Discovering an uncanny world: Cymatics software and the journey to the creation of knowledge within the field of contemporary Cymatics

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Abstract

Creating images out of sound is an ancient idea. Recently, individuals from different scientific and spiritual backgrounds have tried to make it into a (still broadly unacknowledged) field of research called Cymatics. No one knows the exact logics of sound images, but people create a fascination and a tangible connection between the sound and image by means of practices and ideas. The various discourses that exist within the field of Cymatics are what I discuss in this thesis, specifically with regard to the development of the newest Cymatics software: the Cymascope application. First, I use the case of the Cymascope app to discuss the role of software in the field and discourse of Cymatics. Aided by sound theory and a software studies situated affordance analysis I investigate the technical context of the App (as compared to the professional Cymascope). As we undo the app from its black box, we discover a non-live mechanism that makes it appear as if sound is translated into image. Also, we discover hidden discourse strategies enclosed within the design of the app. Secondly, I discuss the social and cultural context with regard to the online expressions through social media and key authors' Cymatics websites about the meaning of sound images within the field of Cymatics. The leading ideas about the meaning of sound images helped shape the Cymascope app to a certain degree. And in turn, now the App has the potential to shape ideas on Cymatics. Current focus on aesthetics will not bring us further in the development of Cymatics nor Cymatics software. I argue that there could be a more interesting and useful place for software within this field of research that would allow for more perspectives and detailed knowledge. This could be achieved by 3 dimensional modelling through software and more openness to findings outside of the academic frame of reference.

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Part 1: Introduction: Modal patterns, assumptions and promises

Playing with re-enactments of ancient sound visualizations

In 1446 a beautiful chapel in Rayonnant gothic style arose in Midlothian near Edinburgh. 213 geometrical patterned cubes decorate the ceiling of the chapel. As discovered in the early 1970s, these decorations display sound images, carved out of stone. A sound image is a literal translation of sound waves into image form (see figure front page). Every frequency has its distinct visual footprint. In the accompanying decorations, a stone-carved angel refers to a note bar with the notes corresponding to the patterned cubes on the ceiling (see figure 1, attachment 3). The Scottish composers and researchers Stuart and Thomas J. Mitchell tried to translate the chapel decorations back to the music it is said to refer to (Mitchell 2011). They used the cubes' tones and the Angel's image's 'instructions' to create an interpretation of what the images could sound like. Sound images like the ones in the chapel are studied by Cymatics[1] experts who position themselves as artists, scientists and hobbyists in the still somewhat rudimentary and undefined 'field' of Cymatics[2]. These experts try to form a tangible connection between the sound and what is created visually by connecting the phenomenon of sound images to scientific fields like psychology, history, chemistry, mathematics, natural sciences, but also spiritual and natural phenomena. One of the first successful attempts to visualize sound by means of scientific methods was made by Ernst Chladni (1756 – 1827), a German physicist and musician sometimes referred to as the father of acoustics. He worked on what would later be called Chladni patterns (see figure 2, attachment 3)[3]. A few centuries later, in the 1950s – 80s, Cymatics expert Hans Jenny started producing Cymatics movies, snapshots and books about the subject, along with more theory on sound and her relation to image based on Chladni's findings.

Ever sharper and more detailed images through modern technologies

Nowadays, the old methods for making sound tangible are still used, though many technological applications have lately entered the Cymatics arena to test their worth in the Cymatics debate. Take for example the countless Chladni tonoscope software that generate Chladni-patterns using mathematical equations (Clark 2013). A state of the art device, invented by current Cymatics experts James Stuart Reid, Annaliese

[1] Also called the field of modal vibrational phenomena. Cymatics is a term derived from the Greek word Kyma, meaning 'wave' and refers to sound waves or vibrations.

[2] Though the history of Cymatics as a scientific subject does not go back a long way, knowledge about the existence of these images is already thousands of years old. For example, Asian monks already used singing bowls filled with water to show the resonance in the rippling water and mandalas were made on the basis of musical ratios.

[3] Chladni researched the different modes of vibration by rubbing a (violin) bow against a plate covered with lycopodium powder. Through the standing waves created by the bow, the powder formed patterns by shifting towards the points on the plate without much vibration (nodal-points and -lines)It should be noted that before Chladni, Robert Hooke (1635 – 1703) had already discovered the wavy-nodal principle, when he ran the bow of a violin along a glass plate and saw the flour on top of the glass plate form patterns, corresponding to the frequency created by the bow, forming the acoustic figures. The patterns were also researched and noted down in an appendix by Michael Faraday (Faraday waves) in 1831, forming an interesting base to experiment with for people like the singer and amateur scientist Margaret Watts Hughes (19th century) and 'father of Cymatics' Swiss medical doctor and natural scientist Hans Jenny (20th century). In short, Chladni is not the inventor of sound images.

Reid and John Stuart Reid, and launched in 2010 is the Cymascope (see figure 3, attachment 3). This technology creates high quality digital stills of vibrating water surface on a plate. It picks up more frequencies than all foregoing sound imaging methods[4]. The Reid's also designed a digital tonoscope application to introduce the patterns they found to a broader audience: the Cymascope app (see figure 5, attachment 3), available on iPhone, iPad and iPod (Cymascope.com 2015).
Regardless of all the scientific and non-scientific findings and applications created for sound images, a scientifically complete answer as to how the images work has not been found yet. Especially the scientific interpretation of the image is problematic (Stephen D. Lewis 2010). There is still no agreement on what the images mean and how they fit within the scientific framework. Soundwaves correspond to each other and work together to create resonance and overtones – it forms incredibly complex structures (Cymascope.com 2015). Predictive modelling is therefore up until now impossible, though every Cymatics expert would dream of finding out about it, as well as discover what the logics behind Cymatics science would mean for mankind.
Because the images' true nature is not known (yet) to man, different groups that are active in the field have used their own discourse strategies to create fascination for the phenomenon. In this thesis I show that Cymatics software is brought to the user as a scientific tool for exploration and gaining understanding about sound images, though actually software is used as a discourse strategy. Apps like the Cymascope app, which I use as a case study, do not explain much about the relation between sound and image at all in a neutral or scientifically correct way.
Investigating the current situation in the subject of Cymatics with regard to the role of new media and their relation to Cymatics discourses is necessary to understand what role Cymatics software could fulfil in the (near) future.

Main question: Software as interpreter and interpreted
It is intriguing to see what role software like the ones mentioned above play in the debate on the meaning and workings of sound images, for they add another layer of interpretation to the already existing translation from moving air to image. To investigate these layers that together with Cymatics discourses constitute the meaning of sound images, I ask the following main question:

How does Cymatics software shape our construction of the meaning of sound images and the surrounding discourses on Cymatics?

To systematically and transparently address the main question, I introduce sub-questions. First I study the technological layer, that is, the newest application in the

[4] Sharper images are possible because the Cymascope uses water instead of sand. Water does not have the boundaries that the other media have; its fluidity makes that one can see *all* the harmonics that hide within the sound (see figure 4, attachment 3), instead of those that resonate with the membrane's tension. Therefore, one can see a way larger part of the existing frequencies in one set of photos[4] than before. Also, cameras have gotten better at filming the high speed process of capturing sound resonance in water since Jenny's research.

field of Cymatics to ground the analysis in the material (and not just discuss statements found in text). I answer the first sub question by performing a perceived affordance analysis of the Cymascope software. I ask the following:

1. How do the Cymascope and Cymascope app function? In what sense do they differ from each other? I mostly focus on the question: What system is hidden beneath the visible and visually focused surface of the app?

Then, to not just focus on the Cymatics tool but also take into account the social meaning of sound images as they are embedded in tools like the Cymascope app, I study how interpretation of the app and the phenomenon of Cymatics is present in the Cymatics discourses:

2. In what way do the creators and online sharers grant meaning and authority to the sound-images in online environments?

Lastly, I connect the Cymatics discourses with the app and ask how they work in conjunction with one another to create meaning.

3. How do the Cymascope app and related software frame the different discourses in the field of Cymatics? How do they shape the discourse and how are they shaped by the discourse?

Together, these sub-questions will help me answer the main question and allow me to suggest directions for future research on Cymatics software. From an academic point of view it is useful to study how software is used in a specific environment and how it is connected to image culture. Furthermore, there is great need to acquire contextual understanding of software and how it functions within niches in our society. With knowledge about how software actively or passively shape the field in which they are used, we can carefully reconsider and revise the role of software as it is used in a certain environment.

Theoretical framework

A software studies approach

Depending on the angle of research, there exist many fields of expertise on sound theory to pick from, like acoustics, music, and physics, but also mathematics, biology and cultural studies. In this thesis I refer to principles from other scientific fields as positions in the overall Cymatics discourse to understand the place of different arguments and principles they are built on (on a basic level). This includes insights from physics, mathematics and cultural studies (new media studies and image culture). The heart of the theoretical framework consists out of theories from the field of software studies, since we focus on software within Cymatics discourse. Software studies is a recently born interdisciplinary field that researches how software systems are in use in cultural and social contexts (Fuller 2008).

