Visualisations of Sound Waves.

The Visual Phenomenon of the Invisible.

A Master's Thesis for the Degree of Master of Arts (120 credits) in Visual Culture

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KOVM12, Master Thesis, 30 credits
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Spring semester 2020

Abstract

This thesis investigates diverse visualisations of sound waves and searches for visual evidence of the aural in the images. The invisible often has its own visual culture even though it has never been seen with a human eye. Due to science and its validations, these visuals are perceived as 'true' images. However, they are ambiguous and can always be questioned about its authenticity. This thesis focuses on the digital illustrations of the sound waves and the sound sculptures, excluding the sonic in the analysis. The selected illustrations and artworks will be investigated focusing on seeing aural senses based on the visual depictions. Since sound is an invisible phenomenon, this thesis will explore the possibilities of seeing the existence or characteristics of the sound in visualisations of sound waves. In this thesis by using relevant theories and methods the visual depictions are examined carefully, and the visuality of sounds is highlighted, based on the significations.

Keywords (5): Sonic materiality, sound waves, sound sculptures, semiotics, inscriptions, gestures, visual culture.

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Introduction

According to the visual culture theorist Nicholas Mirzoeff (1962), visual culture as a field tends to 'picture or visualise existence', including the creation of the images for the invisible.[1] Undoubtedly it includes the visualisation methods of the sound, as the sound is an invisible phenomenon. In the opening of 'Vision and Visuality' the American art critic Hal Foster (1955) forms a distinction between vision and visuality accordingly - 'vision suggests sight as a *physical* operation, and visuality sight as a *social* fact'.[2] In this research, I will focus on the visuality of the sound waves, which has a socially accepted visualisation due to the scientific inscription. According to Foster, visuality is constructed with the following questions - 'how we see, how we are able, allowed, or made to see, and how we see this seeing or the *unseen* therein'.[3] Thus, the unseen/invisible/invisibility is a part of visual culture, which is also concerning the sound and the images of sound. In the thesis, I will examine the digital representations of sound waves and sound sculptures which have been created by using the sound wave as the foundation.

Background and Relevance

Before the analysis, one must be introduced to various examples of representations of sound and the main background topic in sound art. The background will provide a broader understanding of diverse sound visualisations and the reason I have chosen sound waves specifically. It is necessary to introduce the general idea of sound art, as the sound sculpture is a part of it. However, the sculptures are rarely presented in silence.

Any visualisation of sound can potentially be an authentic depiction of the sound heard, because there is no explicit image which portrays sound as it is, on the contrary, the image is constructed and lived in society due to scientific validation. As sounds are still invisible, it has led to the creation of diverse representations of sound that are not scientific. Perhaps the most familiar is notation where one sign represents a sound that alters depending on the instrument used and the musician playing the note. The notation is a representation or a translation of music into writing, it

[1] N. Mirzoeff, *An Introduction to Visual Culture*, London, Routledge, 1999, p. 5.
[2] H. Foster, Vision and Visuality, Seattle, Bay Press, 1988, p. ix.
[3] Ibid.

has a long history and is still used today.[4] It is a complex representation, which must be taught and learnt, developed into skills for the musician. It is not understood by everyone, and thus, it cannot be the only representation of sound. There are other multiple ways of how sound can be represented through signs - letters and other written units. For instance, a question mark will signify to the reader the shift of the sound in the voice while reading the sentence, similarly as for the exclamation mark.

Music and sounds are frequently visualised on digital media and are often combined with changing, dynamic colours, depending on the audio depicted. For instance, media players visualise the sound with an abstract form of elements, which are moving in the rhythm. This depiction helps to understand the tempo, volume and rhythm for the sound played, even when it is not heard. Also live performances include sound visualisations through the use of impressive lighting elements in order to emphasise the rhythms, breaks, smaller background sounds or a sudden, ominous guitar solo. Through lighting, the sonic is visualised, and the music or sounds can be understood through these depictions. The vocal is explicitly being visualised through the artist, who is being present on the stage.

Moreover, chromesthesia must be mentioned, which is sound-to-colour synaesthesia. It is a neurological condition when an individual listens to music and unconsciously imagines it in vivid colours. It makes them capable of drawing songs, therefore materialising the sound in a particular method.[5] Most people with this condition take it for granted and believe that everyone can see music in colours. The virtual game 'Synthesia' is using colours in combinations with sounds, basing it on the main elements from synaesthesia, thus helping to learn and remember the mixtures of sound and colour swiftly. From the length of the cube and colour, the user can learn to play an instrument or find it more comfortable.

The previously mentioned sound representations and visualisations are only a few examples from the broad availability. However, I will focus on the sound waves specifically as I am interested in exploring the image of the sound and believe that sound wave illustrations are perhaps the closest depiction of its visual. This phenomenon will be investigated thoroughly in the analysis.

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[4] S. Halliday, *Sonic Modernity*. *Representing Sound in Literature, Culture and Arts*, Edinburgh, Edinburgh University Press, 2013, p. 118.

[5] S. E. Palmer, 'Nautilus What Color Is This Song? Test your inner synesthesia.', *Nautilus* [website], para. 1-4, 2015, http://nautil.us/issue/26/color/what-color-is-this-song, (accessed on 23 February 2020).

The empirical material used in this research is examples from sound art, specifically, sound sculptures. It is a niche division from sound art and is generally about the sound in space.[6] The origin of the sound art roots back to 1913, when the Italian futurist painter Luigi Russolo (1885-1947) proclaimed sound art as a new dimension of art. Rossolo believed that artworks from this field, specifically, installations or sculptures in environments, must include one of the following - speakers, custom-made instruments, noise, sampling or music made by devices.[7] On the other hand, sound sculpture, as a specific division from sound art, by definition is an object, which produces sound, it is the exchange between the visual and music it creates on the place.[8] These two definitions are similar to each other and contrast in the medium exhibited. A sound sculpture can also be defined including other sound-related terms - an audio sculpture, sonic sculpture or as the visual artist Michael Brewster (1947) has defined his work - acoustic sculpture.[9] These sculptures can be both mechanical or engined. The mechanical approach to the sound sculptures is a common characteristic for the well-known sound sculptors, such as the Italian-American artist Harry Bertoia (1915-1978), the Swiss sculptor Jean Tinguely (1925-1991) and artist Zimoun (1977). Their sound sculptures produce sound through engines activating the movement of the materials. Unlike Bertoia and Tinguely, Zimoun creates massive installations, recreating the space in order to transform it into a vast room with the focus on the sound created, where the spectator has an embodied experience of the sound.

On the contrary, the French brother duo, the engineer Bernard Baschet (1917-2015) and sculptor Francois Baschet (1920-2014) encouraged the sound sculpture movement to use only natural sounds, avoiding electricity and electric devices as artwork engines.[10] These sculptures are often placed in nature and include collaborations with architects. The most significant example of a sound sculpture in an open space today is 'The Singing Tree' (2006) by the two architects Mike Tonkin and Anna Liu.[11] It is made out of multiple steel pipes, which make the sound when the wind blows through.

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[6] P. Napolitano, 'About Sonic Art. Between Disciplines Categories', *DIGIMAG* [website], para. 2-3, http://digicult.it/digimag/issue-054/about-sonic-sculpture-between-disciplines-categories/, (accessed on 27 February 2020).
[7] P. Weibel, *Sound Art. Sound as Medium of Art*, London, Center for Art and Media Karlsruhe & The MIT Press, 2019, p. 13.
[8] J. Bosseur (ed.), *Sound and the Visual Arts. Intersections between Music and Plastic Arts today*, Paris, Dis Voir, 1993, p. 80.
[9] Weibel, 2019, p. 23; Bosseur, 1993, p. 80.
[10] Bosseur, 1993, pp. 80-81.
[11] S. Conradt, 'Listen to These 7 Sound Sculptures', *Mental Floss* [website], 2016, para. 1, https://www.mentalfloss.com/article/74466/listen-these-7-sound-sculptures, (accessed on 23 February 2020).

All these examples are significant artworks producing a sound. The objects are impressive both in its visuals and scale, emphasising the appearance of the sonic through its visual observation. It is necessary to be present and hear, because the sound and the visuals are equally important and highlight one another. However, the examples do not depict the scientific image of sound, instead present the diverse relationships between the sound and the object. Alternatively, I have chosen to explore the sound sculptures, which have a strong scientific foundation. A few examples include sound when exhibited, yet I will analyse them in silence. While the typical sound sculpture produces sound, the empirical material of my choice allows the viewer to observe the objects in silence and investigate the sound visually. I believe objects with no audio or sound production are part of sound sculpture movement, as long as it roots within the sonic.

