13

   (2.1) EQUIPMENT AND VARIABLES ...................................................................................... 14

   (2.2) OBSERVATION .................................................................................................................. 18

   (2.3) INDUCTION ...................................................................................................................... 19

   (2.4) DEDUCTION ...................................................................................................................... 19

   (2.5) TESTING .......................................................................................................................... 22

       (2.5.1) Sweep Test ............................................................................................................... 22

       (2.5.2) Pitch Test ............................................................................................................... 25

   (2.6) EVALUATION ................................................................................................................... 30

3. CREATIVE PRACTICE ............................................................................................................. 31

   (3.1) CREATIVE WORK 1 – ‘KYMA’ (2019) ........................................................................... 31

   (3.2) CREATIVE WORK 2 – ‘GENESIS’ (2020) .................................................................... 33

4. CONCLUSION .......................................................................................................................... 36

BIBLIOGRAPHY .......................................................................................................................... 38
INDEX OF FIGURES

Figure 1. A depiction of a metal plate bowed with a violin bow in which the vibrations reveal a pattern......................................................................................................................................................2
Figure 2. Different vibrational patterns created by varied frequencies applied to metal plates...........................................................................................................................................................................2
Figure 3. Image of the cymatic phenomenon in water taken using photography technology......................................................................................................................................................................................2
Figure 4. Historical Harmonograph device that creates drawings by the swinging of pendulums............................................................................................................................................................................................................4
Figure 5. Photo of Robin Fox’s work with an Oscilloscope. The Oscilloscope controls a laser while a long-exposure photo is being taken......................................................................................................................................................................................4
Figure 6. An image of a Cymoscope, invented by John Stuart Reid..................................................................................................................................................................................................................5
Figure 7. The empirical research methodology, showing the cyclical nature of the elements of empirical research...........................................................................................................................................................................9
Figure 8. A model of the link between empirical and practice-led research..............................................................................................................................................................................................................12
Figure 9. Image taken from Tinkercad showing dimensions of water vessel..............................................................................................................................................................................................................16
Figure 10. Script used in software application Arduino to turn on pixel ring..................................................................................................................................................................................................................16
Figure 11. Screenshot of cymatic calibration inside Logic Pro..................................................................................................................................................................................................................18
Figure 12. Image of Max patch used for creating sinewaves..................................................................................................................................................................................................................22
Figure 13. Colour coordination system applied to the categories of the taxonomy of movement..............................................................................................................................................................................................................22
Figure 14. Graph of each sweep test showing the results of the analysis..................................................................................................................................................................................................................23
Figure 15. Average of all the sweep tests.................................................................................................................................................................................................................................................................24
Figure 16A. Test 17 of the pitch test which depicts the slowest increase to the lowest level of movement..............................................................................................................................................................................................................26
Figure 16B. Test 7 of the pitch test, which depicts the fastest increase to the highest level of movement..............................................................................................................................................................................................................26
Figure 16C. An average of all 25 pitch test results displaying a consistent increase overall the pitch tests in their development of the cymatic movement..................................................................................................................................................................................................................27
Figure 17. A screenshot taken from ‘Genesis’ displaying the technique used in organising pitch and sound intensity automation in Logic Pro X..................................................................................................................................................................................................................31
INDEX OF TABLES

Table 1. A summary outlining the five different stages of empirical research methodology.................9
Table 2. MIDI note names and their corresponding frequencies between 30 and 150Hz.......................19
Table 3. Taxonomy of stages of movement through cymatics.................................................................20
Table 4. Cymatic movement according to the taxonomy of movement sampled from the pitch test..........................................................................................................................25
1. CYMATICS, FROM SCIENCE TO ART

(1.1) Introduction

Cymatics is an invisible reality that emanates from all sound. In the late 1960s, a Swiss medical doctor and scientist Hans Jenny coined the term ‘cymatics’ to describe the effects of passing sound as kinetic energy or vibration, through a physical medium such as water. The term is based on the Greek word ḵâma, meaning wave, and is used to illustrate acoustic wave phenomena and sound frequency.¹ The study of cymatics relies on the transference of vibration in the same way our bodies rely on the transference of vibration, though the air, which we interpret as sound. Galileo Galilei was one of the first to record the effect in 1638 where he describes accidentally coming across the cymatic phenomenon as he was scraping a brass plate with a chisel in his text Dialogues Concerning Two New Sciences.² Ernst Chladni is another notable figure in the history of cymatics, who is well known for the invention of a technique that visually shows the various modes of vibration over a rigid surface. These chladni figures³ as they are now known originated as a series of experiments published in 1787 using differently shaped metal surfaces with fine powder sprinkled on top. When the metal surface was vibrated, shapes would appear in the powder, as shown in Figure 1. Chladni’s findings showed that as the pitch rose so did the intricacies of the shapes (see Figure 2.) The chladni figures presented the first documented investigation of cymatics and its functions as we know today.

It was the work of Hans Jenny, often nicknamed ‘the father of cymatics’, who popularised his cymatic method and is widely known for his exhaustive work in the field. Developments in technology such as photography and videography, allowed for the documentation of cymatics in ways that had

not been possible before, as shown in Figure 3. Jenny, who published two volumes of work, first in 1967, and secondly 1972, presented a highly methodical exploration of cymatics, experimenting with a variety of methods and different substances. As technology has improved and become more accessible, cymatics has journeyed from being a science to an art. As cymatics has increased in popularity, cymatic inspired art is becoming more prominent in public exhibition. One example of this is the cymatic inspired tribute to health workers presented throughout Times Square in New York on August 19, 2020. Cymatics has inspired artists, photographers and composers such as Alexander Lauterwasser, Nigel Stanford and Kymat to explore cymatics as part of their artistic practice.

---

**Figure 1.** A depiction of a metal plate bowed with a violin bow in which the vibrations reveal a pattern.⁵

**Figure 2.** Different vibrational patterns created by varied frequencies applied to metal plates.⁶

**Figure 3.** Image of the cymatic phenomenon in water taken using photography technology.⁷

In order to discuss cymatics as art, cymatics can be understood through the lens and theoretical framework of *visual music*. Lewis Jeremy Sykes⁸ uses the definition of *visual music* from the Electronic

---

Arts Experimentation and Research Centre (CEIArtE) as the foundational understanding of visual music in his PhD. CEIArtE offers this definition in a Call for Papers for their 2013 symposium on Visual Music:

The term “Visual Music” is a loose term that describes a wide array of creative approaches to working with sound and image. It’s generally used in a field of art where the intimate relationship between sound and image is combined through a diversity of creative approaches typical of the electronic arts. It may refer to “visualised music” in which the visual aspect follows the sound’s amplitude, spectrum, pitch, or rhythm, often in the form of light shows or computer animation. It may also refer to “image sonification” in which the audio is drawn - in some way - from the image. Sometimes visual music describes a non-hierarchical correlation between sound and image, in which both are generated from the same algorithmic process, while in other instances, they are layered without hierarchy or correlation altogether. Sound and image may be presented live, on a fixed support or as part of an interactive multimedia installation.  