I draw upon media theory about computer language (Manovich 2001), the flourishing image culture nowadays (Pauwels 2008) and the notion of the scientific image (Galison 2002, Frankel 2004, de Rijcke and Beaulieu 2014). The last concept is differently used in this thesis than it is by the media authors I just mentioned. Media

scholars Felice Frankel, Peter Galison, Sarah de Rijcke and Anne Beaulieu all discuss 'actual' scientific images and how they are and should be used in scientific research. Frankel states for example: "The visual expression of research is a powerful means of communicating important science, and must gain the respect it deserves. A 'pretty' picture of science is not mere decoration but one that reveals the beauty and substance that is already there" (Frankel 2004 419). Media scholars remind us to be critical about what meaning we grant to images, for "…images deceive. Pictures create artefactual expectations, they incline us to reason on false premises. We are human, and as such are easily led astray by the siren call of material specificity" (Galison 2002 300). Media scholars like Galison and Frankel point at the ever-lasting debate of the place of scientific images in knowledge gathering and display. Sound images are more of an artistic origin, not solely tied to a scientifically situated discourse. Though the context is in this case different, the images have a certain authority of their own. This ties to theory of writer and film scholar Guy Debord, who takes us a step further in discussing the visual spectacle. The images would have created a whole different way of living reality, a materialized autonomous worldview that we humans navigate through (Debord 2002). Blinded by the quality or beauty of the images, people tend to not look beyond how they come to be. Knowing of the "iconoclasm and iconophilia" (Galison 2002 301) debate and the self-authorisation that images carry in themselves, we can be more prudent in studying them. It therefore helps us greatly in answering the main question.

Sound as a literal object of study through new media

Cymatics software not only shapes the discourse on sound images. As I will show, it is also part of discourse strategies and is shaped by various discourses[5]. To connect the Cymatics discourses to the material software-layer, I draw from theory proposed by Professor of modern and contemporary art and media scholar Ann-Sophie Lehmann, as she suggests to analyse software in three contextual fields (2012 157). These are the technical (what software is most prominent), social (conflation of different discourses) and cultural (practices within the field) context.

First I discuss Lehmann's concept of the technical context, which will help define what to research with regard to the software layer and aid in answering the first sub-question. A helpful start is given by the theory affordances, a term coined by ecological psychologist James Jerome Gibson in 1986. He investigated the affordances of natural occurrences as 'action possibilities' in his book *The ecological approach to perception*. Framing sound in terms of affordances makes it easier to understand it as a material thing (which Cymatics is all about). However, partly we have to reject Gibson's view on sound for the following reason. When discussing sound, Gibson states:

[5] Discourse strategies here can be seen as ways to pursue an audience by means of making verbal claims (Gumperz 1982). It must be said that though Gumperz was a sociolinguistic theorist, so he focused mostly on language. In this thesis I also take written (online) claims into account.

"… the transmission of […] sound […] [is] consistent with […] acoustics […], but [it is in fact] of higher order that [has] never been made explicit by other sciences and [has] gone unrecognized" (Gibson 1986 17 -18). Gibson further states that sound is a *characteristic* of the medium air, with air as the surface that lends itself for the sound action. This makes it impossible to see sound as a visible object with affordances according to Gibson, since sound is constantly moving and invisible.
By pointing at sound images, Cymatics experts argue that sound *is* an object that can be made visible (Adams 2015; Jenny 1967; Merrick 2011; Reid 2007; Gadman, Reid, Reid and Reid 2015 on Cymascope.com 2015c; Kljatov 2013). Their insight is built upon the same kind of knowledge that software- and new media studies experts like Lister et al. (2010) and Lehmann (2012) use. That is, sound can be stored in or translated through other media. It can be rephrased in different forms of "materiality" (Lehmann 2012 157)[6]. An example would be sound as stored in digital data (or temporarily in water[7]). Lister et al. (2010 21) already wrote: "The digital principle does not escape the demands of physics or the economic principles of scarcity." This means that the data is still a 'reflection' or 'translation' of sound that can be converted back to soundwaves (in theory!). It explains that neither digital data, nor sound can escape physical reality, as they are part of it and can be heard and seen.

Someone who elaborated on Gibson's theory is expert in design, usability engineering and cognitive science Donald A. Norman (1999). He has suggested in *Affordance, Convention and Design* to use *perceived* affordances theory in the case of software. This is necessary because in software design "[t]he designer cares more about what actions the user perceives to be possible than what is true" (Norman 1999 39). He continues: "affordances, both real and perceived, play very different roles in physical products than they do in the world of screen-based products. In the latter case, affordances play a relatively minor role, "cultural conventions are much more important" (39). Perceived affordances can highlight the true functionality of specific software, and therefore, it is Norman's theory that I will use in the affordance analysis that is to follow. It focuses on the software (the object in which Cymatic images are embedded), the user and the designer. The cultural conventions, or the habits of choosing certain affordances over others because they are more convenient to a person in a certain culture, are discussed in part three of this thesis, since they are responsible for a major part of the software design.

Aspiring to the theoretical heart of sound as a visible object: The main argument of Cymatics experts

Now that we have theorised sound as a physical object and tied it to the software it is displayed in, we can extend our understanding of sound as related to image a bit

[6] We do, however, always need to translate sound into a form that we can measure through another medium, for our ears cannot objectively 'hear' as other media can (though some people have an extremely good hearing, it is still subjective compared to a machine). In that sense, Gibson certainly has a point.
[7] IncredibleScience water droplet experiment https://www.youtube.com/watch?v=qFXIhrDc6Rw

more to fully grasp the concept we're dealing with. With that we also arrived at Lehmann's second and third contextual fields: the social and the cultural. Theories discussed here will guide us to answer the second and third sub-question.
There exist a few different ways to give sound a visual shape, with different methods of display that are based on theories and principles. I chose to describe two of the many possibilities to prove the point on how Cymatics interpret sound. Classical scientific research depicts sound in a sinusoidal mathematical model to measure air compression in time, symbolized by a 'wave patterned' graph (see figure 6, attachment 3). The principle on which sound works is explained in this way, and it helps us search for regularities and rules. This results in a mathematical graph with the frequency shown as a wave.

Since this way of modelling sound is aimed at understanding physical laws, details are left aside. An image like this cannot always be brought back to its original sound-form (unless you have a very clear cut single frequency). According to Cymatics experts, measuring frequencies in sinusoidal waves especially misses the core workings and *real shape* of sound. They take measuring frequencies a step further and promote a more holistic and 'raw' way of understanding the shape(s) of sound, based on theories designed by Jules Antoine Lissajous, Ernst Chladni and Herman von Helmholtz. One of the founding fathers of modern Cymatics, acoustic physicist John Stuart Reid, speeches in 2006 at the International Sound Healing Conference in Santa Fé about the *real* shape of sound. He states that sound is in fact spherical, instead of 'wavy'. Sound is according to him a periodical motion, going back and forth from the centre to the space surrounding it, creating an outer rim of the sphere (see figure 7, attachment 3). This movement causes the outer rim of the sound 'barrier' to tremble (Reid 2007).

To give an example of this, Reid takes the sonic energy that we create with our own voice. This creates a 'sphere' around us. The 3 dimensional bubble has a structure that forms a pattern of the voiced tones and defractions (resonances) (Reid 2007).
So sound images are all built on the principle of making the vibrations visible. By imagining sound in raw 2D and 3D spheres a totally different way of 'measuring' or *showing* frequencies has come to life: measuring by transforming sound into more literal spherical images, more so than the 'wave graphs' that usually roll out of a set formula. 2D depiction happens with help of the Cymascope device, which can catch the delicate and incredibly complex invisible structures of sound (frequencies and resonance)[8]. The Cymatics view on sound therefor puts way more focus on aesthetics and (detailed) visuals than any other field. The focus on aesthetics is an important factor in Cymatics discourses, as we will see in the analysis when finding an answer to sub question 3. Cymatics software counts as a material utterance of the

[8] Forming these detailed structures also means that in theory one should be able to make the translation back from image to sound with great accuracy. However, science did not crack the code yet on how to make the translation back (Cymascope 2016), and one has not discovered yet how to predict the images for as far as I know of.

discourse strategies that are used. Discussing the connection between Lehmann's three contextual fields in the conclusion will lead to answering the main question.

Methods

Affordance analysis of the Cymascope App

I take the Cymascope app as a case study as it is one of the newest applications that builds upon older Chladni tonoscope apps. Since the Cymascope app is made by leading (influential) people within the scientific field of Cymatics, taking the Cymascope app as a case is a logical step. It clearly mirrors the economic and scientific ideas of its designers. The App also sets an example of how to approach Cymatics and makes a statement about what they are worth, especially with regard to aesthetics. Secondly, social media software like YouTube, Facebook, Tumblr and Pinterest are discussed as they are the basic online channels through which the different stakeholders try to get their message across about the meaning of sound images.

Following the sub-questions I first explain how the Cymascope app functions in detail. I investigate Lehmann's technical context in how the app relates to (and deviates from) the professional Cymascope and the scientific Cymatics theory behind the professional device. What does the app 'show' us through the screen? And what hides behind it, in the underlying code and mechanisms of the software? By taking examples of 'perceived affordances' (Norman 1999) of the professional Cymascope and comparing them to the affordances of the Cymascope app I discover how the app is used as a discourse strategy. It expresses ideas about how Cymatics should be interpreted in a clear manner. With a perceived affordance analysis I introduce the argument that a non-live translation is created and that this fact is hidden from the user. Dissecting the black boxed Cymascope application and relating it to the professional device leads us to the first conclusion that in this software Cymatics are primarily seen as an aesthetic phenomenon.

Discourse analysis: The social and cultural context

Then, building on the affordances analysis, I discuss Lehmann's suggestion of the social and cultural context in a discourse analytical approach, with the most important question: In what way do the creators and online sharers grant meaning and authority to the sound-images in online environments? To gain a greater understanding of the contemporary Cymatics world and research the aesthetic focus in depth, more context is to be explained. I start at the scientific and commercial online heart of Cymatics, the Reid family, and spread the search by following the most relevant connected sources and initiatives, following social media trails and promoted links. I took the sharing aspect of Cymatics as a base for the analysis, because in online practices it is well visible how people write about Cymatics in an environment where everyone sees their work (shared thoughts; discourses). Within their (online) practices people communicate and promote this image of Cymatics

and of the meaning that sound images would contain in a particular way. I discover that the strong focus on aesthetics, mediated by software (social media as well as the App), supports the uncanny side of sound images, rather than enabling an easier sharing and forming of new knowledge. Lastly, I explain that the discourses on Cymatics mediated and enhanced by software partly keep the ambiguity within the subject of Cymatics alive, though they also in some respects try to aid a better understanding of sound images. This brings me to conclude that if software would be used with a focus on modelling instead of aesthetics as a first, the field would be able to introduce more fruitful perspectives to gain knowledge about the workings of the beautiful sound images. It seems like software shapes the subject of Cymatics heavily, as it enhances the focus on aesthetics more so than on researching the workings of sound images. Because of this, research and knowledge on Cymatics is controlled by the few behind the software.