Aim and Research Question

This thesis will analyse diverse visual depictions of sound waves, including visual sound sculptures, which are made rooted in to the scientific inscription of sound. An illustration of a sound wave is a depiction of sound that has been validated through the disseminations of science. These images are mostly representing sound and not visualising it. Also bearing a significant influence on how we perceive sound visually. I will depart from the scientific foundation by choosing a sound wave as the focus image, and examine more artistic visualisations of sound waves.

I want to emphasise the fact that this research is not about sound art or sound installations, where hearing and listening is a significant part of experiencing the artworks. It is focused on the visuality and human perception of a visual material that activates other senses. I want to understand if it is a plausible way of perceiving the sonic in the images of sound waves. Even though the audio is included in one of the examples I will provide with, the artworks will be investigated in silence.

The main question I will focus on is how a sound is visualised through a sound wave and how these depictions signify the existence of sound behind them? A sound wave can represent a sound on digital platforms as well as it can be transformed into an artwork. Analysed will be the two-dimensional inscriptions and their transformation into three-dimensional objects. Generally, I want to see the sound, I want to see the aural depicted in artistic visualisations, I want to see the

sonic characters of it and its depictions in silence. I acknowledge that it is almost impossible to visually understand the sound of a sound wave without hearing it, but my goal is to see the sound when it is muted. The theories and methods chosen for this research will assist me investigating these images and point to the sound that is visible.

Theory and Method

This thesis requires a combination of theories and methods that explores visual depictions thoroughly. The following theories allow seeing more than depicted, however, the methods supply with the consistent structure and attention on visual details.

Intermedia

Intermedia studies are applicable for this research since I will be analysing visual representations of sound and the hidden sonic elements in the sound waves. Intermedia is a term that originated in 1965 by the American composer Dick Higgins (1938–1998), that describes a composition identified by more than one genre or media. It is an artwork, which has fallen in between mediums and 'opening up aesthetically rewarding possibilities'.[12] Intermediality has a long history, and various theorists have been interested in and examining this field specifically. In 'There are No Visual Media' the American image theorist W.J.T Mitchell (1942) states that there is no such thing as pure visual media.[13] Explicitly viewing paintings, photography, and architecture include activation of other sensory perceptions, thus allowing the spectator to experience the object or image through its visuals. While vision has been the dominant sense throughout history, I believe it is still hegemonic today.[14] Not only Nicholas Mirzoeff has affirmed the authority of vision in the past, but also Jonathan Crary, Rosalind Krauss and Norman Bryson in Hal Foster's 'Vision and Visuality'.[15] When we hear something, we want to see where the sound comes from. When we

[12] D. Higgins, 'Intermedia', *Something Else Newsletter 1,* No. 1, 1966.
[13] W.J.T. Mitchell, 'There are no Visual Media', *Journal of Visual Culture*, vol.4, no. 2, 2005, p. 258.
[14] M. Schedel & A. V. Uroskie, 'Introduction: Sonic Arts and Audio Cultures. Writing about Audiovisual Culture', *Journal of Visual Culture*, vol. 10, no. 2, 2011, p. 137.
[15] See J. Crary, R. Krauss, N. Bryson in H. Foster (ed.), *Vision and Visuality*, Seattle, Bay Press, 1988.

smell something, we immediately start to search for it. One sense is giving a signal to the other, thus seeking validation by the eye. Despite the authority vision has over the senses, I believe when the visual media is being investigated, it always includes, as Mitchell has defined - mixed media. It includes tactile and aural, letting the spectator see more than the visual material alone by activating other senses.[16] The German art historian Hans Belting (1935) expands Mitchell's idea on mixed media. Belting investigates the medium and the body critically, as well as taking into consideration not only images but also mental images. Belting argues that images do not exist alone - they are remembered, perceived and projected mental images, carried by the body.[17]

I will focus on analysing the sensory perceptions through the investigation of the visual by using Mitchell's idea on mixed media. I find it relevant to discuss the medium or the body that Belting stresses as crucial, but due to the limitations of this paper, I have chosen to focus on the visual aspect alone. I will refer to Belting but use Mitchell's theory as the foundation. In this thesis, it will provide the ability to analyse aural and tactile by examining the visuals independently. Moreover, 'since there is no such thing as pure visual perception in the first place', I want to expand the visual exploration and search for sonic expressions within these depictions.[18]

Immutable Mobiles

Due to the scientific foundation, in the thesis, I will use a theory that investigates science critically. The French philosopher Bruno Latour (1947) is well-known for the work in the field of science from philosophical perspectives. Latour criticises science as being only validated by relevant institutions in order to be trusted and argues that science must be *social* rather than based on facts. In that case, science would become networked and more effective, and its production was transparent.[19] The development of the theory of sound and technology throughout centuries has led to the possibility for humans to see the sound, not as it is, but how it has been represented visually. According to Latour, visible evidence of a scientific fact is more influential than any

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[16] Mitchell, 2005, p. 257.
[17] H. Belting, 'Image, 'Medium, Body: A New Approach to Iconology', *Critical Inquiry*, vol. 31, no. 2, 2005, pp. 302-319.
[18] Mitchell, 2005, p. 264.
[19] A. Kofman, 'Bruno Latour, the Post-Truth Philosopher, Mounts a Defence on Science', *New York Times Magazine* [website], 2018, para. 19, https://www.nytimes.com/2018/10/25/magazine/bruno-latour-post-truth-philosopher-science.html, (accessed on 10 April 2020).

other scientific utterance. In the article 'Visualization and Cognition: Drawing Things Together', Latour writes about *inscriptions* or *immutable mobiles*, that are two-dimensional illustrations retrieved from three-dimensional processes. It would be difficult for a scientist to make an impact by sharing their experiments with stories. However, it shifts when a graph is provided that represents the experiments and is presented as a part of a written text about the process.[20] Latour names the main characteristics for inscriptions – they are *mobile*; *immutable* when they are moved; on a *flat* surface; *modified* into two-dimensional form; it is possible to *reproduce or recombine*; are a part of a written *text*.[21]

This theory is significant for this research as I will analyse images of sound waves that are immutable mobiles. Even though the sound is invisible, it is presented to the public in illustrations and inscriptions. I will not analyse scientific illustrations of sound waves but believe that any artistic visualisation of it departs from the scientific immutable mobile. Latour believes inscriptions are valuable as they encompass the three-dimensional processes. I will twist it around as I will analyse three-dimensional objects that have been created from the immutable mobiles.

Musical Semiotics

Musical semiotics must be implemented in the thesis in order to see the visualised sonic in the images of sound waves. Theory on musical semiotics elaborates on notation and the auditory perceptions, which limits the usage of it for the investigation of this thesis. Due to these constraints, I will focus on the gestures and implement it in the portrayed sound waves. The Finnish musicologist Eero Tarasti (1948) argues that musical perception should not be only limited to aural expressions and divides musical semiotics into three sections - belonging to the visual sense, the auditory sense and the tactile sense.[22] Since I will be analysing the visual material, I will focus on the visual sense in musical semiotics, which includes gesture, mime, musical movements and touches, from which I will aim attention at the gestures specifically.[23] According to the British violinist and music theorist Naomi Cumming (1960-1990), the

[20] B. Latour. 'Drawing things together', in (ed.) Lynch, M. & Woolgar, S. *Representation in Scientific Practice*, Cambridge, MIT press, 1990, p. 18.
[21] Idid. p. 19.
[22] E. Tarasti, *A Theory of Musical Semiotics*, Bloomington and Indianapolis, Indiana University Press, 1994, p. 4.
[23] Ibid.

performer's attention for the creation of the sound is specifically on the gestures and movements. The action is the movement activating the sound and constructing the performance.[24] This being said, it is necessary to see these gestures visual in sound waves, when the music is discussed behind it.

I believe that the musical gesture is crucial for the development of any sound and is later transformed in a visual form on a sound wave. This theory will provide me with the ability to analyse the gestures in the sound waves that are not seen, yet been visualised in the sound waves. For some examples, gestures will be emphasised in specific sub-chapters, but it will also be used as a tool to search for the sound in the visuals.

In semiotics signs play a crucial role. Therefore it is vital to elaborate on the definition concerning musical semiotics. A sign is a unit, which in collection with other units create music, including the text.[25] Meaning, one note is a sound, a collection of them is music, and both are considered signs. Similarly, in linguistics, where a 'phoneme' is the smallest unit of the word and a collection of phonemes construct a word or a sentence. This allows me to study the sounds, music, as well as text, also perceiving that visualisation of a sound wave encompasses multiple visual depictions of separate units defined.