Cymatics is unique within visual music practice as it has a distinctive analogue transference between sound and image. Cymatics is a phenomenon that is always present but not always visible. The simplicity of placing water on a speaker reveals a nature of sound that is seldom witnessed through other methods. In contrast to this, many forms of visual music rely on digital composition techniques, compositing and mixing various forms of media into a single creation.

As contrasting to these digital methods, explorations of an analog-like transference of sound and vibration for audio visualisation can be found in historical examples such as the harmonograph, shown in Figure 4 and more recently in the Oscilloscope work by Australian composer Robin Fox, shown in Figure 5. Cymatics is another such approach that explores an analogue transference of sound and vibration that few visual music practices utilise. The process of cymatics is also unique in that it is dependent on both a sound source and a physical medium to exist. Without sound, a medium such as water cannot form cymatic shapes, and without water, or other physical mediums, sound cannot be visualised.

---

Cymatics is well documented, particularly in the sciences with the work of Jenny and Reid, as mentioned earlier in the introduction. By contrast, there is substantially less literature concerning the cross-disciplinary intersection of cymatics and art, and perhaps even less on cymatics and the practice of music composition, or what Lewis Jeremy Sykes refers to as *cymatic music*. Whilst there is literature concerning the intersection of cymatics and music, there is a definitive gap in knowledge when concerning the crossover of cymatics and the practice of music composition. This study aims to fill this gap in knowledge through an artistic exploration of cymatic techniques driven by the practice of music composition. Through the lens of the empirical investigation, this research includes both documentation and reflection on the creative works possible through the choreography of cymatics outlined in the taxonomy of movements. This research aims to present the findings in a way that they can be recreated by other artists and researchers in the field.

---

(1.2) Literature Review

This literature review aims to discuss authors relevant to cymatics while engaging in the critical discussion of different philosophies surrounding cymatics and cymatics as art. As there is limited academic literature on cymatic music, this review aims to use sources that discuss how cymatics is placed in art through the lens of visual music practice to build a foundation of supporting material for this research.

The work of Hans Jenny is a common primary source and referenced extensively throughout cymatic literature.\(^\text{15}\) Jenny’s comprehensive work in documenting cymatics has become a platform of discovery, innovation and inspiration for scientists and artists. Many have continued Jenny’s work investigating cymatics, its qualities and applications. A notable figure currently advancing cymatic knowledge in the sciences is John Stuart Reid.\(^\text{16}\) Reid is well known for his research in marine biology, specifically how dolphins see using sound. Reid’s work has also re-established cymatics in the 21\(^\text{st}\) century, notably with the invention of the Cymascope, shown in Figure 6. The Cymascope is a device that is highly calibrated to produce sound and capture the resulting cymatic imagery.

![Cymascope](image)

Figure 6. An image of a Cymascope, invented by John Stuart Reid.

---


There are varying views when it comes to the application of cymatics in art. Stephen Lewis, in the chapter “Cymatics as Art”, indicates that only cymatics documented in the same manner as Jenny is scientifically valuable\(^\text{17}\) and that the majority of cymatic art is made by “hobbyists, or do-it-yourself craftsmen who have a spare sheet of metal, a bag of sand, a subwoofer, and a camera.”\(^\text{18}\) While there is a broad demographic of the cymatics community who explore the cymatic phenomenon with simple experiments such as a home-made Tonoscope\(^\text{19}\) or simple speaker arrangements, many artists strive far beyond what Lewis describes as “do-it-yourself” craftsmen in their method, development and virtuosity. Beyond artists who incorporate cymatics into artistic practice, others have documented cymatic based research that extends far beyond Lewis’ generalisations.

‘Resonant Waves’ is an interactive, multisensory cymatic art installation\(^\text{20}\) created by Richard Grillotti. While Grillotti’s work in creating and developing ‘Resonant Waves’ uses a scientific method of documentation Lewis would describe as scientifically valuable, the primary function of Resonant Waves is to present a cymatic installation designed to nurture participation with cymatics that is experiential, explorative and aesthetically driven. Extending beyond Lewis’ understanding of the bridge between science and art in a meaningful way, this work uses the scientific method to create a project which aims to have creative outcomes and which can also be scientifically valuable, as seen by Smith and Dean in their fluid model of research\(^\text{21}\) which is discussed in the methodology.

Multisensory experience, as described in Resonant Waves, is a common sentiment found throughout cymatics and visual music practice. As visual music is concerned with the fusion of sound


\(^{19}\) The Tonoscope is an invention of Hans Jenny that allows the user to sing a tone down a pipe that vibrates a membrane to create cymatic movement similar to the chladni plates.


and image, creating art and environments that blend the senses is commonplace in visual music practice. \[^{22}\] Multisensory experience is often a driving mechanism of visual music practice as the authors of *Visual Music: Synaesthesia in Art and Music Since 1900* explore cross-modal/multisensory experience as an aspiration of visual music. Strick writes:

If synaesthesia represents the unity of the senses, the dream of synaesthesia is the unification of the arts. Over the past century, artists have found ever more powerful means of evoking and provoking the state of synaesthesia, linking color, form and sound in extraordinary fashion. . . . music and visual art truly are united, not only by the experiencing subject, the listener/viewer but by the artists. \[^{23}\]

Strick’s assertion is relevant to the creative practice component of this research as it links cymatics and visual music together in the synthesis described by Strick as music and visual art becoming genuinely united. Lewis Jeremy Sykes also makes this connection of cymatics and visual music in his PhD “The Augmented Tonoscope.” \[^{24}\] The Augmented Tonoscope is a research project that presents an exegesis on the symbiotic relationship between sound and image. Sykes examines many instances of the amalgamation of sound and visual media in his thesis, such as the work of John Whitney Sr\[^{25}\] who was pivotal in early computer animation, Michel Chion who provides a “framework for studying the mutual relationship between sound and image in audio-visual perception” \[^{26}\] and Hans Jenny, as already discussed, is a prominent figure in visual music but specifically cymatics research. Sykes also examines many other figures and philosophy on the nature of sound, forming a greater understanding of the relationship between sound and image.