Part 2: Affordance analysis: The Cymascope app as a case study

The professional Cymascope and the Cymascope app: a comparison of affordances
Focusing on aesthetics draws much greater attention to the images themselves than to the source they originated from, in comparison to other methods. One could call this a harmonization of sound, which could be seen as an important affordance of sound images. These images create a totally different focus because of this, namely on the vibrations present in every sound, while our ears always tend to differentiate between various sound sources. The Cymascope as well as Cymascope software try to enhance this focus on visuals and aesthetics even more, though they work in drastically different ways. One by means of water as a medium, the other by means of the screen (of a phone).

The app as a visual spectacle
As discussed in the introduction, the professional Cymascope uses water as a medium to translate air pressure into visual water ripples. The affordance of water in this case is that it lends itself to be moved by air pressure and therefore photos can be made of the live sound bubble that occurs as we introduce the sound to the bowl of water. Also, it is the 'surface' of the translation (Lehmann 2012 173). The app, however, is software based and installed on a phone. Therefore, as Norman would say, perceived affordances play a more relevant role than real affordances. It leads our attention to the screen, which is in this case the surface. As blockbuster movies try to immerse us in the action on screen, so does the app try to immerse us in the world of sound images. Within the app we see a same kind of change on the visual aesthetic level as we see in other media. Namely, the visual feedback the app provides prefers "techniques and images over content and meaning" (Darley 2002 102), a change in the mode of spectacle that we also see in music videos and mass cinema. This different focus on the images changes our mode of thinking about

them, where the images gain an autonomy of their own. This reminds of the 'society of the spectacle', described by Guy Debord in *The society of the spectacle*:

"**Fragmented** views of reality regroup themselves into a new unity as a *separate* **pseudoworld** that can only be looked at. The specialization of images of the world evolves into a world of autotomized images where even the deceivers are deceived. The spectacle is a concrete inversion of life, an autonomous movement of the non-living. The spectacle appears simultaneously as society itself, as a part of society, and as a **means of unification**. […] The spectacle is not a collection of images; it is a social relation between people that is mediated by images. The spectacle cannot be understood as a mere visual deception produced by mass-media technologies. It is a worldview that has actually been materialized. […] the spectacle represents the dominant *model* of life." (Debord 2002 4, emphasis as in original)

We would be the spectators, gazing at the world of Cymatics that unfolds itself by means of self-authorized sound images that are applicable everywhere and any time (more on this in chapter 3). We could say that the app is a materialized form of social relationships and ideas. Dissecting the elements of the app brings us closer to the worldview (or discourse) it poses upon us. If we start at the real affordances of the hardware and software, we can say that its surface (the screen) lends itself for finger tapping. The *perceived* affordance here would be that the app encourages a certain use of this tapping. On screen for example, we see a few piano keys[9], and if we press the keys, we hear a piano-like sound coming out of the speakers. Also, at the same time that we hear the sound, a moving Cymascope image appears on screen, in the middle of the screen, a make-believe cause and effect chain, because the images that appear on screen are the ones that are enclosed within the code of the software, instead of being delivered in real time as a visual translation of the users' input. The choice for inserting piano keys as the default operating mechanism is interesting, as is positions piano sounds as a universal phenomenon, something everyone knows. It creates a very familiar visual arrangement to guide the user in experiencing the strange images and their relation to daily phenomena.

A make-believe cause-effect chain: The database behind the sound-to-image translation
Another perceived affordance is that of 'translating' your voice or live music into Cymatics images on screen. But instead of forming the image live as is the case with the water Cymascope, something else happens. The sound that is picked up by the microphone of the phone is compared to the sounds inside a database with set images. These set images have been captured by the creators of the Cymascope. Because of this mechanism, there is an imperfect match with real-time sound.

This has consequences for the way we perceive the sound images and their connection to the real-time sound we want to be translated by the app. The software makes it seem as if a real sound to image translation takes place, by not showing us the database and not discussing it anywhere within the software itself (only on the

[9] Demo: https://www.youtube.com/watch?v=gH53pqAnaCs

website, in one of the last sentences). Worth mentioning is the difference between the pre-installed piano key sounds and the function of recording and translating your own sounds. The piano sounds and related Cymascope images are presumably a just perfect match. That is because the pre-installed sounds might be recordings that were matched to live recordings of piano sound (though we still are not sure about this, since the app does not give us the answer). When we record a live sound and the database is searched for an image that is close to this sound, it can never be a perfect match for two reasons. First, the recording function of a telephone does not have a broad range of frequencies, so it will not be able to record all the tones that you hear in live sound. Next to this, and more importantly, the live sound will always contain overtones (resonance) that correspond with the place where the sound is heard. Due to these disturbances and the special blue print that every sound has when it is made, there is an incredibly small chance that the sound image that would correspond to this is found in the database of the researchers in the exact same shape. As the Cymatics experts themselves insist, sound is everywhere around us all the time and its beauty lies in its complex structures and in its (hard to track) timing. The Cymascope app software hints at an idea of translating back from image to sound. Something that every Cymatics scientist dreams of being able to do.
All in all, the back-end, where only admins are allowed to see and change things (that is, the Cymascope experts and programmers of the software) hides the real workings of the app from users and makes the user believe that the app is performing live translations.

The human and computer cosmology: Shaping software to focus on aesthetics
The app takes our interpretation of Cymatics a step further. The sound to image approximation that takes place within the Cymascope app bares resemblances to the concept of 'transcoding' by media scholar and computational scientist Lev Manovich (2001 63). He poses in *The Language of New Media* that the computer has its own language, which exists next to human culture and language (the plane of meaning). Storing data in a computer and using it according to certain conventions that are created through use of computer language and code, a paradigm is created where the computer cosmology would influence the human cosmology (Manovich 2001). However, Manovich does not elaborate on where and how this influence takes place exactly, only referring to the way computer language (code) and appearance (conventions) change over time in a same way as human culture changes over time. He does not make clear how file size, format and compression (to which he refers as 'code') shape the way we use information on a computer. Also, the two sides that Manovich sketches seem a bit too rigid to me, though of course they shape each other.

When returning to our last perceived affordances point, we can clearly see the difference in the exchange of both 'languages' (that of human meaning/culture and computer code/software) and how they shape each other. On the level of the conventions that are shaped by software and human ideas we see that the 'fake'

cause-effect chain is formed in the software in front of our eyes. The software decides how we can save the data on sound images and how we can display and therefor interpret them. In the algorithm it is described how the link between software and hardware is formed and how it forms the connection between the sound and image (from the database). Also, as software is only visible on a screen, it automatically keeps our focus on the aesthetics, that what is visible.
In short, Cymatics software sketches a more principle-based and rough sketch of how Cymatics work (simulation), while the literal *translations* of sound into image made by the Cymascope sketch a 'real' translation (emulation). With the Cymascope, you only have the spectator and the water translation deciding on the interpretation of the image. With a computer-generated image there is an extra factor that intermeddles in our interpretation: An algorithm is at work behind the scenes. This extra human-computer touch makes the understanding of Cymatics in the case of the Cymascope app really different from the professional Cymascope.

Some thoughts for the future: Software focused on emulating the process of forming sound images?
Saying this, not only 'deceiving' affordances should be highlighted. Sound travels 700 miles per hour and this incredible speed makes that we need to research a lot of movement and 'stills'. Next to enabling analysis of dozens of Cymatics images at the same time, software like the Cymascope app would in theory allow us to make models of sound images in 3D. The professional Cymascope does reproduce the entire sound sphere, though its' screen interface is only able to present a 2D image, a slice of this sphere, to the user. We could dissect 3D sound images (see for example Jason Verbelli 2014) like this through software, which would potentially make the job easier to understand the process of forming sound images from many more different perspectives than just the aesthetic one. It could give a user a more nuanced understanding of how the images work. Generating images digitally (with the goal of predictive modelling) would be a next step in the promising field of imaging sound, since it would mean that we more fully grasp the laws to which sound images listen (as to predict them). Modelling and matching 3D sound images is one of the possible advantages of using software.

Part 3: Online Cymatics practices: Digging for patterns and searching for meaning

Discourses on sound images: authorisation of the 2D image
So why only imitate 2D images when emulating in 3D would possibly be very beneficial? To answer this question we have to delve a bit deeper into the world of Cymatics and return to the three factors by Lehmann introduced earlier. Next to the technical understandings, cultural and social understandings of software use within

the field of Cymatics complete the picture (Lehmann 2012). Ann-Sophie Lehmann wrote her analysis on materiality of digital artefacts and their surfaces and her point is that "we are missing insights into how exactly computer generated artefacts function in technical, cultural and social contexts" (Lehmann 2012 157). Insights in the context of Cymatics applications and devices often remain under the radar, though powerful discourses are at work beneath the designed surface. An example of this ambiguous situation is given by Sarah de Rijcke and Anne Beaulieu, who discussed in *Networked neuroscience: brain scans and visual knowing at the intersection of atlases and databases* (2014) how neuroscientists use brain scans to interpret the workings (and dysfunctions) of the human brain. They state that often these scans "show how these grounds for authority are (too) easily granted to scans, given their complex constitution as digital objects" (2014 2). They wish that more attention is given to the development of a critical view on the media and mediation (Bolter and Grusin 2000) and spacialities (how the phenomenon is symbolically related to how one experiences space) (Lynch 1991; Hine 2008) of the creation and use of these kinds of translations.