Methodology

In the thesis, I will analyse artworks through the photographs. Thus, it is necessary to choose a method that allows me to study the decided material through the images. The American art historian and theorist Amelia Jones (1961) in '"Presence" in Absentia. Experiencing Performance as Documentation' writes that performances can be analysed through the various documentations. Moreover, Jones' method has the advantage to watch the performance several times, hence notice additional details.[26] Jones and Latour share similarities - both focus on transferring and exploring three-dimensional processes in two-dimensional images, thus allowing me to work with the visual material and find new aspects and nuances to discuss concerning the focus area. By using

[24] N. Cumming, *The Sonic Self: Music Subjectivity and Signification*, Bloomington, Indiana University Press, 2000, p. 28.
[25] A.van Baest & H. van Driel, *The Semiotics of C.S. Peirce Applied to Music. A Matter of Belief*, Tilburg, Tilburg University Press, 1995, pp. 20-21.
[26] A. Jones, '"Presence" in Absentia. Experiencing Performance as Documentation', *Art Journal*, vol. 65, no. 4, pp. 11-12.

inscriptions and photographs of artworks in the analysis, I am excluding Belting's extension on intermedia, that includes broader discussions of the medium. I am aware that seeing the sound sculptures myself would give me other relevant aspects to analyse, including the lightning, display, atmosphere, and it would contribute to a phenomenological approach for the research. However, as I have stated earlier, I am focusing on the visuals and the sound through the visuals, which are easily accessible from the documentations based on Jones' method.

Furthermore, the structure for the visual analysis for the empirical material must be applied with a method. A coherent structure for analysing the visual elements has been developed by the French literary theorist Roland Barthes (1915-1980). In the chapter 'The Photographic Message' from *Image, Music, Text* Barthes writes about the decoding of photographic messages as denotation and connotation, which is applied to photography.[27] According to Barthes, denotation is a layer of decoding the message; it is a description of the visual elements in a photograph without a further signification.[28] In order to have a more structured system, in this section, I will follow the American art historian Henry M. Sayre's (1948) guidelines of artwork descriptions. I will briefly implement denotation of lines, shape, colour and other visual elements that are necessary to highlight.[29] Furthermore, the other layer of Barthes' method is a connotation that decodes meanings by searching features that signifies the unshown.[30] Since both denotation and connotation are visual decodings of meanings, they depend on the interpreter individually. While there is no pure denotation, connotations, on the other hand, are often constructed culturally and changing over time. I will use this method in order to have a structure of the analysis that will include descriptions of the visual sound sculptures as well as allow me to search for the meanings by examining connotations.

As the primary method, semiotics and musical semiotics will be implemented in the analysis. I will depart from the classical semiotics by the American philosopher Charles Sanders Peirce (1839-1914), who writes on the sign concerning its object, that is an *icon*, an *index* and a *symbol*. Peirce's terms for the method will additionally be used to highlight various visual elements from the depictions connoting the invisible. Peirce firstly explains the sign or

[27] R. Barthes, *Image, Music, Text*, London, Fontana Press, 1977, p. 17.
[28] Ibid., p. 20.
[29] H. M. Sayre, *Writing About Art 5th Edition*, New Jersey, Pearson Education, 2002, pp. 38-50.
[30] Barthes, 1977, p. 17.

representamen that it 'stands for that object, not in all respects, but in reference to a sort of idea'.[31] Particularly the sound wave stands for the sound or the idea or the reference of a sound, that it has been heard and transformed into an inscription. Furthermore, the trichotomy of a sign can be explained. Firstly, an icon refers to its object due to the correlation, resemblance or the general idea of it.[32] Secondly, an index refers to its object, not because of the resemblance, but the direct connection to the object. It can be an individual convention where memory has a decisive role, but it must refer to the imagined or real.[33] Thirdly, a symbol has a connection to its object due to the general idea, which is culturally learned, for instance, numbers and letters that do not identify the object but are learnt throughout time.[34]

While Peirce's theory of classical semiotics is essential to reflect upon, it is necessary to utilise modern theories in musical semiotics. The American ethnomusicologist Thomas Turino (1951) in the article 'Peircean Phenomenology and Musical Experience' implements Peirce's trichotomy, stating that sonic index and icon can often be hardly distinguishable and, same as for the classical semiotics, depends on the individual's past experience. Turino's theory differentiates due to the definition of the symbol, which in musical semiotics, in Turino's mind, can only be defined through the text.[35]

This conceptual framework is crucial because it analyses both visual and aural with an analytical approach. The empirical material will indicate visual details of icons, indexes and symbols where each one of them will potentially signify an aspect of the visual sound. Peirce's trichotomy focuses on the visual material, whereas Turino's on the sonic interpretation of it. I have defined the focus on the visual material where I will exclude the sound, yet, music semiotics must be implemented in order to analyse the inner sound from the text and the sound of the text itself, as it often supplies the meaning of the visual material. Peirce's and Turino's versions of the triad of the sign will provide me with significant visual and aural links to the sound. I will be using this method as a tool to highlight and analyse the sound seen in the visual depictions. Certainly, due to

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[31] C.S. Peirce, 'Logic as Semiotic: The Theory of Signs' in J. Buchler (ed.), *Philosophical Writings of Peirce*, New York, Dover Publications, 1955, p. 99.
[32] Ibid., p. 105.
[33] Ibid., p. 107.
[34] Idid., p. 114.
[35] T. Turino, 'Peircean Phenomenology and Musical Experience', *Karpa 5.1-5.2*, 2012, p. 4, accessed online on https://www.academia.edu/7791169/Turino_Thomas._Peircean_Phenomenology_and_Musical_Experience_, (accessed on 15 Feb 2020); The article used for the thesis is not paginated, thus, I will base the referred page numbers on the downloaded PDF.

the focus on the visual, sound itself cannot be taken for granted. At least if not listened to, it has to be mentioned, analysed and discussed concerning the linguistic layer.

The classical semiotics by the Swiss linguist Ferdinand de Saussure (1857-1913) will be excluded from this thesis. It focuses on linguistics instead, and when implemented in musical semiotics, the signified is hardly definable. I believe Peirce's theory is applicable; it is more adjustable and fruitful and can be twisted around analysing many aspects and relationships, or how various visual elements can signify the presence of sound. Tarasti is one of the theorists who implements Peirce's triad into musical semiotics. However, he does not elaborate on the description of the theory, instead discusses it in classical music semiotics, which in this research is irrelevant. I am confident Turino's theory by itself is suitable. Moreover, I will use only Turnio's definition of the symbol and exclude Peirce's. While the symbols in semiotics stress words and their meanings, Turino's definition implemented in musical semiotics is valuable for analysing the sound and the symbol concerning it, providing the meaning for the sound when it is muted.

Empirical Material

Sonic art is often emphasising the existence of sound through different materials, instead of providing the visualisation itself. Then it requires a phenomenological approach where the body is placed in space that is surrounded by the sound. It does not depict the sound. On the contrary presents it to the viewer, which is not my focus in the thesis.[36] I have chosen to focus on, firstly, more scientific visualisation that depicts the perceived image of sound and, secondly, the visual sound sculptures where the sound is muted, in that manner transforming the two-dimensional inscription into a three-dimensional, tangible object.

Firstly, I will study the digital visualisations of sound waves, which will continue with the analysis of the chosen visual sound sculptures. Science has a significant ground for this research,

[36] There are a few examples worth mentioning. Already in the mid 50'ies, the American composer and artist Alvin Lucier (1931) was interested in sonic vibrations. In his installation 'The Queen of the South' (1972), Lucier places different materials on speakers, thus showing directly the existence of these vibrations. 'Tanz für Insekten' (Dance for Insects) (2010) by the German sculptor Timo Kahlen, shows the presence of sound due to the materials used. Again, the movement of the insect on speakers signifies the sound waves.
The Artist Institute [website], para. 1, http://theartistsinstitute.org/artists/feb-june-2019/alvin-lucier/, (accessed on 20 Apr 2020); *Timo Kahlen* [website], http://www.timo-kahlen.de/soundsc.htm, (accessed on 20 Apr 2020).

yet my interest is to explore more contemporary depictions of sound waves, where the inscriptions have been taken as a foundation.