It is these sources that all discuss cymatics each in their unique way that contributes to cymatic practice and its interpretation. The limitation of not having various sources that precisely define the practice and research is that it can be hard to situate where the research is placed among what has

\[^{22}\] Other installations that blend the senses together include Kyle Andreas (2018), Roger Dannenberg (2005) and Oliver Gingrich (2013) which are referenced in the bibliography.


already been done. The advantage of this is that the research has freedom of design, enabling distinctive interpretation of doctrine and data providing unique pathways of research and findings.

(1.3) Research Question, Aims and Rationale

The question that this research aims to answer is, “How can cymatics be approached intentionally and meaningfully when explored alongside the practice of music composition?” This question practically manifests as an exploration of the scope of the kinetic and visual language of cymatics, creating a method or series of compositional techniques that idiomatically explore such phenomena for the practice of music composition.

This research aims to document how a cymatic practice functions practically. In my experience, many artists do not share their process thoroughly, which leads to frustration and disappointment in cymatic beginners who do not have the background knowledge to find the information they are searching for. Because of this, this research aims to ensure practical knowledge is documented to contribute to the broader body of knowledge on cymatics and to assist other composers and artists interested in exploring this as part of their artistic practice.

This research interacts with cymatics exclusively in a physical way, creating and discussing techniques to apply to the practice of music composition. Although there is a demographic within the cymatics community that use the cymatic phenomenon to demonstrate spiritual science and anthroposophical ideology and teaching, due to the intention and limitations of this research, there will not be any discussion around cymatics and mysticism and their relationships to sound and frequency. This research will also show an honest interpretation of cymatics to ensure that all media shown in this research can be replicated with the information given within this research. Often a common practice in visual media, artists use editing techniques to enhance colour or alter content creatively. There has been no image processing, alteration, colour correction or filtering on any of the cymatic images used in the study.
(1.4) Methodology

To answer the research questions of this investigation, a multi-method approach has been adopted. As described in detail below, this multi-methodological research design uses a scientific and creative method in tandem with one feeding into the other. This research project has been approached firstly through the empirical method, and secondly through a practice-led method. These two phases have been documented in chapters 2 and 3, respectively. Phase one utilises the empirical cycle, which was a method established by Adriaan Dingeman de Groot in 1969, outlining a five-stage process.

Figure 7. The empirical research methodology, showing the cyclical nature of the elements of empirical research.

Table 1. A summary outlining the five different stages of empirical research methodology:

| Observation | Observation is the first stage in this cyclical methodology of investigation. In this stage of testing, an observation is made that initiates an idea for a hypothesis. This observation is allowed to come from a variety of places, for example, a sample of data, a thought, an interesting pattern or an unusual circumstance. |


28 Hazel Smith and R. T Dean, eds. 2009. *Practice-Led Research, Research-Led Practice in the Creative*

An example of an observation might be that fewer black cars are bought in summer than in winter.

**Induction**

Induction is where the researcher formulates a hypothesis to explain the observation. This could be a specific instance to explain how or when the observation happens or an overarching rule that is hypothesised to contribute to why the observation happens when it does. Continuing with the car example above, a hypothesis to explain the observation could be that fewer black cars are purchased in summer because black cars are warmer, resulting in discomfort which biases a customer against a black car purchase.

**Deduction**

In the deduction, it is deduced that if the induction is correct, new data should support the hypothesis if tested. Continuing with the example, the data already shows that fewer black cars are purchased in summer. It was then hypothesised that this is due to black cars being warmer than other cars. It can then be deduced that if the temperature of different cars were tested, black cars would record having higher temperatures than other coloured cars, supporting the hypothesis.

**Testing**

The testing stage tests the idea formulated in the deduction. The results are then analysed using descriptive statistics, for example, charts and graphs, to examine the data then inferential statistics are applied to analyse what the data to either support or contradict the hypothesis. It is important to note that new data supporting the hypothesis does not automatically confirm that the hypothesis is correct. The same is true if the data seemingly contradicts the hypothesis. In the ongoing example, the temperature was taken from 10 white cars, ten green cars, ten yellow cars and ten black cars. A table of all the results was made, which also was used to calculate the average temperature of each unique colour sampled. The average of each colour was taken to create a graph charting all the average temperatures. The graph showed that green cars had the highest temperature. Through inferential logic and reasoning, it is concluded that the data from the test contradicts the hypothesis.

**Evaluation**

The results are then evaluated against the hypothesis and then used to support, update or reject the hypothesis. The data collected in the testing stage can then be used as new observational material to update the hypothesis. The evaluation stage of this methodology is crucial as it can be used to cycle back to the first stage of this cyclical methodology. This enables the researcher to refine the hypothesis collecting more data to either support or contradict the hypothesis. In the example, the data seemingly rejects the hypothesis. The researcher remembers that three of the black cars tested were in the shade while all other cars were in the sun. It is hypothesised that this caused the average of the black cars to be lower than all the other cars sampled. We deduce that if all cars are tested at the same time, and all cars are in the sun, then the data will confirm the first hypothesis. Time is now taken to update the testing model. It is decided that the test will commence between 1:00 PM and 1:15 PM and requiring all cars sampled to have been in the sun since 5 AM. The test is then carried out, and the data extrapolated now shows that black cars were recorded having the highest temperature. This data can be used to support the hypothesis further.
and the cycle may continue as far as deemed necessary until the researcher is content in the findings. At this stage, a researcher may publish the findings supporting the hypothesis. Although the research and the data seemingly confirm the hypothesis, at any stage, another researcher can resume where the first researcher concluded, resulting in a new conclusion confirming or refuting the first researches findings.

Phase two utilises a practice-led methodology designed from Smith and Dean’s fluid model of practice-based and research-based practice\(^{30}\) which also shows the interconnections and logic used to design the multi-method approach to this research and its outcomes. Figure 8 shows the journey that is undertaken in this research from the initial idea through to the final output of this project. At the top of the chart, we see the *idea generation*, which in this case is a study of cymatics in music. Moving to the left of Figure 8, this research selects an *empirical approach* of investigation, which leads to *develop, interpret and synthesise a new idea*. Moving through this section, the research moves to test *the theory empirically*. The output of this section is a *new technique* which is then applied to the creative components of this research. A line is then drawn from the bottom of the academic research across to *develop chosen ideas* inside the practice-led research third. This development leads to *artistic output* and then the *output of documentation of the artwork and its production*.