This third part of the thesis is directed at discovering the role that software plays in forming discourses on Cymatics through an exchange of technical (instruments), cultural (practice) and social (shared ideas) factors. More software are used than just the Cymascope app, like for example Facebook, Pinterest, Tumblr, and Cymatics websites. Since sound images are most interesting when depicted, and screens give us the means to do that more easily (online), it is logical to find many active websites and social media that discuss them. Sight is chosen above all other senses when discussing digital media (Pauwels 2008), with code as an underlying abstract basis. As Johanna Drucker (2001) has theorized (in Lehmann 2012 178), code is part of the entire series of events that make the digital image material, as well as a complex system of its own. Human (mind) and computer (code) shape the image through an interaction process where they work together from calculation to generation, making an image believable, giving it an authority of its own. By describing how the images get and gain authorization in different discourses, we can investigate what role software takes in the ideas (discourses) that are promoted within the field of Cymatics. Starting at the Cymascope developers, we find a vast and intertwined network of groups and individuals who all have a different way of using and authorizing their ideas about the images by means of software.

How software stimulate ambiguity and clarification

There is a lot of ambiguity when it comes to the meaning that sound images are said to contain. People symbolically fight over gaining authorization on the 'real' meaning of them. As I will argue, intertwined yet polarised discourses are at work in the construction of the meaning of sound images. These meanings are embedded within software designs and exchanged and shaped through software.

Different discourses hold two key concepts, through which ideas are promoted. At one extreme, the images' uncanny side is used as a powerful discourse

strategy to maintain control over the knowledge they would hold. The images are quite 'uncanny', that is to say mysterious, but more so: "strangely familiar" (Freud as cited in Royle 2003 vii). "The uncanny is ghostly. It is concerned with the strange, weird and mysterious, with a flickering sense (but not conviction) of something supernatural […] It is a crisis of the natural, touching upon everything that one might have thought was 'part of nature': one's own nature, human nature, the nature of reality and the world" (Royle 2003 1). In short, it is where the unfamiliar and the familiar, ideas about the natural and supernatural, mysterious and obvious, collide.

On the other extreme, a 'democratization of knowledge' in forming understandings of Cymatics is said to have arisen with help of social media; the unravelling of sound images' true nature(s). The transition since the 1960s that wants to explore the real knowledge behind phenomena (Delanty 2000), grounded in scientific as well as non-scientific endeavours, has also hit the field of Cymatics. "As a result of mass education, the media and technological developments in the post-industrial society, knowledge is more available than ever before and is at the same time more and more a functional necessity. But with this expansion in knowledge has come its growing contestability" (Delanty 2001 24). What Delanty means by that is that if knowledge is shared more freely, it is difficult to keep track of its credibility. This means that a more open stage for speculation and free opinions comes into existence, though also a fragmentation of knowledge and a doubt of what is real knowledge. As we will see, these two in some respects contesting concepts are vital to understand the diverse role of different software within Cymatics discourse.

Scientification and commercialization of sound images

"See the actual geometry of music for the first time on iPad and iPhone!" (Cymascope.com 2015 Music made visible)

"The imagery you will see is not a computer simulation; all the beautiful imagery in the app was created on a physical CymaScope then stored in digital memory for you to enjoy." (Cymascope.com 2015 Music made visible)

Ever since Chladni and others have experimented with visualizing sound aided by scientific methods, a scientific groundwork has been laid for today's scientists to build upon. One of the most well-known research group within the field of Cymatics nowadays could be John Stuart Reid and his research group. They are also the developers of the Cymascope app. Their thoughts on expectations about use of the app are summed up on the Cymascope website, free for everyone to read. On the website, they state:
"[…] the app is useful for experimentation on the relationship between sound and form" (Cymascope: Sound Made Visible 2015a). Moreover, the app would be useful for everyone who "finds pleasure in seeing the beautiful geometry of sound"

(Cymascope.com 2015). The app is promoted as a popular and foremost personal interaction with sound images, made possible on one's very own phone. Also, the app is presented as a tool for learning (about sound images) and 'experimenting' in daily life, for parents, children, teachers, et cetera.
From the price one has to pay to acquire the Cymascope ($10.000) it becomes clear that the Reid family is trying to commercialize Cymatics way more than any other party. They encourage people to produce the images with help of their expensive Cymascope device. The device in this sense is their business card and is promoted as the most fine-tuned and precise way to create the images; a scientifically approved device. They also sell the most beautiful images (on canvas, in digital format, etc.) they discovered with the Cymascope for $45.00. To ask them an online question about their research, a fee of $25.00 is charged.
This all means that the Reid's keep a certain power over their work and over who sees the images. They state that they try to open the world of Cymatics up to a larger audience and share their discoveries, though by this monetization of their findings, Cymatics research remains an exclusive practice.

Another discourse strategy used by the Reid's is that of connecting visual sound theory to knowledge in other fields to create a network. For example, they already work together with NASA (space research), dolphin sonar (oceanography) research, behavioural responses to the images research (psychology) and develop measurements to research sound in pyramids (Egyptology) with help of sound imagery. Also, the Reid's recently started a new field they call the *Mereon Matrix* (Cymascope.com 2015e), where Cymatics are the basis of sound as connected to more or less everything (like string-theory): A clear statement about the importance of Cymatics to explain worldly phenomena and a great opportunity to enlarge their network and credibility. As these images have only recently been connected to so many scientific fields there is plenty of room to philosophize, calculate, connect and experiment. This opening up the multidisciplinary field-approach is perhaps most interesting, as it demonstrates that these scientists take advantage of the still uncanny side of Cymatics and try to get as many angles together as possible to explain and support their theories. One could think that these people have the strongest position when providing the images with meaning. But there are other people than these scientists who practice Cymatics. And they envision the workings of sound images in a drastically different way, as we will see next.

How DIY-Cymatics experts experiment with Cymatics images in an online environment
Since science cannot give all the answers on the workings and meaning of the images and their relation to sound (due to their price tag and scientific focus), people search their answers elsewhere. They do this by sharing their feelings and emotional reactions to seeing and working with the images in an online context.

"And here is some eye candy for you, from a range of DIY scientists and artists from all over the globe. Cymatics is accessible to everybody. I want to urge everybody here to apply your passion, your

knowledge and your skills to areas like Cymatics. I think collectively we can build a global community. We can inspire each other." (Grant 2009 Subtitles and manuscript)

In more open online environments like YouTube, Tumblr, Pinterest and Facebook it is well visible how people write about Cymatics in an environment where everyone sees their work (shared thoughts). When searching for well-known Cymatics experts, it is striking that the list of key authors not only contains physics experts and mathematicians (see appendix I), but also many authors that write about paranormal or spiritual characteristics or connections between Cymatics and nature (and religion). Some scientists cross the natural scientific border, as do spiritualists, to combine scientific methods with holistic, spiritual or philosophical ideas. For example, crop circle photographers search cornfields for images which they believe are formed by frequencies emitted from the cosmos and imprinted in soft ground. Another example is the work of researcher Masaru Emoto, who investigated the effect of sound on water, by freezing water that has been exposed to certain words and music. Each different word seems to create another kind of crystal within the frozen water[10]. Do It Yourself-ers (or non-experts) and artists also work with the images. They go by names like *Modern Health Coach, 432Hz, Cymatics Today* or use their own name. For example, artists on the website Cymatics.co.uk (2016) take photos of the images and use them in installations. These groups contribute to the discourse foremost through symbolism and cultural understanding, aided by image culture, philosophy and mathematics. Providing sound images with meaning is a huge part of Cymatics practices.

Within their (online) practices, people communicate and promote the meaning that sound images would contain in a particular way. Cymatics fanatics reproduce Cymatics images with the sand-plate (Chladni) technique (Stuart Mitchell Music 2007; Nigel John Stanford 2014; Prepond 2015; brusspup 2013; Nightjarflying 2011). People create their own resonant table, use the technique Chladni used or make a digital frequency display by themselves. Also, many experiments with speakers and fluids exist that create (less clear) images (Nigel John Stanford 2014; Snoitar biv 2014; Cymaticsmusic 2010). Cymatic images also become visible in frozen water bubbles, made outside in areas with a temperature of -10 degrees Celsius or less (NightHawkInLight 2014; Ace Jackalope 2014; RandomiFLC 2014). They put their findings online by means of video (YouTube) or images guided by quotes (Facebook, Tumblr, Pinterest) (see for an example image 8, attachment 3).

Sacralisation: How people strive towards a positive and practical image of Cymatics

"If you want to find the secrets of the universe, think in terms of energy, frequency and vibration.
- Nikola Tesla" *(quoted by Brusspup 2013)*

[10] There are some problems with the validity of Emoto's research, though he does bring up the idea that not all Cymatics are balanced and beautiful, which I used as well to prove the one-sided view on Cymatics that is generally represented on the Internet. See Lisa Be (2014) for more authors on this subject.