The empirical material will include the selected sound sculptures by the French artist Gilles Azzaro - 'Barack OBAMA - Next Industrial Revolution' (2013) and 'This is Joy' (2014). I am interested in Azzaro's artworks due to the significance found in the voice as a phenomenon and the intrinsic depiction of the sound wave. 'Barack OBAMA - Next Industrial Revolution' (2013) is a visualisation of a speech by Barack Obama (Fig. 6 & Fig. 7, see in Chapter 2), that is a three-dimensional sound wave. 'This is Joy' (2014) is a visual depiction of a recording of the word 'joy', that is made to be touched (Fig. 8, see in Chapter 2). While the first artwork will visualise the speech, the later will accentuate the tactility. Therefore, I will apply Mitchell's theory on intermediality and study the aural and tactile seen in these artworks.

Furthermore, I will analyse the series of data sculptures *Cylinder* (2003) by Andy Huntington and Allan Drew. *Cylinder* consists of 8 sound sculptures materialising sounds from different environments. I will focus on the sound sculptures 'Breath' (Fig. 10, see in Chapter 3) and 'Market' (Fig. 11, see in Chapter 3) and mostly analyse as a one-piece due to the similarities. These sculptures differ from Azzaro's due to the unfamiliar visual outlook that does not signify the existence of the sound. In this example, the title is an important aspect of the cognition process of the sound and visual sound sculpture itself. There is no information available about Allan Drew, and the artworks have been published on Huntington's website, therefore I will mention Drew in respect to the art, but I will not elaborate on the artist.

Lastly, I will examine a project by Japanese designer Tokujin Yoshioka (1967). From the artist's work, I will focus on the artworks from the exhibition *Crystallize* at the Museum of Contemporary Art in Tokyo, Japan, in 2013. *Swan Lake* (2013) series includes spectacular crystal 'paintings' and sculptures. The crystals in the artworks grew during the six-month exposure of 'Swan Lake' by the Russian composer Tchaikovsky.[37] Among the artworks, one is a tank filled with a liquid, which allows the crystals to grow successfully (Fig. 13, see in Chapter 4). The rest consists of crystal wall 'paintings' (Fig. 14, see in Chapter 4). All artworks are made by the creations of natural processes that resulted in a fragile and unique aesthetic, called by the author as an 'accidental beauty'.[38] This example differs from both previously mentioned artworks, because the sound wave is not seen. However, it has been used in order to grow the crystal naturally.

[37] P. Noorata, 'Crystal "Paintings" Made from Swan Lake Music Vibrations', *My Modern Met* [website], 2013, para. 2, https://mymodernmet.com/tokujin-yoshioka-crystallize/, (accessed on 22 Feb 2020).
[38] Ibid.

Unlike other examples, at the exhibition, the 'Swan Lake' soundtrack is played in the room. I will not investigate the sound from the aural perspective, which Jones' method allows me to exclude from the thesis. I will be analysing only the photographs of the artworks, and create a discussion about the phenomena itself, focusing on the crystal, rather than talking about each artwork separately.

My general interest in choosing the empirical material lies in the artists' decision in materialising the sound through the depictions of sound waves. Despite the little number of attempts in sonic materialisation, the theory of sound has been a significant source of inspiration for the artists in the last decade. My departing point is as a visual culturist, that analyses images and investigates them critically. By using the technology for the creation of the artworks and portraying the sound in more or less abstract three-dimensional sound waves, I believe the chosen empirical material has a scientific foundation. I will provide two additional examples as support empirical material to present with similar examples worth mentioning.

Previous Research

Music visualisations have been the focus area for studies in film and media. These fields have been interested in investigating the relationship between the sound and image closely. American cinema and media theorist Vivian Sobchack (1940) writes on the silent cinema, specifically, moving images by Dolby Digital that activate imagination in the spectator's mind, thus allowing to imagine the sound of the objects, without even hearing it.[39] Another research similar to Sobchack's is by the Professor of Cultural Studies at Flinders University in Adelaide - Tara Brabazon (1969), who differentiates by adding the sound. In Brabazon's book *Popular Music, Topics, Trends & Trajectories*, she includes a chapter 'Visualizing Music'. Here again, the focus is on the relationship between the image and sound, additionally, by including the sound, it emphasises one another. Brabazon focuses on music visualisations in music videos for musicians.[40] While Sobchack is investigating the cognition process of understanding the sound through a silent image, Brabazon writes on the experience of audio when it is supplied in a combination of a visual element.

[39] V. Sobchack, 'When the Ear Dreams: Dolby Digital in the Imagination of Sound', in J. Khalip and R. Mitchell (ed.), *Releasing the Image. From Literature to New Media*, , Stanford, Stanford University Press, 2011, pp. 112-138.
[40] T. Brabazon, *Popular Music, Topics, Trends & Trajectories*, California, SAGE Publications, 2011, pp. 18-22.

In the past, there has been a remarkable amount of scientific research done, starting from the early development of the theory of sound. The material that derives from the field of physics does not investigate the phenomena from a visual culture perspective, rather focuses on scientific development.[41] Thus, it is irrelevant and excluded from the thesis. After searching topics in English, Latvian, German and Russian regarding the sound waves in the visual field, I did not find a study that focuses on the visual illustrations, instead of scientific experiments. I have searched for materiality in sonic arts. The topic has been introduced, yet these discussions aim to bring sound to the foreground and not stress the constructed image of the sound wave illustrations. By rarely including sound art in art history, the scholars, philosophers and musicologists are willing to argue against vision and its hegemony between other senses.[42] Nevertheless, these discussions do not raise up the question of silent arts in authentic and scientific depictions, but focus generally on materialisation of sound in sound installations and sound art.

The American musicologist Richard Leppert in the essay 'Seeing Music' argues that musical representation is performative and acted, and focuses on the live performances.[43] Significantly, he also includes the gesture and semiotics in his paper, therefore, includes two topics moderately relevant to the thesis. However, Leppert's foundation is art history, and investigates live music, which is not in my interest. The closest research in relation to sound waves in art has been done by scholars in the field of sound studies - Heidi Fast, Taru Leppänen and Milla Tiainen. They have brought vibrations in the focus of their research as a materialisation of sound. It is not a visual analysis. On the contrary, it encompasses discussions about the relationship between the sound and body and requires a phenomenological approach.[44]

To sum up, the previous research mostly aims to discuss music representations - not visualisations; through images - not sound waves. Besides the scientific research, none investigate the intrinsic depictions, but rather the relationship between sound and image or in the last example - the body. The topic I have chosen is undiscovered and analyses a small division from the field of sound art - the focus on the visualisations of sound, the transformation of intangible phenomena into an object. I will analyse images, but I will not examine the relationships or correlations to

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[41] For instance, W. L. Finlay, 'Soundless Sound Waves', *Scientific American*, vol. 162, no. 4, 1940, pp. 216-217.
[42] Schedel & Uroskie, 2011; C. Cox, 'Beyond Representation and Signification: Toward a Sonic Materialism', *Journal of Visual Culture*, vol. 10, no. 2, 2011.
[43] R. Leppert 'Seeing Music', in T. Shephard and A. Leonard (ed.) *The Routledge Companion to Music and Visual Culture*, New York, Routledge, 2014, p. 7.
[44] H. Fast, T. Leppänen and M. Tiainen, 'Vibration', *New Materialism* [website], 2018, https://newmaterialism.eu/almanac/v/vibration.html, (accessed on 11 Mar 2020).

other aspects, rather than focusing directly on the visual. I believe that the thesis about the sound waves differs because it departs from a scientific ground. And by investigating more artistic visualisations, it still maintains and follows its foundation.

Disposition of the Thesis

In the first chapter, I will discuss five examples of sound waves as visual representations, firstly, focusing on the still images and continuing with moving images. In this chapter, I will introduce a brief history of sound. Furthermore, provide with the diverse depictions of the sound wave illustrations, arguing why these abstract images are still scientific inscriptions. Moreover, I will search for the musical gesture within the visual elements. It is necessary to depart from analysing the digital representations of sound waves in order to move further and discuss more complex structures, where the sound wave perhaps is not as conspicuous.

The following part of the research will examine explicit visual sound sculptures, each chapter explaining how the sound wave has been transformed into the object. Consequently, the titles for the chapters are the same as it investigates the same phenomena - how the aural can be recognised visually. Chapter 2 will focus on Gillo Azzaro's voice sculptures, the third chapter on *Cylinder* by Andy Huntington and Drew Allan and, lastly, the fourth chapter on Tokujin Yoshioka's crystal artworks.

Each chapter will include a brief description of artists and denotation of the artworks, which will be followed by analysing the visual elements. I will discuss the two-dimensional inscription transformation into three-dimensional objects, search for the musical gestures to see sound, and investigate intermediality to argue that aural and tactile sensory perceptions are activated by looking at the artworks through the photographs.