Using this method of research, two experiments have been designed to answer two observations of cymatic practice that have developed from my previous experience in the practice of music composition. The tests have been designed to output new data supporting the original observations that will be used to extrapolate a taxonomy of movement which will be used as material to build a practice of music composition. After discussion on how to use the new taxonomy of movement as a method for the practice of music composition, two individual works will be discussed in the creative practice, one composed before the commencement of this research and the second composed in light of this research. A discussion of cymatic movement will be discussed using the

---

taxonomy of movement created as an analysis. This analysis will involve both works discussing their strengths and weaknesses according to the taxonomy as well as their success of displaying the choreography of cymatics in an intentional and meaningful way.

Figure 8. A model of the link between empirical and practice-led research.\(^\text{31}\)

2. EMPIRICAL INVESTIGATION

Kyma is a work that I composed in 2019 before the commencement of this research. Kyma was fundamental in my basic developmental understanding of cymatics, which in turn was used as my observation to spark this research. The creation of Kyma had aided the research design in two ways. Firstly, in composing Kyma, I learned a substantial amount regarding the process of cymatics in the practice of music composition. This information was used in the form of assumptions to inform this research creating boundaries for the empirical testing and the creative practice. The first assumption was that the artistic application of cymatics in the practice of music composition was possible. Second, that cymatics in artistic practice functions better with a low-frequency range. With this assumption, 30-150Hz was placed as a limit of exploration empirically and creatively. The third assumption, used as the observation for empirical testing was that cymatics could be controlled using two primary variables, frequency and sound intensity. These two variables are tested independently with the results used in creative practice.

The second reason Kyma was fundamental to this research is that in the formation of this work, the equipment needed to conduct a cymatic based practice of music composition has already been collected and assembled. Having this established setup meant that the research could start further along the journey of cymatic practice. As the practice of music composition relies on the composer to design and build a system to compose and produce cymatics in the practice of music composition, this is a significant step in establishing a personal practice. As I had already been through this process, it also created constraints for the empirical and creative output as they both needed to be able to be tested, performed and recorded using this setup. The rest of the introduction of this Chapter will be discussing the practical elements used in the practice of music composition.
There were many variables involved in producing and documenting cymatics within this research. All the steps between the sound source to the vibrating water, then from the water to the final video or image file, all contributed to the way the cymatics responded and were perceived. The purpose of this section is to outline all of the physical elements in the process to ensure that this research is well documented, and all the results can be replicated.

Software applications Apple Logic Pro (version 10.5.1) and Cycling '74’s Max (version 8.1.5) were used to generate sinewaves. Max was used prominently in the research as it was able to adjust decimal places of frequency, which allowed me to create smooth sinewave sweeps and micro-adjust the tuning of the sinewaves. A limitation I found in Logic Pro that I was unable to adjust the frequency in smaller increments than whole numbers, which created noticeable jumps in frequency when using automation to drive changes in frequency over time. Max has a level of customisation and manipulation of sound that is not found in other Digital Audio Workstations. Although the comparison of Max with traditional DAWs can be problematic as they are very different applications, the level of customisation Max provides cannot be overlooked. Max comes with a steep learning curve as it is a graphical coding environment which is very different compared to the workflow of traditional DAW’s.

By using a third-party audio device driver known as Soundflower, I was able to route the audio from Max to Logic Pro to ensure that I was able to keep the sound intensity consistent irrelevant whether the sound source was from Logic Pro or Max. From my computer, I used a Focusrite Saffire Pro 40 as my interface. The interface output is entered through to a QSC GX5 500W power amplifier. As this power amp has a high watt rating than my speaker driver, I have been careful to ensure the amp is always used well below its maximum gain setting.

The use of sinewaves was applied in both the empirical investigation and the creative works. Sinewaves are a ‘pure’ sound in the sense that they do not produce overtones. Overtones are a quality of sound that musicians and composers rely on for timbral variation in music or the element of music that makes a trumpet sound like a trumpet and a flute sound like a flute. As cymatics behaviour requires
careful application of frequency, other sound sources present a problem of generating overtones that would interfere with the development of cymatic behaviour. Sinewaves are presented as an ideal choice to elicit cymatics movement, as sinewaves are absent of overtone frequencies that could interfere with cymatic behaviour.

*The GX5 power amplifier* makes use of detented potentiometers, or ‘stepped pots’, which has been ideal for setting the output gain to a consistent level,\(^{32}\) ensuring the same response each time. Even micro-adjustments to the gain can change the appearance and behaviour of the cymatics. All these steps have been intentionally fixed, so the only way of changing the output gain is inside the channel strip of the *Logic Pro* software mixer. By doing it this way, this has ensured that any compositional work or testing can be reproduced at a later stage.

The output of the power amp is then sent via a Speakon connector to the side of the speaker housing, which is then internally wired to the speaker driver. The speaker driver is a *Soundstream Picasso P.152 Subwoofer*. This driver was chosen as it was able to drive the low frequencies and the cone which is made out of polypropylene which over a paper or cardboard would last with the occasional spill of water goes on the speaker. There was no available information regarding the frequency response of this speaker driver, but it should be noted that every driver has a different frequency response depending on the size as well as other factors. This means every speaker will have different sound intensity at different frequencies depending on the design.

\(^{32}\) The volume of the GX5 power amplifier was set each time to the 10\(^{th}\) notch on the ‘stepped pot’ each time which was approximately halfway.
The container used in the experiments and the practice of music composition was created by 3D printing a small cylindrical container. This was designed using Tinkercad, shown in Figure 9, which is a web-based 3D modelling platform ideal for beginners which also has the functionality to export files to 3D print. A future objective beyond the scope of this research is to print different container shapes and sizes observing how the cymatics respond, potentially adding a variety of movement to the practice of music composition.

The image capturing process is equally as important as the sound generation, as the position of the light and the camera can severely change the look of the cymatics. For the light, I have used a 24 LED NeoPixel Ring from Adafruit. The pixel ring is wired into an Elegoo Uno board running on Arduino’s open-source Integrated Development Environment. On the Arduino software, I am running a small sketch with the Adafruit NeoPixel library added to apply a single solid colour to the pixel rings.