A more spiritual or philosophical reference to the images is made by people who draw the geometrical shapes and try to explain and discover how geometry is related to sound images in general. Often sound images are related to subjects like religion, nature (see figure 9, attachment 3), learning, ancient knowledge or cultures, mathematical principles, emotion, and the human body (CommonlyKnownAsDom 2012; Daniel Frank 2011; Elspeth McLean 2014). 'Sacred' or 'holy' geometry means to attribute a deeper meaning to numbers and calculations. This ancient Pythagorean belief (based on philosophical statements that are tied to mathematical calculations) says that certain numbers are connected to visuals (named polygons, poly= more, gons=angles), where the polygons "carried even more emotional baggage than the numbers themselves, because they were visual" (Calter 1998 Polygons, Tilings & Sacred Geometry). Geometry is said to be sacred when specific geometric shapes are formed out of proportions that have a symbolic meaning ascribed to them. Churches, mosques, temples and altars are built on these proportions and shapes and it is said that even nature builds itself upon these holy mathematical laws. People that try to understand sound images work by the same line of reasoning.

The connection of religion and ancient cultures to sound and sacred geometry seems to occur in holy books or texts, drawings, carvings and paintings. For example in the bible, as Kirkpatrick (2014) shows in his analysis by connecting the power of creation to the power of the word (where saying something means creating sound):

"In the beginning, God created the heavens and the earth. The earth was formless and empty, and darkness covered the deep waters. And the Spirit of God was hovering over the surface of the waters. And God said, "Let there be light," and there was light." (Bible ESV 2009 Genesis 2:1-17)

The 'word' or 'voice' is also found to be present in ancient Buddhist mantras (see figure 10, attachment 3). Those give us an idea of the healing function of sound found in concentration, self-reflection and relaxation.
Lastly, we are directed way back to the ancient Arabic language and imagery, where the connection of geometry to the word took a central place in representing the world in imagery (see figure 11, attachment 3). Maths was used as the basis for art.

In the case of visual sound images, the repeating shapes that are created in the images are all seen to have a single ground pattern, which is known in older cultures as the 'Flower of Life' (see figure 8, attachment 3). This geometrical shape has been found in many countries all over the world, as is often referred to on social media like Pinterest (Marko Manninen 2015).

The fact that the Flower of life symbol is found about everywhere in the world and in the oldest cultures raises an interest in how this ground pattern of all sound images could be used. First of all, the flower of life is spoken of as a symbol that works protective (devkhalsa 2012), enabling the way for sound images to come with the same characteristics. Also, some frequencies (in sound as well as in image

form) are said to have special (sacred) meanings, like the frequency 432Hz (Ryan Franklin 2013) (as opposed to the standard 440Hz), being in resonance with the frequency of the earth and the cosmos. Since frequencies and sound images are related to the flower of life, they are believed to carry sacred meanings and purposes (Palm 2010). Frequencies are used in meditation, to sleep better (illume in essence 2012) and to revitalize, to enhance states of awareness (TheSpottydogg Reviews 2014). Specific sound images would stimulate personal growth and could 'touch upon' a part of you that needs them, if you look at the images. They can inspire you. Also, it is said that sacred geometry informs us about the building stones of architecture, the universe and nature (golden ratio), and that these shapes contain knowledge about creative as well as destructive power (TheSpottydogg Reviews 2014; Skinner 2009; Grant 2009. Physical matter like sand, water, but also the human body and even ideas (in the form of energy sequences within the nerve system) would react and adjust to the frequencies (See figure 12, attachment 3).

In short, alternative Cymatics experts and amateurs ascribe positive meanings to the images as a discourse strategies. To discover what the effect the images have on the human body and mind, one has to apply them or create them oneself. This creates a very spiritual and self-centred connection between sound and 'human-being'. Next to that, people reach out to historically situated ideas to base their thoughts on regarding the meaning of sound images. With their practices alternative Cymatics experts try to find out about hidden truths that the images would hold, and at the same time refer to Cymatics as unexplainable, God in true form, or something sacral. By doing this, they create a cult around the images. Partly celebrating the freer sharing of knowledge, but also putting the uncanny and personal side of Cymatics at the forefront, which makes scientific exploration difficult and results of effects measurement fuzzy.

The role of different software used within Cymatics practices

Overall, software like social media have either a strengthening or mediating role in shaping the discourses on Cymatics. The sharing aspect of social media like Facebook, Pinterest and others makes that people can more easily share their findings, which could be seen as a democratization of knowledge as Delanty (2001) has described. Not only functions like sharing buttons and the option to 'like' an image or video aid Cymatics fanatics in their sharing-quest. Also the option to publish material for many to see at once should be noted. Furthermore, the deep-seated uncanniness that the images carry with them is reflected in all the discourses that we came across. This 'side' of Cymatics is shared more easily as well via social media and software like the Cymascope app (which highlights the less positive side of democratization of knowledge that Delanty warned us about). In this sense, software strengthen or reproduce the discourses on Cymatics.

Another important point that has to be made is that the screen and option to include pictures and videos as a main item to share offers exactly what Cymatics focus on: 2D aesthetics. Software, visible on screen and widely used, makes it easy to

focus on the aesthetic qualities of the images. The images, as well as the software used, are reliant on aesthetics as a discursive frame and in this sense, the focus on aesthetics is maintained.
Lastly, though the app is not found in online Cymatics culture as a main attraction[11], the ideas of its makers are clearly visible in its design. The fuzzy criteria on which Cymatics earn their fame are also cultivated by the Cymascope app, by means of the perceived affordances we saw in the first analysis. Here we saw that not only software steer or strengthen the discourses, also software are partly shaped by the discourses. In the end, the three factors described by Lehmann, technical, social and cultural, lean on each other and form an intricate web of statements and footprints aimed at making the most powerful truth statement about sound images.

Part 4: Conclusion: Understanding sound images through software?

Now that the intertwined discourses within the field of Cymatics have been described and the role of software has become clear, we can answer the main question: How does Cymatics software shape our construction of the meaning of sound images and the surrounding discourses on Cymatics?

How the Cymascope App and social media shape Cymatics discourse
As we found out when performing an affordance analysis, software like the Cymascope app shapes the way Cymatics is presented. The app draws a great deal of attention to the aesthetic qualities of the translations. In doing this, it does not create room to look at sound images from another angle than aesthetics (and literally, no other angle than 2D, since most devices do not lend itself for 3D imaging). Also, by only showing the most beautiful images, extra focus is given to the beauty of the images. Above all, the app is a black box, which is not necessarily beneficial for the understanding of sound images (though one could argue that the app is not meant to be a scientific tool for studying the images). Cymatics isn't ready to make the translation back from image to sound in practice, and the app makes the translation from sound to image more obscure. In this sense, this software does not enhance the practical implications of Cymatics that are so important within Cymatics as a scientific field[12]. The uncanny idea and the beauty of the images are reinforced through software, to appeal to people and win terrain on legitimacy of the Cymascope translations. We can see this with social media like YouTube, Facebook and image websites like Tumblr, where people are relatively free to easily speak up whatever they want about the images. These social media are perfect to focus on

[11] When running the terms 'phone Cymatics' and 'Cymascope App' in a few search engines (Google, YouTube, Pinterest, Tumblr) I found either no results at all or only promotion material related posts without any reactions or shares by non-campaign related people.
[12] It seems that the app does not have that much of a shaping role within Cymatics culture. Neglecting the Cymascope app within the online community (no reviews, no likes, no comments) is telling, though should be researched further.

showing off the images' beauty. Still, these media leave people more free to express their ideas about the images than the Cymascope App does. The App strengthens the peculiar status of Cymatics, while YT strengthens democratization of knowledge to a certain degree, next to the focus on the aesthetic qualities of sound images.

How Cymatics discourse shapes software like the Cymascope app

It appears though, that not only the Cymascope app shapes Cymatics discourse, but this process happens also the other way around. The discourse on the images shapes how people develop software.

At one time, emphasis is put on the empirical mathematical and physical characteristics of sound images, where at other times these insights are connected to more artistic, philosophical, historical and religious ideas to form an understanding of the meaning of sound images. They all come together in the aesthetic focus that is often used to classify and draw attention to the images. The images are used as an authority of their own truth, still trapped in a kind of uncanniness, though many claim to currently work on unravelling their secrets. The Cymascope app appears to be heavily shaped by the set of values that reign the field of Cymatics with regard to design and seems to maintain and enhance this image of Cymatics in a literal 2D version. It is used as a discourse strategy to make the argumentation of the Reid's family seem appealing and correct. Other media like YouTube, Facebook Tumblr and Pinterest seem to be less affected by Cymatics discourse, though they do support the 2D, aesthetic angle by means of their perceived affordances. In the end, the answer to the question of 'why not emulating, only imitating' has foremost to do with the aesthetic qualities of images and their related economic worth.

Implications of the current use of Cymatics software within the field of Cymatics

When the Cymatics discourse is so clear about the importance of a pure translation, and so many intertwined discourses have a say on the (aesthetically related) meaning of the images, it becomes hard to imagine the role software could play within this field. It is understandable that software are not often used in the field of Cymatics at the moment, even though in my opinion it could possibly be of great help.

There is software available that could potentially give us a more detailed and nuanced understanding of the mathematical and natural laws that sound images listen to. A method that I did not encounter in my research that could inspire Cymatics research and sharing practices is that of dissecting sound images through software. It appears that software could take this place, since acoustic machinery is so far unable to image sound in this detailed way. Dissecting the images through software could help to get a better understanding of Cymatics, foremost because it is able to work in three dimensions, instead of imaging in 2D only. This takes us away from aesthetic qualities and focuses more on the movement and intensity of sound pearls, for example. A program developed to dissect or model sound in visual form (using for example high resonance techniques) has much potential (and Cymatics

experts are already working on this behind the scenes, though no publications are yet available). Working with models of sound and imaging 2D Cymatics into 3D shapes could be another idea. Lastly, working with visual cues gives us the insights which describing or writing alone could not. Software could potentially offer the key for dragging sound images out of the uncanny, mystifying cloak of statements.