Chapter 1: Sound Wave as Digital Sound Representation.

In the following chapter, I will investigate images of sound waves that require introducing the history and development of the theory of sound throughout the years. I will continue by providing diverse versions of sound waves known today that are obtained digitally and used in different ways. It is necessary to depart from examining inscriptions of sound to be able to continue with analysing the visual sound sculptures and their complex structures.

For the music illustration of a sound wave, the process is time-consuming. Firstly, the composer has to imagine the music they desire to create and write the composition. Then a musician translates the signs into a musical artwork that later is performed, and, finally, it is recorded.[45] Only then the sound wave can be visualised by using relevant technology for the recording, which encompasses a series of actions done in advance. This structure means the processes included consist of both analogue and digital sound representations and are executed in both ways. As a result, the sound wave becomes the *representamen* itself.

I want to propose that any visualisation of a sound wave is a digital one, in spite of the surface it is depicted. However, the analogue sound representation is a layer necessary for the sound waves that visualise music. Those are practical annotations that can be provided physically, for instance, notation. It is a representation of a sound and not a visualisation of it, notation, in general, is considered slightly outdated as it is mostly used in classical music. It is also limited, as it is impossible to translate ordinary sounds into notes precisely. Nevertheless, the notation is often involved in the creation of a sound wave, hence it must be briefly mentioned. As I will continue with sound waves that also depict music, it is important to understand the inclusive analogue representation of sound. Most importantly, because a note alone at least points to the direction of a gesture, it can signify the existence of a sound behind it, which it represents. Yet, in musical semiotics one note has hardly any meaning and is considered as with no practical matter, unless the unit is combined with other signs.[46] Perhaps it is plausible a single note has no meaning when a musician looks at it due to the lack of information, but it has a meaning when the interpreter is not searchingfor the meaning. The sound wave consists of these single notes and can possibly lead to seeing sound and the gesture, which I will elaborate on later in the chapter.

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[45] Tarasti, 1994, p. 4.

[46] K. Agawu, *Playing With Signs: A Semiotic Interpretation of Classic Music*, Princeton, Princeton University Press, 1991, p. 16.

In order to understand that a sound wave is digital due to the involvement of technology, I must present a brief history of the development for the images. The origin of the theory of sound roots back to the 6th century B.C., when Greek philosopher Pythagoras (c. 570-c. 495 BC) investigates the sound from a scientific perspective.[47] Only centuries later the development continued. The Italian polymath Leonardo Da Vinci (1452-1519) was the first to discover sound in the form of a wave in the 15th century. Even though sound itself is invisible, because those are vibrations in the air made by the sound, it can be seen in specific substances. Leonardo Da Vinci explored the sound in water, which allowed it to be discovered and to be seen in waves.[48] Based on these discoveries, a significant improvement of the sound theory was developed by the Italian astronomer and physicist Galileo Galilei (1564-1642) and later, French polymath Marin Mersenne (1588-1648).[49] During the development of the physics and acoustics of sound, the only focus on the receiver of sound was the human ear and only in modern physics the recording process involved technology and became an important feature for receiving the sound.[50] Finally, in 1857 the French inventor Édouard-Léon Scott created a phonautograph, which was the first recording machine and also the first apparatus visualising a sound wave.[51]

Further development continued with the ability to analyse the characteristics of a sound based on the sound wave. According to the definition, the sound is a vibration that is a transverse wave, and its depiction is based on the frequency, pitch and amplitude, that characterise the dynamics of the sound. The amplitude, or the wave vertical form depends on the volume and pitch, whereas the distance from one vertical line to the second is depending on the frequency or speed of the sound. Due to the echoing of the vibrations, it loses its energy from the moment it is released. These are the purest forms of sound waves, thus these are depictions of clear and understandable sounds.[52] More complex structures of sounds like continuous music transform the sound wave into visually demanding structures. Nowadays, there is a wide variety of sound wave

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[47] R. B. Lindsay in B. Rayleigh and J. William, *The Theory of Sound*. *Volume 1*, New York, Dover Publications, 1877, p. xii.
[48] Admin, 'Leonardo sound depends on the density and elasticity', *Wallace and James* [website], 2019, https://wallaceandjames.com/leonardo-sound-depends-on-the-density-and-elasticity/, (accessed on 4 Jun 2020)
[49] B. Rayleigh and J. William, *The Theory of Sound*. *Volume 1*, New York, Dover Publications, 1877, pp. xii-xiii.
[50] Lindsay, 1945, pp.xxii-xxiv.
[51] M. Fabry, '*What Was the First Sound Ever Recorded by a Machine?*', Time [website], 2018, para. 1, https://time.com/5084599/first-recorded-sound/, (accessed on 5 March 2020).
[52] C. Woodford, Sound, *Explain That Stuff Sound* [website], 2019, para. 2, https://www.explainthatstuff.com/sound.html, (accessed on 9 Mar 2020); C. Schmidt-Jones, 'Understanding Basic Music Theory', *OpenStax* [website], para. 2, https://cnx.org/contents/KtdLe6cv@3.74:M8ISkDD_, (accessed on 9 Mar 2020).

visualisations accompanying sounds digitally. I have proposed, every sound wave is a digital one to an extent because it requires technology involvement for the creation process. As I have now summarised the long history of sound and introduced the scientific characteristics of the visual sound wave, I can furthermore provide with more abstract versions of these depictions that are created or used digitally today.

1.1. Inscriptions of Sound.

Besides scientific images of sound, two-dimensional images of sound waves are the closest form of what Latour describes as an immutable mobile. The scientific inscriptions of sound are illustrations of the sonic, where the sound is absent. On an inscription the spectator can see the sound that has been recorded and played in the past and with the two-dimensional image is brought to the present moment. Thus, it also includes three-dimensional processes that are necessary for the creation of an immutable mobile. Even though the sound waves used digitally are abstract visualisations of sound, they still follow the main characteristics for an inscription and are immutable mobiles, as Latour would identify. Firstly, inscriptions are two-dimensional material '*presented to the eye*' in a scientific way.[53] By having a scientific character due to its resemblance of scientific sound images they have the necessary components of the peculiar attributes. The resulting digital image of a sound wave can be easily transported. If Latour focuses on printed immutable mobiles, the digital version creates the transportability easier, as well as immutability - it is not possible to change the visual content while the inscription is being transferred.[54] A simple depiction of a sound wave that is not entirely scientific is still perceived as an inscription due to these similarities shared.

Although a scientific sound wave is a result of a process, the digital depictions allow this creation to be more comfortable and accessible. Today several websites supply sound visualisations that consequently create a sound wave for a specific sound. After playing audio or a voice recording by the user, the platforms create a still image of the specific sound wave.[55]

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[53] Latour, 1990, p. 13.
[54] Ibid., pp. 18-19.
[55] For instance, websites such as soundwavepicture.com, etsy.com, soundwavepic.com, soundviz.com and midnightmusic.com are only a few examples of the wide variety available online.

Afterwards, the sound wave can be used in multiple ways by the user, further printed on a poster, engraved in jewellery or used as an outline for a tattoo (Fig. 1). On any visual surface, this sign becomes an icon for the spectator, based on Peirce's triad. A sound wave visually signifies the sound, despite the fact it is not its visual, on the contrary, how society believes and takes the visualisation for granted . As it reminisces of a sound generally, it does not bear indexical qualities. Supposing that this depiction is moderately new, if it was seen by an individual a few centuries ago, it would not signify the sound visually, because this visualisation did not exist and was not learnt culturally.

Figure 1. An example of a tattoo that depicts a sound wave.[56]

By placing a sound wave on one's body in a visible area, it is a sign unfamiliar to its spectators due to the iconic qualities. An icon links to the idea of the object for the spectator and in this case a sound wave is the idea of a sound.[57] Since an index depends on the individual and how well the relation has been established, for the bearer of the tattoo, as seen in Figure 1, the sound wave is an index for a specific sound, as they are most likely well aware of the meaning. The owner of the sound wave on posters, jewellery or any other depictions has an indexical relation to the sound, whereas it is an icon for the spectator. Only the spectator can ask what the meaning of it is? What does it depict precisely? It becomes an enigma for the interpreter as the rest is unknown.

[56] *Inked*, [online image], http://www.inked-app.com/post/72238/, (accessed on 13 May 2020).
[57] Peirce, 1955, p. 107.

The same as for a single note for a musician, one has to ask plenty of questions in order to understand the meaning of a sound wave.