---

33 An Elegoo Uno board is an after-market copy of the open source genuine Arduino board. These boards connect via USB to your computer where you can upload code or ‘sketches’ to the board to perform the task that was programmed in the sketch. Figure 10 is the an example of sketch that can be uploaded.
which can be seen in Figure 10. The pixel ring is held by a 6mm weighted metal gooseneck with a crocodile clip holding the pixel ring and the weight at the bottom to support the structure.

I am using a Nikon Z6 camera with an FTZ adapter to a Nikon 105mm macro lens. With a powered battery adapter installed, this ensured that there was an endless power supply to remove the need for multiple batteries and to charge. A Mini-HDMI to HDMI cable was used as a live output to an Atomos Ninja V high fidelity monitor/recorder. The Ninja V integration was multi-purpose. Firstly, this removed the need to continually observe the display on the back of the camera body. Secondly, with its primary function as a recorder, I was able to utilise its ability to record straight to a Samsung 1TB EVO internal hard drive. This is advantageous with the ability to record 4K ProRes, which is approximately 1.5GB per minute. This allowed me to record with high quality over long durations and multiple series of tests without having concerns about running out of space on the internal storage card or always moving data to make room for additional footage.

Water volume is another primary consideration in the consistency of cymatic response. I created a method of calibration that I use every time I worked with cymatics, also performing re-calibration every 20 minutes. I created a sub-folder in Logic to perform the calibration. I created a track with a Tone Oscillator installed which is permanently set to 74Hz, and the volume of that channel is permanently set to -13.5dB. With this tone playing, I slowly filled the container with water until the cymatic image was stable and fully developed. Once this ‘tuning’ had been achieved, I muted the channel and proceeded. I also set Output 9 as a master volume which can be adjusted when needed, for example, using a different audio interface that has a slightly different output level. 74Hz was chosen as it is a consistent, stable cymatic image on the setup with a particular volume of water. This aids in replicating consistent responses in the practice of music composition and testing. An image of this process is shown in Figure 11.
Using my previous knowledge from working with cymatics, I made observations of practice that informed how I interact with cymatics in this research. I have found that as a general rule, the higher the pitch, the higher the sound intensity needs to be to produce movement in the water. As a result, I created a boundary of testing for both the empirical and creative research which limited the range of frequency to between 30 and 150 Hertz. Another observation made from my previous work in cymatics is that pitch, and sound intensity are the primary variables that influence cymatic behaviour. It is this assumption which is tested throughout this Chapter.

(2.2) Observation

Figure 11. Screenshot of cymatic calibration inside Logic Pro.
(2.3) Induction

The hypothesis for this empirical phase of the research is that pitch, and sound intensity are the primary variables that influence cymatic behaviour. Firstly, a taxonomy of cymatic movement will be theorised in the deduction stage to enable a quantitative assessment of the experiment. The empirical experiment will establish how changes in pitch and sound intensity influence cymatic behaviour.

(2.4) Deduction

The deduction of my hypothesis is that I will be able to create two experiments that use pitch and sound intensity as independent variables to observe their effect on cymatic behaviour individually. The first test will observe the sound intensity and its influence on cymatic behaviour. This test will involve a frequency sweep between 30 and 150Hz that will remain as a controlled variable throughout the test. The sweep test will run a total of 15 times with each test increasing in sound intensity by 1dB from -40dB to -26dB. Each sequence of the test will be observed to see how the cymatics ‘nodes’, or areas of cymatic activity respond and developed to sound intensity over time.

The second experiment is a pitch test that will test a chromatic scale of 25 pitches from C1 to C3. The notes were calculated to their closest frequency with one decimal placement. This test will utilise sound intensity as the controlled variable as the different pitches are played from -40dB to -25dB over 60 seconds. The 25 pitch tests will then be analysed using descriptive and inferential statistics.
Table 2. MIDI note names and their corresponding frequencies between 30 and 150Hz

<table>
<thead>
<tr>
<th>Pitch</th>
<th>Frequency</th>
<th>Pitch cont.</th>
<th>Frequency cont.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>32.7 Hz</td>
<td>C#2</td>
<td>69.3 Hz</td>
</tr>
<tr>
<td>C#1</td>
<td>34.6 Hz</td>
<td>D2</td>
<td>73.4 Hz</td>
</tr>
<tr>
<td>D1</td>
<td>36.7 Hz</td>
<td>D#2</td>
<td>77.8 Hz</td>
</tr>
<tr>
<td>D#1</td>
<td>38.9 Hz</td>
<td>E2</td>
<td>82.4 Hz</td>
</tr>
<tr>
<td>E1</td>
<td>41.2 Hz</td>
<td>F2</td>
<td>87.3 Hz</td>
</tr>
<tr>
<td>F1</td>
<td>43.7 Hz</td>
<td>F#2</td>
<td>92.5 Hz</td>
</tr>
<tr>
<td>F#1</td>
<td>46.2 Hz</td>
<td>G2</td>
<td>98 Hz</td>
</tr>
<tr>
<td>G1</td>
<td>49 Hz</td>
<td>G#2</td>
<td>103.8 Hz</td>
</tr>
<tr>
<td>G#1</td>
<td>51.9 Hz</td>
<td>A2</td>
<td>110 Hz</td>
</tr>
<tr>
<td>A1</td>
<td>55 Hz</td>
<td>A#2</td>
<td>116.5 Hz</td>
</tr>
<tr>
<td>A#1</td>
<td>58.3 Hz</td>
<td>B2</td>
<td>123.5 Hz</td>
</tr>
<tr>
<td>B1</td>
<td>61.7 Hz</td>
<td>C3</td>
<td>130.8 Hz</td>
</tr>
<tr>
<td>C2</td>
<td>65.4 Hz</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A taxonomy of movement was created with a scale from -5 to 5 to use as a method of analysis. The scale was created using -5 to utilise zero as the middle of the scale. -5 to -1 is primarily used to describe the development from no movement to cymatic emergence. 0 to 5 is used to describe the different cymatic behaviour from 0 being stable and unmoving, and 1 to 5 describing the different stages of movement as the variables are increased. The scale and descriptions were created with preference to qualitative qualities to keep aligned to the primary aim of this research developing a cymatic based practice of music composition.
### Table 3. Taxonomy of stages of movement through cymatics