Future research

Still, it seems that the iconoclasm and iconophilia debate (in Galison's words) that media scholars put their teeth in for so long already cannot be solved yet. And ever renewed Cymatics software seems more likely to contribute to the problem than the solution to 'the right way' of displaying knowledge. The way the images have been captured by various acoustic and digital applications vary tremendously in terms of detail, colour and sharpness. New layers are discovered constantly, which makes interpreting the phenomenon an incredibly complex endeavour, even with software at our side, though also a major challenge and spark for doing holistic, multi-disciplinary research. Future Cymatics practice-related research should most of all focus on developing a way to make sound images comprehensible from an analytical viewpoint. This means for example developing software that enables one to play with numbers, ratios and images.

From a software studies perspective it is important to further question the use of software in the subject of Cymatics in a critical way. More in-depth studies are needed to further explore the impact using software has on a developing field like that of Cymatics. Also, studying how software is developed within and for Cymatics is worth taking a closer look at. Perhaps through means of Actor Network Theory, to create a more holistic view on the use of software in pseudo-scientific subjects like Cymatics. The questions 'what media are used to promote and study Cymatics, and how and why?' remain of great importance within the field of software studies as well as the fresh field of Cymatics.

Discussion

Why I wrote this thesis and how

This thesis hints for a model to connect different disciplines (computational sciences, acoustics, cultural studies, new media studies) in new productive ways. It should be said that the author is schooled in New Media Studies (situated in the humanities branch), and has no background in computational sciences, nor physics, maths or music. Though of course, it is never too late to learn. I have consulted people from these fields to gain greater understanding of the concepts they use to describe sound, music, psychological mechanisms and underlying computer code in applications.

I pinpointed the part in which Cymatics software would get scientific and social value. Most of all, this thesis is aimed at defining where software within this particular field finds itself right now by providing the reader with a critical exploration. I think that I partly succeeded in describing and inspiring this, with

help of many scholars, theories and friends from different fields (special thanks to music expert Marret Vonhoff, mathematics and Cymatics expert Chat Adams, Robert Smit from media studies, Hans Jonker from sociology and Matthew Muscat from game studies for commenting, apart from Stefan Werning for guiding the process overall with very helpful remarks and Michiel de Lange for the useful ideas and comments along the way).

Shortcomings and how I tried to account for them

Partly however, there always remain shortcomings in writing. For example, the affordance theory gives a clear image of some of the underlying principles on which the Cymascope software works. Still, it only focuses on the technical side of software (and a bit on the social). It misses out on the cultural and social background for a great deal, and cannot 'look inside the minds of the designers', only making educated guesses about functionalities. To elaborate on other factors more, I investigated the cultural and social side of Cymatics as tied to software, inspired by a mix of archaeological (digging websites), discourse analytical and anthropological (small informal interviews to learn about the field of Cymatics) approach to research the online context. The weakest point of such analysis is of course its corpus: Where does it start and where does it end? The field of Cymatics is a constantly and very fast growing field. Moreover, it ties itself to more and more other fields, and sometimes even argues that Cymatics is related to all we know. This made it very hard to police the lines on which I built the discourse analysis. Due to the scope of this thesis, I had to focus on specific discourse strategies, and could in no way describe it in its entirety. Lastly, the interpretation of the researcher in general is an important shortcoming (though it can also be an advantage, as it makes one able to emphasize with what others have written). Sometimes it was very difficult to take a step back and see through the discourse strategies that were used in the field. I was tempted at some points to take Cymatics as the subject, though I actually tried to form a critical stance about the *software* used, not Cymatics as a subject in itself. It's difficult to put your own ideas aside and take a more neutral stance. Especially when the discourses are so intertwined and complex, and are said to be applied in any existing field.

Still, after this thorough research and background discussions I think for now my conclusion would still be a good advice to bring the use of new media within the field of Cymatics to a new level of detail. And I hope that the thesis over all sketches a critical side of Cymatics that helps it move forward within a new media landscape without losing its experimental democracy. All in all, my point is not that the aesthetic angle of sound images is useless or wrong, but it heavily colours our understanding of them. We need to think about how to address the design-part of the images, and this always leads to personal taste and individual judging of how to correctly depict them. We should be aware of this happening, especially in the visually-focused software within the field of Cymatics to gain from the insights it can give us.

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***Many usernames I have quoted in this thesis (like Ace Jackalope) are regarded of authors and therefor shown in this bibliography. However, they do not show their first or last name, only their username, so I chose to keep the entire username as author name when referring to posts on webpages or social media**

Exploration interviews

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Appendix I: List of key authors in Cymatics as a scientific field

German physicist Ernst Floris Friedrich Chladni	Invented the Chladni patterns
English chemist and physicist Michael Faraday	Invented Faraday waves and knots (rough explanation for the shapes of the forming of the patterns)
English acoustic engineer John Stuart Reid	Invented and refines the Cymascope
Swiss physicist Hans Jenny	Regarded as the founder of Cymatics and experiments
French Mathematician Jules A. Lissajous	Wrote about acoustics and sound patterns
Japanese Alternative healing scientist Masaru Emoto	Researched the memory of water (crystals) through sound
Dutch crop circle investigator Robert Boerman	Tries to tie knowledge about water together with geometry
German researcher and photographer Alexander Lauterwasser	Built on work of Hans Jenny and Ernst Chladni, presenting the arts, science and mystical side of Cymatics
Scottish composer Stuart Mitchel	Creates music based on the formulas of geometry and of the cymatic images, between art and science
Various Cymatics artists	And they work together with scientists http://www.Cymatics.co.uk/category/artists/
Mereon matrix	A collective that works on the knowledge of sound and 'everything'
Stephen Skinner	Teaches on ancient (holy) books and the connection of nature to geometrical proportions
American physicist, chemist and engineer Robert James Moon	Connects the structure of the table of elements to geometric ground patterns
Chad Adams	Cymatics artist, researcher in mathematics, researches the connection between sound and shape through digital modelling
Richard Merrick	Blends art, science and technology to create new forms of communication; approached sound theory from a physicist angle
Aerospace Institute, University of Stuttgart (Germany)	Researches the memory of water and how memory is formed by cellular vibration
Artist and composer Brian T. Collins	Promotes 432Hz music and tries to discover the effects it has on human wellbeing
Marret Vonhoff	Researches how sound ground patterns influence human states of mind; approaches Cymatics theory from a historical perspective, referring to her roots in ancient India, Egypt and other ancient cultures

*There are more experts in this area, since the field of Cymatics is rapidly expanding and a very individual endeavour. These are only the authors I encountered during my research that popped up in search results and were quoted a lot in online posts on Facebook, Tumblr, Pinterest and YouTube.

Appendix 2: Search terms

Youtube	**Tumblr/Pinterest**
Cymatics	Cymatics
Cymatics drawing	Flower of life history
Cymatics Water (memory)	Geometry basic
Cymascope app	Sacred geometry
Sacred Geometry	Phone Cymatics
Sacred geometry drawing	Sound bubble
Ice bubbles Cymatics	Vesica Piscis
Ice bubbles patterns	Fractals
Phone Cymatics	Chladni patterns
Fractals	Lissajous tuning forks
John Reid Cymatics	Nonpattern Cymatics
Nonpattern	Nonpattern
Chladni experiment	
Nonpattern Cymatics	

Appendix 3: Facebook/YouTube links related to Cymatics

https://www.facebook.com/chad.adams.5648?fref=ts
https://www.facebook.com/Holonmusic432Hz-182873441780834/?pnref=lhc
https://www.facebook.com/CellularEnlightenment/?pnref=lhc
https://www.facebook.com/QuantumShapeshifting/?pnref=lhc
https://www.facebook.com/groups/121377100492/?pnref=lhc
https://www.facebook.com/groups/phigoldenratio/?pnref=lhc
https://www.youtube.com/watch?v=qFXIhrDc6Rw
https://www.facebook.com/techinsider/videos/427022940829401/?fref=nf
https://www.facebook.com/3dCymatics/

Appendix 4: Other Cymatics software

http://secretenergy.com/store/spiritek/cymatic-software/ Chladni pattern emulation
https://www.facebook.com/Cymaticsoftware Same Cymatics software
https://en.wikipedia.org/wiki/Physical_modelling_synthesis on mathematical sound modelling (of instruments)

Attachment 1: Note from author: an important turning point in the research

Critique on the beauty of sound images: non-patterns

Most authors so far, scientists and alternative Cymatics experts, ascribe a great deal of power to the images and use their uncanny side to keep their audience interested. They both focus almost solely on the aesthetic side of the images. It is rather logical to focus on this eye catching quality of the images when researching and making statements about them. As the authors of *The Language of Pattern* state, "Counting is one of the many factors in our building up of an 'internal model' of the perceived world" (Albarn, Smith, Steele and Walker 1971 8). This means that when we want to discover the meaning of something, we first try to recognize a visible pattern. We ask ourselves whether we can quantify something, gathering data that proves us right. Saying this, a focus on aesthetics comes into play, since something repetitive or balanced is logically found to be correct or beautiful. The findings of Cymatics shared in an online context mirror just the above, though they are not as neutral as they sound and show. All the aesthetically correct images I had seen so far had sparked the question if there are unbalanced/ 'ugly' sound images, next to the beautiful and balanced ones? Mathematicians and physicists had tried to answer this question, I found out after asking around. Apparently, not every frequency you send through water gives an image like the ones you usually see when searching for Cymatics. Also, some frequencies together form distortion, so an image cannot form. These unbalanced sound images are called 'non-patterns' or in physicist language the constant failing of forming 'standing waves'. Usually, when a pattern is formed, harmonic interference takes place, where a rhythm is formed by two corresponding opposite motions with a same maximum and minimum point in time and space (Merrick 2011). When the creation of a standing wave fails, the counter-symmetrical motions collapse and no overall pattern is formed, or at least not the typical image we hoped for. As I found out when asking people that are working with and sharing (knowledge on) Cymatics, they all stated that you want to be experimenting with the positive and creating force of Cymatics, not the destructive and failing non-patterns. The non-patterns and unbalanced sound images are ignored, people simply do not speak about them. Not only because a non-pattern is of course hard to 'recognize'. But they are simply not interesting, because they are not as aesthetically appealing and they could possibly even have negative consequences. People believe that non-patterning or unbalanced patterns could eventually even cause damage to physical or mental health. The most beautiful patterns are thus, on the other hand, praised for their creative force and are therefore authoritative. In the end, sound is often thought to be the underlying principle for all movement, creation and growth (cymascope.com; mereon.org) and this message resonates in all posts I've read. What definitely misses in all posts is the 'other side' of Cymatics. Negativity and failed Cymatics are not promoted. The images as related to certain (isolated) frequencies apparently have a strong pull and are more often discussed.