An image of a sound wave alone still includes intermediality as the sign reminisces of the aural expression and according to Mitchell, mixed media includes both aural and tactile sensory perceptions. Since a sound wave connotes the sound, because it is an icon to it, the sonic can be immediately recognised. On the contrary, the tactile senses are not activated as the surface is flat. It furthermore opens another layer, when the linguistic message is added to the sound wave.

Figure 2. A screenshot of a sound wave that is a recording of the name 'Laine'.[58]

The linguistic layer has distinguished importance when it comes to the visuals of sound. As the spectator is not aware of the visual entirely, it has to be explained and thus it can possibly be linked not to the idea of the sound, but to the particular sound. The Figure 2 is an audio recording of my name 'Laine', transformed into a sound wave. The linguistic meaning creates the importance for me as an individual and a meaning for the spectator. In the introduction, I stated that Turino has defined a symbol in musical semiotics, and according to him it always is the linguistic part of the sign.[59] Even though the theory focuses on the sonic triad and I am analysing an image, the sound of the title can be imagined when the title has been read. In this case, 'Laine' becomes the symbol that links together the meaning with the sound and finally, the sound wave. It is significant for the cognitive process, as it explains and adds the necessary information for the spectator.

[58] *Sound Wave Pic* [online image], a screenshot from my recording, www.soundwavepic.com, (accessed on 20 Feb 2020).
[59] Turino, 2012, p. 4.

The American composer Pauline Oliveros (1932-2016) expands the term 'auralization', which originated in the 1980s by the architect Mendel Kleiner that was initially focusing on the room and building acoustics. Oliveros believes that society is living in sonorous surroundings, continuously ignoring noises, that are conditioned and taken for granted, hence, forms a distinction of sounds - that we can hear, and inner sounds - that we can imagine. Auralization indicates the imagination of sound that has been remembered or created mentally. She believes that the body is able to resonate with this sonic expression.[60] For the sound wave, the title explains it which gives an imagined sound to the reader. After reading the title 'Laine', the interpreter will have the sound of this symbol in their imagination. This also relates to musical perception. If it is the title of a familiar song, the song will be remembered. If the title of the song is unfamiliar to the spectator, the sound wave remains an icon to the sound, and the text is still a symbol. On the contrary, the auralization process is not activated, and even if the sound is muted, the interpreter can find out the meaning of the sign, based on the symbol.

1.2. Still Gestures on Inscriptions.

Both Figure 1 and Figure 2 are based on the voice, and according to Tarasti '*the human voice is referred to as a gesture*'.[61] The sound waves depict the movement of the sound in a visual form of the syllables, pitch, dynamics of the words and the auditory perceptions, which include the physical and muscular gestures while these words are being said. Here I have to make a distinction between the voice and speech. While voice can be any sound made biologically by an individual, it also has to be performed in order to be understood correctly. Same as for playing instruments, the character of the performance signifies the emotion of the sound. Not always crying is due to sadness, not always screaming is a reaction to fear. Voice is ambiguous, whereas speech is a concrete collection of words that make sense to the interpreter who understands the words being said. Moreover, speech can be translated into text, which is beneficial to the cognition process of the sound waves. All things considered, not only human voice is the gesture, but any sound, as it requires movement. If a musical instrument must be touched to be played, the words have to be

[60] P. Oliveros, 'Auralizing in the Sonosphere: A Vocabulary for Inner Sound and Sounding', *Journal of Visual Culture*, vol. 10, no. 2, 2011, pp. 162-163.
[61] Tarasti, 1994, p. 13.

said to be heard. In nature, the trees have to be in the movement to create sound. Therefore, the sound wave captures these movements and depicts it on an inscription.

According to Tarasti, a musical gesture can be repeated and not developed.[62] The repetition of these gestures or movements are creating the sound. Words can be repeated, sounds can be heard twice from the same instrument. This makes one question the outcome and the influence of the repetition on the visual sound wave. If Tarasti's argument is considered to be true, then the repetition must leave consequences on the visual material. Meaning, if the text is known for the sound wave, the sound can be repeated by anyone's voice, which is the gesture. But does it sound the same? Does it look the same in a sound wave? The answer for both is a denial. However, it is still important to believe that gestures can be repeated, as it is the only possible way for the creation of the sound. I believe inscriptions of peculiar sounds are unique since those are recordings of a specific human voice, in a specific time and space, including the background sounds, which would be challenging to repeat identically. Latour's idea on immutable mobiles is that they are unchangeable, yet transformable. Inscriptions allow the transportation of the captured gestures to be successful. As in Figure 2 in the beginning and end background fragments are captured, they are unlikely repeatable as they will always differ. As the statement focuses on sonic qualities rather than visual and is considered to be plausible, the term must be extended and indicate that if the gesture is repeated, the visual outcome will alter. That being said, the immutable mobile is an exclusive illustration of a sound that can be repeatable through the musical and physical gestures, yet the visual outcome will not be identical.

As the voice and sounds depicted in a sound wave are not typical illustrations for a vast audience due to the iconic qualities, I suggest continuing with the visualisations for music specifically. The origin of music is based on performative gestures and are translated into musical artwork.[63] A sound wave visualising music has transformed these gestures again in a visual form, because they have been translated from notes, performed and recorded - as a result capturing the movements of the gestures in a still sound wave. The complexity with the musical gesture, when it comes to the sound waves depicting music, is that the gesture cannot be seen precisely and is nowadays becoming secondary due to the technology development and popularity of music

[62] Ibid., p. 14.
[63] E. Rothstein, 'Importance of Gesture in Musical Experience', *The New York Times* [website], 1982, para. 2, https://www.nytimes.com/1982/08/11/arts/importance-of-gesture-in-musical-experience.html, (accessed on 10 April 2020).

streaming.[64] In live performances, the audience is capable of seeing how the guitar sounds, by the gesture of the musician touching the guitar string.

Another layer is the attitude or the character the musician is expressing. In the past, music was meant to be seen by the spectator, but today it is rapidly changing due to the constant development of technology.[65] The physical movements and character of gestures were directly observed - if it was violent, the guitar sound would come out as ominous, and it was presented to the spectators' eye. In the sound waves the gesture itself is not seen, however, it influences its visual outcome. A more violent sound will create a vaster amplitude, a fast-playing rhythm will be depicted in the frequency of a sound wave. In musical semiotics, a minor change in the composition and expression will also contribute to a change in the content.[66] Even though it would be hardly noticeable in the visual of a sound wave, it would still create a significant change in the musical composition.

1.3. Motion Gestures on Inscriptions.

The moving images of sound waves are often combined with sound. These depictions are widely used when audio files are being produced or transferred and the combination is made in order to emphasise the sound and have a cognition of it through the process of auralization. Moving images of sound waves show another aspect of gesture, because part of the gesture is signified immediately - with the motion. According to J.W.T. Mitchell, visual media is never purely visual, it is always including sensory experience and is in a way mixed media.[67] By looking at these moving sound waves in silence, signified is the existence of music due to resemblance to scientific inscriptions of sound. The spectator has the ability to auralize the sound by looking at the visual depiction. It is again mixed media that is muted, where the interpreter can feel the existence of the sonic in silence.

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[64] F. Iazzetta, proceedings from International Association of Semiotic Studies IV International Congress in Guadalajara, México, on 13-18 July, 1997, 'Meaning in Music Gesture', para. 7, published on http://www2.eca.usp.br/prof/iazzetta/papers/gesture.htm, (accessed on 4 Mar 2020).
[65] Ibid. para. 4.
[66] Tarasti, 1994, p. 11.
[67] Mitchell, 2005, pp. 257-258.

The moving sound waves are abstract visualisations of sound.[68] The importance links back to Latour's idea on immutable mobiles and questions it, as it visually steps away from the authentic image of an inscription. In my mind, a moving image of a sound wave is an inscription of a sound and an immutable mobile, that still visually resembles a scientific ground, and, indeed, because of the remembered mental image and the scientific validation of it. Hans Belting states that new media can bring old images back to the present.[69] Due to the constant use of sound waves as digital visualisations of sound, these depictions are brought to the present, their ageing has a deliberate pace because they are constantly used in music visualisations and are accessible easily.