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Turbulent / Chaotic</td>
<td>The category of Turbulent and Chaotic is used to describe cymatic behaviour that is at the high end of energy with no observable cymatics being sustained over time. Characterised by what appears to be random formations, quickly changing and bouncing water.</td>
</tr>
<tr>
<td>4</td>
<td>Strong Movement / Flickering</td>
<td>Strong movement and flickering cymatics are characterised by a high energy cymatic response, with rapid moving water and images. There is still a discernible cymatic image in the water.</td>
</tr>
<tr>
<td>3</td>
<td>Evolving / Complex Shapes</td>
<td>Evolving and Complex are used to describe stable cymatics shapes that seem to be blending into one another in a kaleidoscopic manner, also used to describe instances where two distinct cymatic images are visible at the same time seemingly on top of each other.</td>
</tr>
<tr>
<td>2</td>
<td>Rotating</td>
<td>Rotating is used to describe a stable cymatic image which is rotating inside the dish.</td>
</tr>
<tr>
<td>1</td>
<td>Small Movement / Pulsing</td>
<td>Small movement and pulsing are used to describe a stable cymatic image that has a little more image than a stationary cymatic image where a small amount of movement or pulsing side to side can be observed.</td>
</tr>
<tr>
<td>0</td>
<td>Cymatics Established, No Movement</td>
<td>Established Cymatics and No Movement is used to describe cymatic behaviour has been established, and the image is clearly visible with strong movement with micro to no movement inside the dish.</td>
</tr>
<tr>
<td>-1</td>
<td>Emerging Cymatics</td>
<td>Emerging cymatics is used to describe the instance where it seems that a clear cymatic image is on the verge of appearing, just needing a little more energy to break through.</td>
</tr>
<tr>
<td>-2</td>
<td>Developing Cymatics</td>
<td>Developing Cymatics is used to describe an instance where cymatic behaviour is appearing in the dish with more energy required to create a strong cymatic image.</td>
</tr>
<tr>
<td>-3</td>
<td>Observable Rings</td>
<td>Observable rings is a category used to describe when a full formation of rings is visible in the water.</td>
</tr>
<tr>
<td>-4</td>
<td>Minimal, Swirls in water</td>
<td>Minimal, Swirls in water is used to describe when the water has transitioned from no movement to slight changed in the movement in the water.</td>
</tr>
<tr>
<td>-5</td>
<td>No Movement</td>
<td>Zero movement noticeable in the water, with only the reflection of the light ring visible.</td>
</tr>
</tbody>
</table>
This Taxonomy of movement will be used as a method of analysis for cymatic behaviour in empirical investigations. The scale was designed to define cymatic movement while also showing the spectrum of vibrational energy required starting from none at -5 and very high at 5. This will aid the descriptive statistical analysis by exposing linear patterns of movement through the different stages of the taxonomy.

(2.5) Testing

(2.5.1) Sweep Test

The sweep test was conducted by utilising a constant frequency sweep between 30 and 150Hz that remained as a controlled variable throughout the test. The sweep ran a total of 15 times with each test increasing in sound intensity by 1dB from -40dB to -26dB. Each test was recorded, and the footage was used to analyse the data from the test. During the early stages of the test, it became evident that the sound intensity was no longer strong enough in the higher frequencies to elicit a cymatic response. Because of this, most of the tests were cut short before reaching the 150Hz. The decision was made at the time of testing for efficiency, also as it was evident that there was going to be no cymatic activity for the rest of the test. In hindsight, this was a mistake as it could have potentially altered the data of the high frequencies towards the end of the test.

The test was conducted using Max and Logic Pro X. As mentioned earlier, Max was used as it is able to create a sine wave using decimal places in frequency. A Max patch, which is shown in Figure 12, was created with three inputs of starting frequency, end frequency and time, which is used to direct the duration of time taken from the first frequency to the second frequency. A time of 500,000ms was used as the duration of time between 30Hz and 150Hz. This enabled a slow, long and smooth sweep between the frequencies. A gain output was used to change the volume through each test.
Each test was then analysed using a spectrum of movement presented in the taxonomy of movement. Each test was analysed between every 10 Hz range between 30 and 150 Hz. The highest energy movement for each section was then recorded. A colour was assigned to each number from the taxonomy of movement scale shown in Figure 13. It is noticeable from Figure 14 that as the sound intensity was increased through each series of the test, the level of cymatic behaviour increased pushing the scale of movement across in a diagonal fashion, due to the low frequencies gaining levels of movement faster than the high frequencies.
The score of each section was then tallied and given an average. The average was then graphed, which can be seen in Figure 15. This sweep test average shows a linear increase of cymatic movement over the 15 tests. The analysis of the vertical, horizontal, the overview and the graph of the averages all support the hypothesis that sound intensity contributes to the control of cymatic movement and behaviour. Each sweep test was recorded and can be viewed in the supporting material folder as well as the YouTube link provided.34

34 Sweep Test YouTube playlist link: https://www.youtube.com/playlist?list=PLRr2NTG2V2c99Xholq287KD8Z7YwI9Nn
Figure 15. Average of all the sweep tests.

(2.5.2) Pitch Test

The pitch test was completed by conducting 25 series of tests increasing pitch chromatically over each test. The system of analysis was different for the pitch test than it was for the sweep test. As the sweep test was directly adding more energy into each increasing over each series, the sweep test was analysed measuring the output of energy as movement from the taxonomy of movement scale. The energy input of each pitch test was the same using a scale of -40dB to -25dB over 60 seconds. This was changed to -30dB to -25dB from test 18 through to 25 as it was taking longer and longer to initiate cymatic behaviour and as a way to observe cymatic behaviour over a longer time. The question that was asked to interoperate this portion of the investigation was “can any given pitch create movement analysed as valuable or consistent according to the taxonomy of movement?”
Table 4. Cymatic movement, according to the taxonomy of movement sampled from the pitch test.