Discussing and sharing them online, connecting them to the past, and creating them yourself, enhances their presence and the meaning attached to them makes them prominent and authoritarian. Software that is now on the market does not support non-patterns either. All Cymatics applications I found are focused on forming patterns in 2D.

Attachment 2: Log Andrea Rhodenborgh

Week	Uren	Taken	Uitgevoerd/commentaar
36	Ma 4 Di 5 Wo 3 Do 5 Vr - Za - Zo -	- Mailen Stefan en Michiel datum/tijd mondeling tentamen - Doornemen handleiding en aanvullen - Richting bepalen; afbakenen - 1 artikel per dag uitpluizen en 600 woorden schrijven	- documenten starten en ordenen - gevonden literatuur schikken - nieuwe literatuur zoeken - Overleg met Marret, Lucas - NewMedia boek h 1
37	Ma 6 Di 4.5 Wo 4 Do 5 Vr - Za - Zo-	- Richting afbakenen - Proef proposal Stefan sturen - Literatuurlijst voorlopig af - Verdiepen in Barthes, objectanalyse en media achreologische methode - cases vaststellen	- gevonden literatuur schikken - nieuwe literatuur zoeken - lezen en samenvatten literatuur - Overleg met Marret, Lucas - Afspraak gemaakt oral exam -afspraak Stefan proef voorstel bespreken
38	Ma 6 Di - Wo 5 Do 3 Vr 3 Za 1 Zo 2	- proposal schrijven - leesanalyses maken	- leesanalyse cymascope en gs, Cymascope/vergelijkbare fenomenen - Leesanalyse affordance analyse - Afspreken Wiktoria en fam. Rhodenborgh -hoofd-,deelvragen en table of content in orde maken
39	Ma 4 Di 1 Wo 6 Do 2 Vr - Za - Zo-	- theoretisch kader maken - methode - leesanalyses uitwerken - planning maken - opsturen voor proeflezen Hans en Marret	- theoretisch kader maken - methode - leesanalyses uitwerken - planning maken - opsturen voor proeflezen Hans en Marret
40	Ma 5 Di 1 Wo 1 Do 3 Vr - Za 2 Zo -	- Proposal sturen en bespreken S en M	- Denken over vervolg thesis
41	Ma 4 Di Wo Do Vr Za Zo	- Proposal herschrijven in bullet points - Artikelen zoeken M - Artikelen lezen en kijken wat bruikbaar is	
42	Ma Di Wo Do	Wachten op commentaar Stefan en bijwonen Spiel	

	Vr Za Zo		
43	Ma 5 Di - Wo 4 Do - Vr 2 Za Zo	- Commentaar Stefan verwerken - Schets maken thesis inhoud en indeling - Uitwerken hypothesen en schetsen duidelijke rode lijn naar hoofd- en deelvragen; theoretisch kader	Goedgekeurd door Stefan! Uitwerken proposal in hypothesen en literatuur Griep
44	Ma Di Wo Do Vr Za Zo	Griep	
45	Ma 5 Di 4 Wo - Do - Vr - Za - Zo -	- Uitwerken theorie geluid en verbinding leggen nieuwe media discussie - beginnen analyse affordances cymascope versus app	
46	Ma 4 Di 5 Wo - Do 4 Vr - Za - Zo 1	Analyse affordances afmaken Geheel lezen en aanpassen	
47	Ma 4 Di 4 Wo 5 Do Vr Za Zo	Verder met analyse culturele niveau, discourse en heilige geometrie link schetsen naar theoretisch concept 'vertaling' van Manovich	
48	Ma 3 Di 5 Wo 2 Do - Vr Za Zo	Hoofd- en deelvragen opnieuw nagaan Lehmann, Lissajous, Manovich uitzoeken en passen in argument Gesprek met Stefan over voortgang (+)	
49	Ma 4 Di - Wo - Do - Vr - Za - Zo-	Rode lijn herontdekken Extra case aannemen om app-bevindingen verder door te trekken: Cymatics software Teksten afstemmen en schrappen onnodige tekst	Trip naar Slovenië, woensdag t/m maandag
50	Ma - Di 10:30 - Wo -	Werken aan affordances analyse Deel 2 verfijnen	

	Do - Vr - Za Zo 2	Boek The language of pattern doornemen en inzichten noteren	
51	Ma 6,5 Di 3 Wo 4 Do - Vr 4 Za 2 Zo -	Deel 2 herschrijven Nieuwe inzichten toepassen gesprek Stefan week 48 en nieuwe literatuur Geheel op elkaar afstemmen/herschrijven	Veel tekst bleek vooral interessant als achtergrondkennis, zodat ik geen fouten zou maken in mijn beredeneringen. Toch heb ik uiteindelijk heel wat geschrapt wat niet direct nuttig was voor het verhaal
52	Ma - Di 5 Wo - Do 1 Vr 2 Za 2 Zo -	Tweede deel herschrijven Auteurs invoegen	Allerlei feestdagen tussendoor
1	Ma 3 Di - Wo 3 Do - Vr - Za 2 Zo -	2de deel en conclusie verfijnen Afbeeldingen invoegen Abstract schrijven Vraagstelling en methoden verduidelijken Mailen naar Stefan	Geveld door de griep
2	Ma Di Wo Do Vr Za Zo	Afwachten feedback Stefan	
3	Ma Di Wo 3 Do 2 Vr Za Zo	Malta/wachten op feedback Stefan Feedback Stefan over inhoudsopgave per email verwerken	Malta
4	Ma Di Wo Do Vr Za Zo	Vakantie	Malta
5	Ma Di Wo Do Vr Za Zo	Feedback inhoudsopgave verder doorvoeren Afspraak maken gesprek Stefan	Voorhoofdsholteontsteking en koorts, bedrust
6	Ma Di		Voorhoofdsholteontsteking en koorts, bedrust

	Wo Do Vr Za Zo		
7	Ma Di Wo 4 Do 3 Vr 2 Za 2 Zo	Doorlezen scriptie en voorbereiden op gesprek met Stefan	Voorhoofdsholteontsteking en koorts, deels opgeknapt
8	Ma 2 Di 4 Wo Do Vr 2 Za Zo	Verwerken uitgebreide feedback Stefan	
9	Ma Di 2 Wo 2 Do 4 Vr Za 3 Zo	Verwerken uitgebreide feedback Stefan Vragen feedback sessie peers	
10	Ma Di Wo Do Vr 3 Za 2 Zo 4	Stukken op elkaar laten aansluiten, lijn van argumentatie controleren Commentaar laten geven door Hans en Robert Lay-out en vorm op orde brengen	
11	Ma 3 Di Wo 2 Do 3 Vr Za Zo	Commentaar verwerken Afbeeldingen invoegen Bronvermelding op orde Inleveren bij Stefan en Michiel	
12t/m 24		Doorlezen en op spelling en inhoud verbeteren Lay out Inleveren Wachten op feedback Feedback ontvangen Bespreking Stefan en Michiel feedback Laatste aanpassingen aan theoretisch kader, methode, inleiding, conclusie en inhoudsopgave	

Attachment 3: Figures

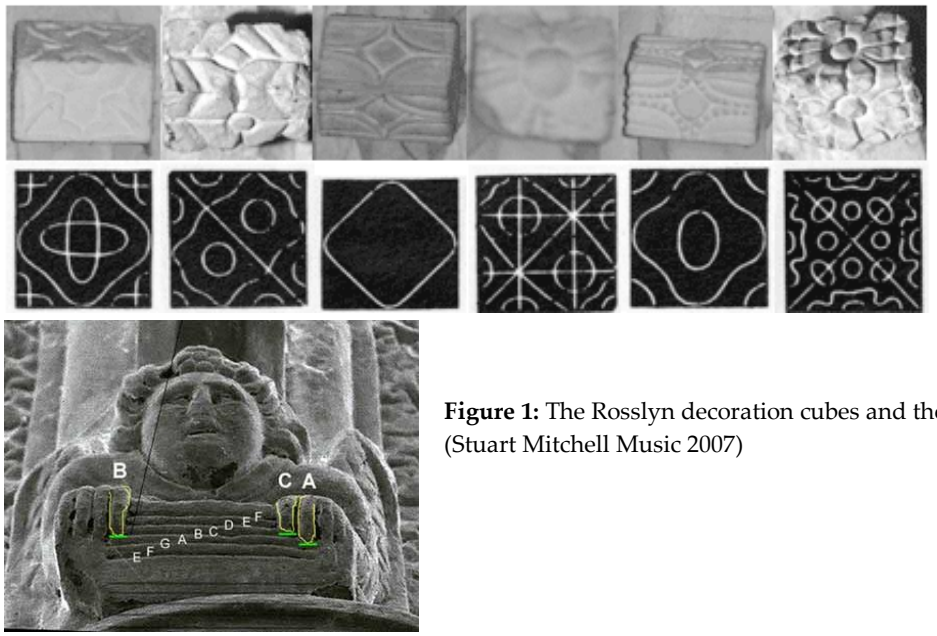

Figure 1: The Rosslyn decoration cubes and the stave angel
(Stuart Mitchell Music 2007)