Earlier I analysed the musical gesture that is captured still on an inscription. It encompasses events in the past that leave a visual mark on a sound wave at the moment. Conversely, a gesture is not only a physical movement and aural dynamics. According to the Italian philosopher Giorgio Agamben (1942), the element of a moving image in cinema is a gesture. Agamben states that the movement itself is a gesture.[70] Thus, not only concentrating on the images and their visual components, but also on how these images are shifting and changing in movements. Agamben's idea on semiotics differs from classical semiotics as it is about the dynamics and expressions. Instead of focusing on signs, Agamben directs it to the shift itself, that signifies to the viewer the necessary information. It is something in between that is hardly describable with language, and thus the gesture becomes the medium, and according to Agamben - a '*communication of a communicability*'.[71] This kind of gesture in moving images perhaps will not signify a precise sonic expression of the music, yet it will potentially indicate characteristics of it. For instance, the speed of the changing details of images can signify the flow or speed of the sound.

Before analysing the moving images of a sound wave, it is necessary to briefly introduce the most simple form of a visual movement when it follows Agamben's idea on the gesture. SoundCloud is a well-known music streaming platform providing its millions of monthly listeners to a remarkable amount of music daily. On the website each song is depicted in the form of a sound wave (Fig. 3). The image is still, but when a song is being played, the colour of it changes with a movement to the right, showing the precise part of the song that is being played at the

[68] Belting, 2005, p. 306.
[69] Ibid., p. 310.
[70] G. Agamben, 'On Gesture', in *Means without End: Notes on Politics,* Minneapolis and London, University of Minnesota Press, 2000, p. 55.
[71] Ibid., p. 59.

moment. If the spectatorship is taking place in silence, this expression visually narrates that the music is being played now. This movement firstly becomes a gesture, and, secondly, an icon. If a sound wave is an icon for the sound, the gesture in movement is an icon signifying the presence of it. As a result, a sound wave encompasses another type of gesture additional to the captured sound wave that is still and the outcome of the visualisation encompasses different tenses of time and signifies the sound. Similar visualisations can also be recognised at the moment of playing audio messages.

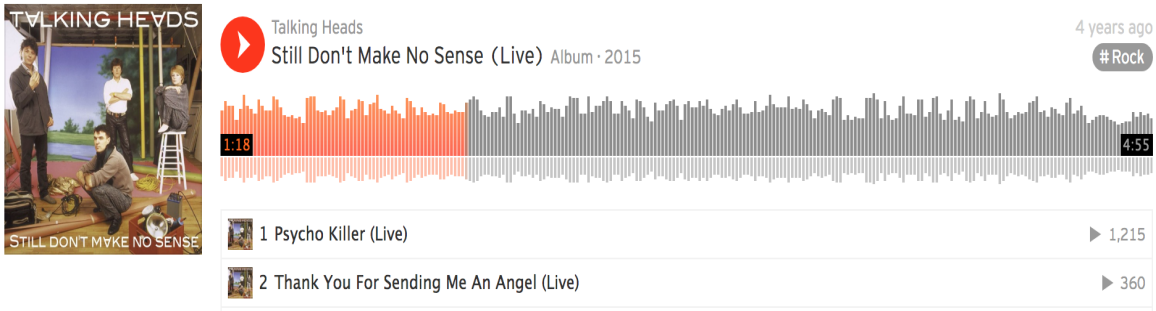

Figure 3. A screenshot from a sound wave that is depicting 'Still Don't Make No Sense' by Talking Heads on the music streaming platform SoundCloud.[72]

In this SoundCloud example, the individual will choose a specific song to play and thus will be provided with the additional visualisation of the particular sound wave. Therefore, the title is already known, it again bears the symbolic qualities, as the title provides additional information, but it is not as essential as in Figure 2 due to the behaviour of the user. If a tattoo is unfamiliar and the text is needed for understanding the meaning, in this instance, it is known beforehand. As Turino has stated that sonic index and icon are often indistinguishable and depending on personal experience for the individual, this example proves it visually precisely.[73] If the user chooses the song but does not hear it, the sound wave is an index for the specific song that can be auralized accordingly. On the other hand, if another person notices the sound wave and is not aware of the specific song, the sound wave is an icon for the sound. It is the latter by using Jones' theory on analysing performances through documentations and depends on the individual, therefore, can be both.

[72] *Sound Cloud* [online image], the photo has been accessed from the personal profile, www.soundcloud.com, (accessed on 25 Mar 2020).
[73] Turino, 2012, p. 5.

The visual that is provided on SoundCloud can be learnt after the sound wave has been seen multiple times, as it includes the relationship between the audio and the visual. Perhaps not on a vast scale as remembering the full sound wave as a sign, but more or less the relationship between the depicted image and sound. Additionally leading to the ability to navigate in the sound wave and understanding certain parts. The audio plays a considerable role in order to learn navigation. After the song has been heard a plethora of times, one can learn the dynamics of the song, faster or slower parts, that are remembered. The result is the ability to link it together with the sound wave. That being said, the audio in this instance has a considerable meaning despite the exclusion of the sonic part of the example. Only then the listener can understand the song visually. If the user prefers the chorus, they can switch immediately to that part by recognising the gesture depicted in the sound waves and placing the movement line where it is needed. The sonic in combination with the movement helps the learning process and cognition of their relationship.

While SoundCloud is an example of a still image to some extent, now it is possible to move further and evaluate changes to the gesture when it comes to decent moving images. Winamp is a media player for Windows, which was invented in 1997 and is also used today. It combines the played music with visualisation by the users' choice, and one example is a dynamically moving sound wave (Fig. 4). The image includes a half of the sound wave and its amplitudes that are moving rhythmically signify the pitch. In my mind, this visualisation that took place two decades ago could potentially be a modern visualisation of a sound today. By basing the idea on Belting, continuous usage of sound waves as digital visualisations, interpreters get used to these images, which are constantly updated with new media. This example also presents Agamben's idea on the gesture precisely. Agamben writes that the gesture does not '*produce* or *act*', but it '*endures* and *supports*'.[74] The movement of sound waves, thus, supports the sound itself, adding the focus on different expression elements visually, which are relevant for the auralization process. The gesture becomes a form of communication itself. It supports the sound wave visualisation, endures it with a duration, and visually supplies the dynamics of the sound. The gesture becomes the medium that signifies the character of the sonic and conveys the presence with it.

[74] Agamben, 2000, p. 57.

Figure 4. Two screenshots of different sound visualisations on Winamp (1997). The sound wave is an additional visualisation for the audio that is being played.[75]

Although I will not analyse sound waves in motion when visual sound sculptures are discussed, it is necessary to mention them. The movements link back to the intrinsic qualities of a sound wave itself as is seen in nature. As discussed in the background section in the introduction, based on science, a sound is a vibration in the form of a sound wave, that is naturally in movement. Sound waves are echoing in peculiar material, for instance, in water. Therefore, Agamben's idea on gestures implemented in the sound waves brings out not only the characteristics of an audio, but also the authentic qualities of a natural sound wave not as science has depicted it, but as seen in nature. The artworks that aim to demonstrate the presence of sound portrays movements of materials and signifies it. Inscriptions of sound I discussed earlier might seem more rooted within the scientific foundation. But also more abstract visualisations are scientific in a way, as a few qualities are shared. Often these depictions can become remarkably abstract, but does it change the quality of the scientific background? Maybe it is easier to understand the sound if it is visualised in a more abstract approach? It is not easy to define which version signifies the spectator more of the sound. Perhaps a moving image expresses more with the moving gestures as a little is known from inscriptions of sound. Even though these immutable mobiles are considered to be representing the characteristics of audio, one of the similarities shared is the necessity of the linguistic explanation for the cognition of the interpreter. Regardless, the spectator can only have a glimpse of the sonic when it is muted, yet I believe that gestures as movements can signify a great deal more than a still inscription.

[75] 'Winamp Plugins', *Music Page 33* [online image], http://musicpage33.tripod.com/links/id12.html, (accessed on May 27).

1.4. Indexical Sound Waves in Music Production.

Often sound waves are being used to visualise sounds for each instrument on the software used for music production. In this case it is necessary to mention that these visualisations are made for a distinct target - musicians or music producers. The sound waves assist in navigating the understanding in the sound, both, when the sound is muted or heard, allowing to work with sound visually. Unlike only creating the relationship between the image and sound, this case expands it.

For example, Sonic Visualiser is a software that allows the user to analyse the audio file visually (Fig. 5). With sound waves, it portrays the melodies and frequencies, depending on the need.[76] The visuals are highly scientific, made for research purposes, rather than production or additional sonic visualisations for visual entertainment. In this example, the sound wave is an icon, which is studied in order to be understood. It becomes an index after time.