<table>
<thead>
<tr>
<th>-5. No Movement</th>
<th>-4. Minimal, Blur in Water</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Image of No Movement" /></td>
<td><img src="image2.png" alt="Image of Minimal, Blur in Water" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>-3. Rings and Swirls in Water</th>
<th>-2, -1. Basic Developing Cymatics</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3.png" alt="Image of Rings and Swirls in Water" /></td>
<td><img src="image4.png" alt="Image of Basic Developing Cymatics" /></td>
</tr>
<tr>
<td>0. Stable, Strong and Stationary</td>
<td>1. Small Movement and Pulsing</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td><img src="image1" alt="Image" /></td>
<td><img src="image2" alt="Image" /></td>
</tr>
<tr>
<td><img src="image3" alt="Image" /></td>
<td><img src="image4" alt="Image" /></td>
</tr>
<tr>
<td>2. Rotating</td>
<td>3. Complex/Evolving</td>
</tr>
<tr>
<td><img src="image5" alt="Image" /></td>
<td><img src="image6" alt="Image" /></td>
</tr>
<tr>
<td><img src="image7" alt="Image" /></td>
<td><img src="image8" alt="Image" /></td>
</tr>
</tbody>
</table>
Table 4 shows an attempt to table the different movements found throughout the pitch test. It provides a small indication of the test as best as an image can when depicting movement. Examples of all the categories listed in the taxonomy have been edited into short videos that can be viewed in the supporting material folder and also through the YouTube link provided.\textsuperscript{35} The first row of the table contrasts the progression of cymatic movement, which immerses into the strong and stationary cymatic movement shown in the first image of the second row. The first image on the bottom row shows strong movement, which can be seen by the higher contrast of movement which does not appear to be as delicate as the second row. The last image depicts chaotic or turbulent movement, the highest energy classification on the taxonomy of movement, which can be identified by asymmetric patterns in the water. Each pitch test was recorded and can be viewed in the supporting material folder as well as the YouTube link provided.\textsuperscript{36}

\textsuperscript{35} Taxonomy of Movement YouTube playlist link: https://www.youtube.com/playlist?list=PLRr2NTG2V2c9C8FEAMkQKVNlhxrgF0lk

\textsuperscript{36} Pitch Test YouTube playlist link: https://www.youtube.com/playlist?list=PLRr2NTG2V2c9D2vsoz0H2hQSA1Zr9GBq
Each pitch test was analysed using the taxonomy of movement. Each test was examined every 5 seconds though to 60 seconds, and the cymatic behaviour viewed at that point was recorded. Each test was then graphed. Each test, as seen on the graphs, successfully develops cymatic relevant movement supporting the hypothesis that pitch is a primary element in the development in cymatics. Figure 16A shows the lowest progression of movement in the pitch test, while Figure 16B shows the highest. Figure 16C shows the average of all the tests together showing the linear progression of cymatic behaviour that each pitch was able to display as the sound intensity was steadily applied over time. The supporting material shows the graphs in the supporting material folder.

![Figure 16A. Test 17 of the pitch test, which depicts the slowest increase to the lowest level of movement.](image1)

![Figure 16B. Test 7 of the pitch test, which depicts the fastest increase to the highest level of movement.](image2)

![Figure 16C. An average of all 25 pitch test results displaying a consistent increase overall the pitch tests in their development of the cymatic movement.](image3)
(2.6) Evaluation

Both investigations independently confirmed that pitch and sound intensity could be used to develop cymatic movement according to the taxonomy of movement theorised in the deduction. These results both support the hypothesis that pitch and sound intensity are the primary variables that influence cymatic behaviour. These results also confirm the taxonomy of movement as a manual of cymatic behaviour that can be used and interpreted for creative practice. If I were to repeat any of the experiments, I would update the taxonomy of movement. I found it hard to delineate between emerging and developing cymatics, -1 and -2 on the scale. It would have been better if they were a single category.
3. CREATIVE PRACTICE

This Chapter marks the change in methodology from empirical to practice-led research. Where the empirical investigation gave the tools to approach cymatics intentionally, this Chapter deals with the approach of cymatics meaningfully in the practice of music composition, as the research question states, “How can cymatics be approached intentionally and meaningfully when explored alongside the practice of music composition?”

Throughout the empirical Chapter of this research, a significant portion of the discussion was regarding the behaviour of cymatics. Cymatic behaviour was identified and examined then used as a tool for analysis through the experiments. In this Chapter and the research hereinafter the language regarding the behaviour of cymatic will be shifted. This Chapter will still discuss cymatic behaviour, but with the clarity that choreography provides as a definition for better illustrating how the data of the empirical investigation can be applied to creative practice. During the empirical investigation, the term behaviour was beneficial as it implied observation, whereas choreography suggests the intentional approach to scoring the changes in cymatic movement through time and the deliberate action taken to incorporate this meaningfully and intentionally in the practice of music composition.

(3.1) Creative Work 1 – ‘Kyma’ (2019)

‘Kyma’37 (2019) was the first work that I produced incorporating cymatics into my practice of music composition. Although ‘Kyma’ was composed before the commencement of this research, it is included to provide a valuable comparison to ‘Genesis’ that was composed in light of the findings of the empirical investigation. ‘Kyma’ was fundamental in my developmental understanding of cymatics, which in turn was used to spark this research. Through composing Kyma, I learnt that cymatic movement developed best using low frequencies. This is due to the quality of movement and

37 Kyma can be view through this link, https://youtu.be/DXE9ZiWboCI. Also, by navigating to the supporting material folder.
visualisation produced by low frequencies. As higher frequencies required increased sound intensity to produce cymatic movement, this resulted in a loudness limit that I was not prepared to cross aesthetically and practically. ‘Kyma’ is a work that was composed electronically for one speaker. The knowledge gained regarding high and low frequency and cymatic movement was used as a device to produce cymatic movement and musical accompaniment in the same speaker that did not interfere with one another. This was achieved by producing the musical accompaniment in a higher register than the frequency producing cymatic movement.

An example of this separation of musical content and cymatic movement can be seen at the very start of ‘Kyma’. Music is playing at the beginning of the work that does not evoke cymatic movement. As a low frequency fades, cymatic movement develops into the choreography of the opening section. Section A of ‘Kyma’ is very open harmonically, allowing complete freedom of exploration of the cymatic frequency in the set tonality of the music. Section B starts with the introduction of the cello, which with its more complex overtone structure, causes turbulence in the cymatics. The cello also adds a feeling of movement through the work as well as harmonic development. Section C starts at 2:00 minutes with the fade-in of a new soundscape which indicates a change of direction in the work. A simple arpeggiated chord progression immerses soon after and is played to the end of the work. A solo violin plays a melody that the sinewave controlling the choreography of cymatic counters and harmonises while the arpeggiated chord progression develops through to the end of the work.