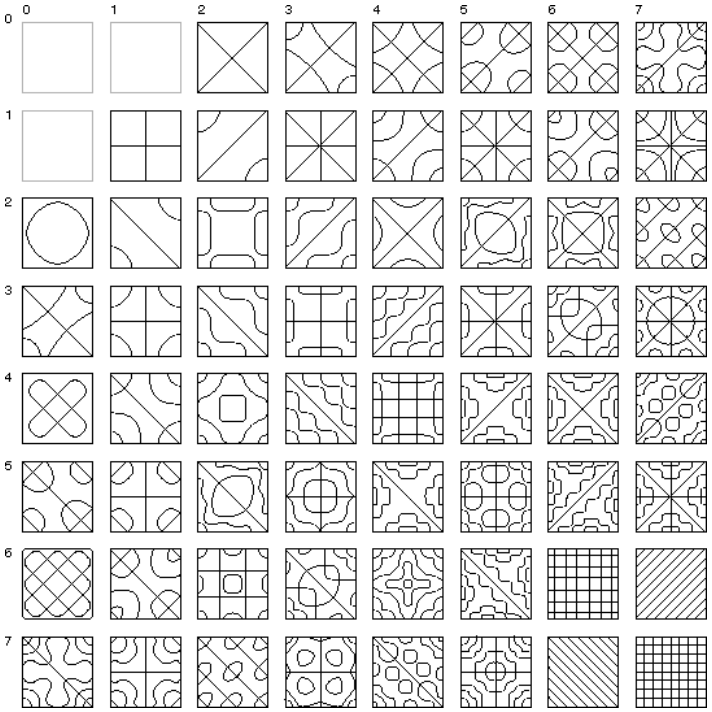

Figure 2: Chladni patterns
(Lehar 2015)

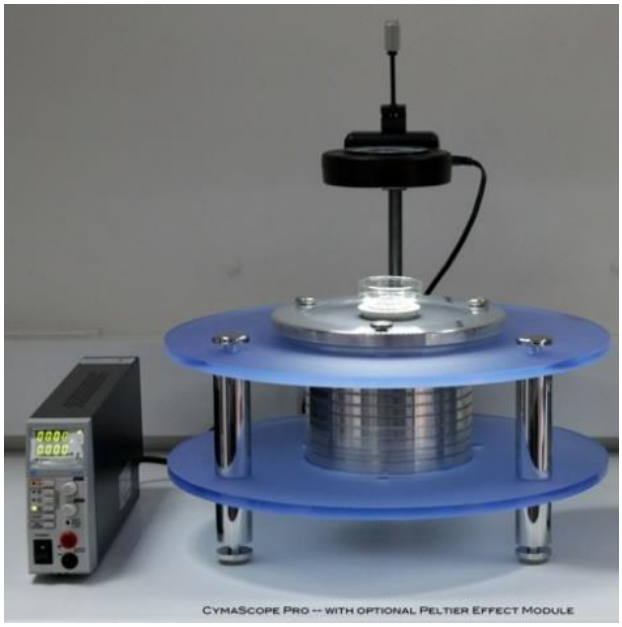

Figure 3: CymaScope Professional model
(Cymascope: Sound Made Visible 2015a)

Figure 4: First, just simple, single frequencies could be translated by help of sand or flour. Now, by use of water and better photography, images and frequencies imaged get more and more complex.
(From upper left to lower right: Hansen and Hansen 2013; MacLean 2015; Cymascope.com 2015b Recorder.sayforard.com 2015)

Figure 5: The Cymascope app
(Cymascope: Sound made Visible App 2015)

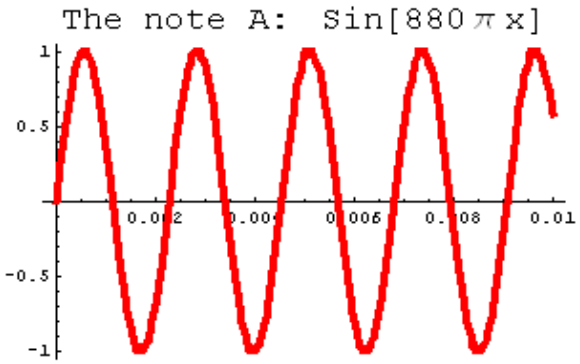

Figure 6: The note A depicted in a graph (Rogness 2016)

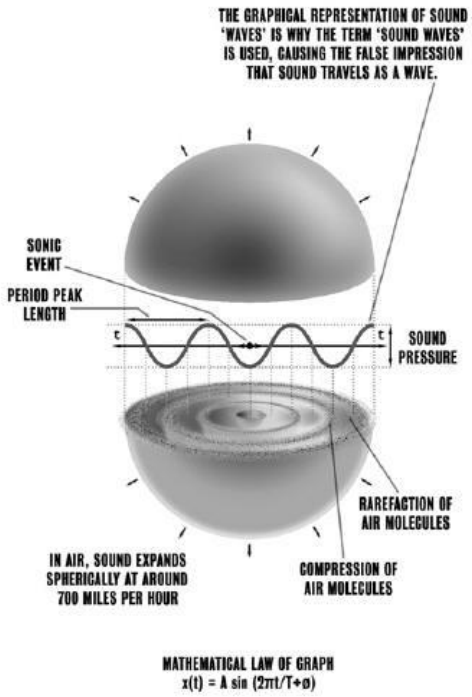

Figure 7: Sound theory developed by John Stuart Reid (Cymascope.com 2015d)

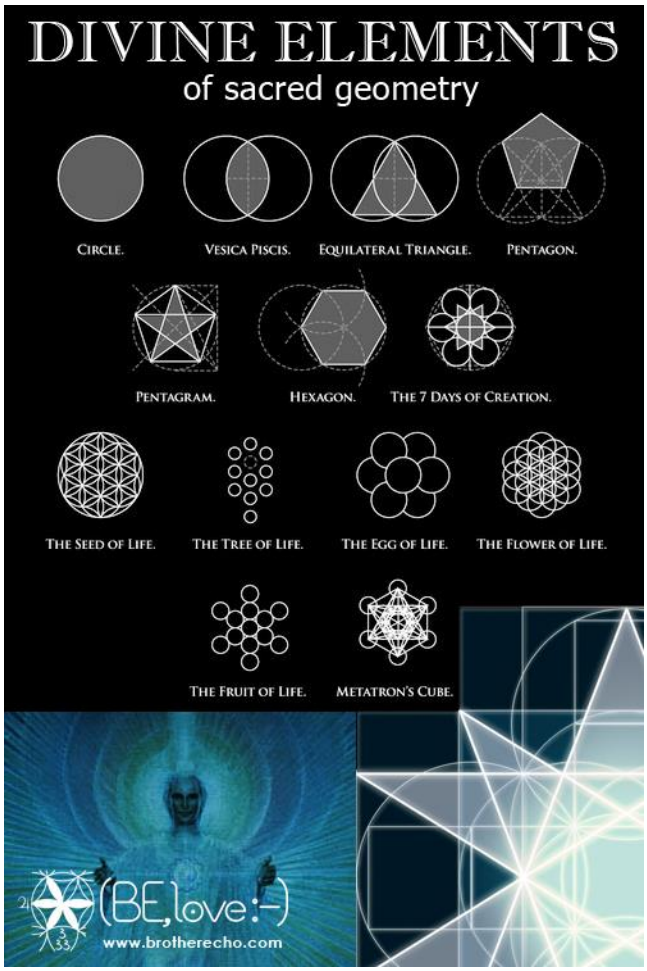

Figure 8: Divine elements in sacred geometry according to a Tumblr post (Tumblr 2016)

Figure 9 Sound image compared to Trilobite
(Cymascope: Sound Made Visible 2015a)

Figure 10: Oh Mani Padme Hum
(Buddhist and Tibetan Jewelry 2015)

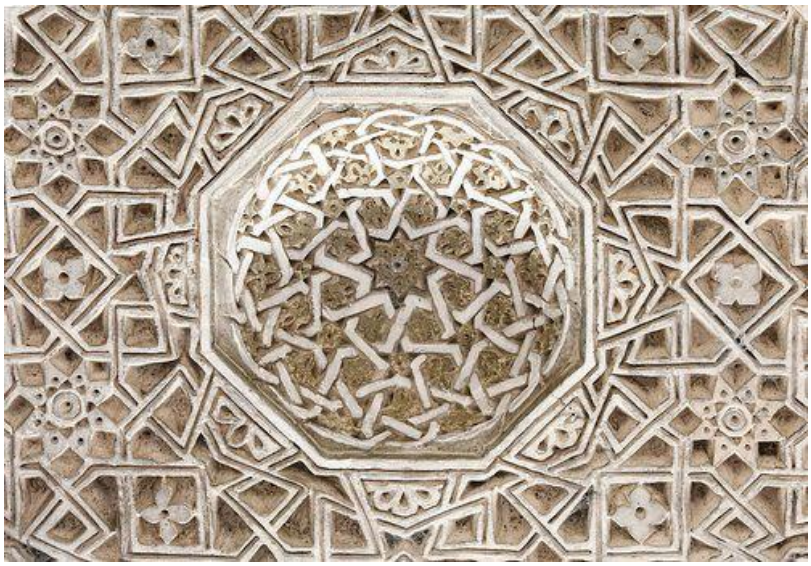

Figure 11: Room of Sultan Uljeitu
(Detengase 2015)

Image 12: Similarities in geometrical shapes between sound images, hand-drawn mandalas, data-analyses, church windows and human DNA
(Return the Planet 2016)