‘Kyma’ used a wide dynamic range of choreography throughout the work. The work focuses on achieving strong and stable choreography through all the sections. The most notable section of high energy exploration of the choreography of cymatics happens in section B as the cello adds strong movement and sometimes turbulence and chaotic movement due to the overtone structure of the cello. Section C includes a noteworthy contribution from the sinewave controlling the choreography of cymatics with its contribution to harmony and melodic input in the section. The melodic independence and harmonisation alongside the violin is convincing with its involvement the cymatics has in the musical material of the section.
In light of the impact this research has had on my understanding of the choreography of cymatics in the practice of music composition, there are some things I would alter if I were to approach this composition again. I would approach the implementation of frequency and sound intensity in the software application Max. The significant enhancement of ability and customisation would aid this work by providing precision control of pitch and sound intensity resulting in greater control of the taxonomy of movement. I would also approach the work with a higher focus on being intentional with the choreographical design of each section. As stated before, section A is quite harmonically open. I would approach this section with a focus on frequency sweeps transitioning through the choreography of movement slowly to display the development of the choreography of cymatics as it transitions through the different categories.

Section C already has a high level of difficulty and complexity with its role of melody and harmony within the section. I would approach this section again, focusing on the choreography of cymatics and violin together with more attention to the voice leading. As this section shows how the choreography of cymatics can be a prominent musical element, with the growth of the voice leading this point could be made even stronger. This is not to say that traditional methods of composition should be applied to all melodies controlling the choreography of cymatics, just that if it is indeed the intention of section C it could be revised.

(3.2) Creative Work 2 – ‘Genesis’ (2020)

‘Genesis’\(^{38}\) is a work that was composed for cymatics surround sound (7.1). This is different from ‘Kyma’ which was composed for one speaker. In ‘Genesis’ only the sinewave controlling the choreography of cymatics was sent to the cymatics speaker while the spoken word section and the other musical material was sent to multiple speakers in 7.1 configuration. Section A of ‘Genesis’ incorporates audio from one of the first video presentation of the cymatic phenomenon.\(^{39}\) As this

\(^{38}\) ‘Genesis’ can be view through this link, https://youtu.be/DQuuLjLPpIs. Also, by navigating to the supporting material folder.

\(^{39}\) “Cymatics, Bringing Matter to Life with Sound” (USA: MACROmedia, March 22, 2008), DVD)
spoken word presents an introduction of cymatics, a tone of 52Hz slowly intensifies. As the sound intensity increases, cymatic movement develops and progresses through the entire choreography of cymatics.

The development of the choreography of cymatics of section A starts with no movement which transitions to minimal movement between 0:35 and 0:55 minutes. The next stage of rings can be viewed between 0:55 and 1:55. At 1:55 the rings quickly transition into a stable cymatic pattern which can be viewed between 1:55 and 2:07. The stable cymatics then transitions to rotating between 2:07 and 2:15. The rotating stage finishes at 2:15 as it transitions into a complex and evolving movement. The complex and evolving choreography gradually develops into strong movement and flickering at 2:50. From 2:50 the strong movement intensifies and borders on chaotic before finding and equilibrium at 3:15.

Section B of ‘Genesis’ starts at the end of the spoken word with the gradual entry of an open chord in the strings. This section continues for the remainder of the work. The choreographical approach for the cymatics in this section was to focus on slower transitions in choreography from the various kinds of movement established in phase two of the research, staying within a range of established categories from no movement (0 on the taxonomy scale) to evolving and complex shapes (3 of the taxonomy scale). The slow nature of the strings complements the slow movement of the choreography of cymatics chosen. The idea for this section is that it would accompany the musical narrative in a tightly integrated and complementary way.

Figure 17. A screenshot taken from ‘Genesis’ displaying the technique used in organising pitch and sound intensity automation in Logic Pro X.
I believe that Genesis succeeds in presenting the entire spectrum of cymatic choreography described in the taxonomy of movement. Utilising the entire section of spoken word, the choreography has time to develop slowly through each category showing the viewers all the steps in detail. Section B in ‘Genesis’ explores choreography in a more convincing way than Kyma. I believe this is partly due to the slow-and-steady approach to the exploration of cymatic choreography, which translates to better control and intention, which I believe this work shows.
4. CONCLUSION

This research project proposed the question “How can cymatics be approached intentionally and meaningfully when explored alongside the practice of music composition?” This research showed how cymatics could be approached intentionally by first establishing a language and taxonomy of cymatic movement. Secondly, the empirical investigation tested whether or not pitch and sound intensity independently influence cymatic behaviour. The results of these experiments were then analysed using descriptive and inferential statistics. By quantitatively determining how pitch and sound intensity measurements impact cymatic movement, the reverse also stands true. That is, a composer can choreograph cymatic behaviour by intentionally applying specific pitch and sound intensity levels.

The research then answered how to approach cymatics meaningfully in the practice of music composition in Chapter Three. Firstly, it was discussed in the opening of the creative practice chapter how the change in terminology from behaviour to choreography influences creative practice. It was argued that the deliberate and intentionally considered application of movement and control of choreography translates in creative practice to meaningful application of cymatics within the practice of music composition. Secondly, Chapter Three then analysed two individual compositions using the choreography of cymatics to show the approach to choreographing cymatics in a meaningfully intentional way.

This research has applied techniques that harness the sound, revealing this invisible reality in an intentional and meaningful way. I believe that cymatics can be used as a legitimate form of musical expression in the same way that traditional composition techniques such as melody, harmony and rhythm are used to organise sound in an artistic arrangement. It is this connection the essence of music through vibration and frequency as well as the practice of music composition that makes cymatics a meaningful pursuit in music.

Although there was much that was covered in this research, there are still areas and concepts that I wish to investigate. In future, I would like to experiment with different shaped containers to observe
the difference in the cymatic choreography produced. As the scope of this research did not allow for further investigation into this, I will design containers of different shapes and volumes and run tests of set frequency and sound intensity to observe how the cymatics movement change with the different containers. Other future extensions include adding to the taxonomy of movement. I would like to experiment with wave inference and frequency beating to observe how cymatics behaves with these techniques which could translate to new or extended choreography. Other techniques to explore include using two tones together, for example, building dynamic chords that slowly change though scale degrees, gliding in pitch from one tone through another. It would also be interesting to experiment with the harmonic series, observing how the cymatics respond to bringing out different degrees of a fundamental.

The unique and systematic approach to the choreography of the practice of music composition can be used as a manual of practice for other visual music artists and composers, a model for further testing and investigation of cymatic behaviour. Cymatics is ever increasing in popularity among artists and the public, especially with presentations like the tribute to health works presented in Times Square, New York. I hope this research will encourage others to explore cymatics in the practice of music composition and release their music for the interest and benefit of all.