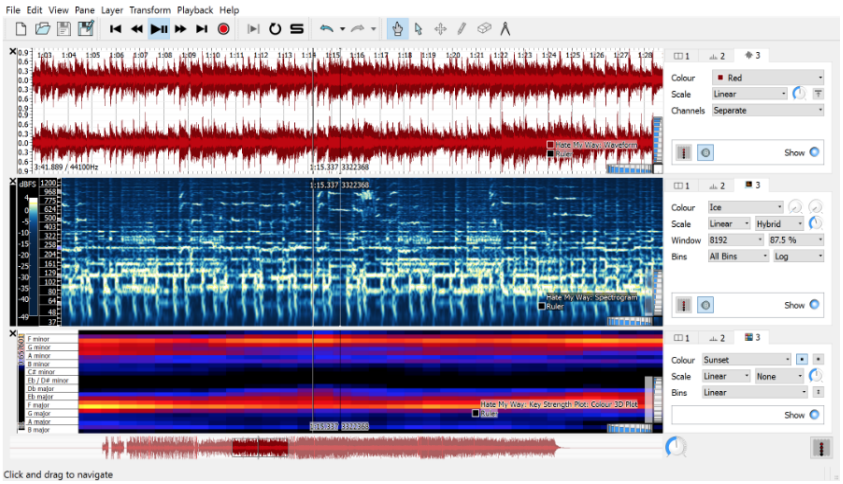

Figure 5. The screenshot from Sonic Visualiser that is portraying frequencies for an audio.[77]

By producing music at the time, the musician is able to make decisions based on the visualisation, what must be changed, so the artwork sounds as imagined. It gives the ability to have a direct connection between the sound, the image and the auralization process. Based on Peirce's triad, firstly, the sound wave is an icon. As a result, it is transformed into an index instead due to the imagined sound and a constant process toward the creation of the familiar sound and the

[76] C. Cannam, C. Landone, and M. Sandler in Proceedings of the ACM Multimedia 2010 International Conference, *Sonic Visualiser: An Open Source Application for Viewing, Analysing, and Annotating Music Audio Files*, 2010, pp. 1-2.

[77] *Sonic Visualiser* [online image], https://www.sonicvisualiser.org/, (accessed on 20 Mar 2020).

sound wave accordingly. In order to understand digital music production software, one has to learn it as a completely new language. The interpreter in this instance is well aware of the potential sound as the outcome and the icon and index can be distinguished. Turino has a term 'indexical cluster' that relates to the repetition of a sound and its learning process. With the term he states that indexical connection to other signs can be learnt and the association executed habitually.[78] In the software the sound is repeated multiple times and the sound wave is memorized consequentally. This relationship between the sonic and the visual becomes an index signifying a specific familiar sound. For this case, the repetition is the condition for the construction of an index. It is what distinguishes an icon from an index, which depends on how well aware the interpreter is with the sound, and the relationship with the image. Additionally, the bearer of the sign is also the interpreter of it.

To sum up, the moving image of a sound wave encompasses the characteristics of inscriptions and its additional qualities when it is in motion. By having a scientific foundation, the inscriptions of sound accompanied by the movement become a more complex form of a sound wave and signifies more details to the viewer. As discussed before, there are multiple layers of gesture depicted in the visual material, that provides a basic understanding of the sound and allows the interpreter to have a glimpse of it. Sound waves signify the sound both in more scientific images or abstract ones. It is impossible to have a broader knowledge of the image and meaning unless there is supplementary information. With these forms of inscriptions in mind it is feasible to furthermore examine artworks that are based on the immutable mobiles presented in this chapter.

[78] Turino, 2012, p. 3.

Chapter 2: When the Sound Wave Becomes the Object I

I have presented the digital representations of sound waves, which allows me to continue and analyse the visual sound sculptures, where the inscriptions have been used for the creation of the artworks. Latour writes that inscriptions are two-dimensional images transformed from three-dimensional processes, that present absent things or objects.[79] I will shift it around and analyse the result of when these inscriptions are transformed into three-dimensional objects again. The first selected artworks I will analyse are selected voice sculptures by Gilles Azzaro.

The French artist Gilles Azzaro (1966) is well-known for creating digital art and voice sculptures. Since childhood, the artist thought of the human voice as something material and had a goal to visualise it. When Azzaro started creating art, the focus has been on creating visual material for recorded words, speech and voices.[80] His first artworks were made in 2006, and those were sound waves engraved in jewelry. In 2012 Azzaro opened his first exhibition *The Vision of a Sparkling Voice*, which consisted of several artworks depicting important voices from the 20th and 21st century. The exhibition was first presented in the Cannes Film Festival, later demanded by 104 French museums, including the Arts and Culture Pompidou Centre in Paris. Visitors were able to scan the artworks by using their smartphones, thus, hearing the voices, which made the exhibition interactive.[81] Most of Azzaro's art includes hearing and seeing in order for the object to be understood completely.

2.1. Denotation of the Artwork.

'Barack OBAMA - Next Industrial Revolution' (2013) (Fig. 6) is a materialisation of the speech of the American president at that time - Barack Obama. It is a visualisation of an excerpt of Obama's State of the Union Address in February 2013, where he states the importance of 3D printing and expresses his support for opening more fabrication laboratories in the United States. The artwork

[79] Latour, 1990, p. 8.
[80] E. Tsirigotaki, 'Gilles Azzaro: an artist like no other', *ERT International* [website], 2017, para. 3, https://int.ert.gr/gilles-azzaro-artist-like-no/, (accessed on 22 Feb 2020).
[81] '3D Printing in Art: Voice Sculpture', *weSEE.it* [website], para. 8-9, https://wesee.ist/3d-printing-in-art-voice-sculpture/, (accessed on 4 Apr 2020).

was created eight months after the speech, which was a 1,53 meters long sound wave, with a weight of approximately 6kg without the stand. It took 350 hours for the printing process. In 2014 Azzaro presented the artwork to Barack Obama in The White House.[82]

Figure 6. Gilles Azzaro, 'Barack OBAMA - Next Industrial Revolution' (2013), photography: Patrick Sarran.[83]

The sculpture is visualising the sound wave accurately, yet it has been transformed into a three-dimensional object. It portrays only a half of the sound wave, the reason at first it may signify a landscape. The black colour used reminisces of the basic inscription of sound. The sound wave alone shares similarities with the first examples in the thesis and is an icon for the sound, even though only half of it is presented. Because of the visual resemblance the spectator has an understanding that sound is depicted. The sculpture is placed in a glass cylinder on a wooden surface, which has been designed by the French designer Patrick Sarran, connoting a form of authority with a place.[84] The placement signifies the importance that it is not just an object, but an artwork. In a closer spectatorship, one is able to see the miniature details of the sound wave, which is similar to what can be observed on an inscription. The higher amplitudes signify the particular sounds, but urges more to aknowledge the meaning.

As mentioned before, the sculpture is interactive - after pressing the button 'play', the audio starts playing the extract of the speech, and the green sensor light follows the audio on the sound

[82] Tsirigotaki, 2017, para. 8.
[83] *Gilles Azzaro* [online image], http://www.gillesazzaro.com/pages/en/printing3D.htm, (accessed on 27 Apr 2020), photo credit: Patric Sarran.
[84] R. Dehue, 'Artist in The Spotlight: Gilles Azzaro - Voice Sculpturing', *3D Printing* [website], 2013, para. 3, https://3dprinting.com/news/artist-in-the-spotlight-gilles-azzaro-voice-sculpturing/, (accessed on 4 April 2020).

wave according to the voice, thus the interpreter can create a link between the audio and the object seen (Fig. 7). Barack Obama's voice is the origin of the gesture, but the act of speaking is not depicted in the sound wave. The gesture, in this case, can be seen in the sound wave itself, how the lines are in the movement, the amplitudes and frequencies. But what does it signify to the interpreter, when nothing else besides the visual sound sculpture can be seen? Since it is the voice portrayed, it is almost impossible to find the meaning if the artwork is lacking the explanation or the audio. The object alone links back to the most simple form of the inscription I discussed first in Chapter 1. It bears the uncertainty and mystery for the spectator. After spectatorship, the cognition process halts, because multiple questions arise in order to receive necessary information in order to understand the artwork.

2.2. A Three-dimensional Inscription.

The three-dimensionality provides other qualities of the artwork for the viewer, what a simple inscription lacks. One can immediately understand the importance of the sound that has been brought to the present moment, even in silence. The subject and object both are located at the exhibition - the validation by space and time provides authority for the artwork. Unlike for inscription, the object allows the viewer to see it and observe it for a longer duration, thus potentially seeing more than on an inscription alone. However, analysing a photograph limits the interpretant to explore visual details. Even so, this Azzaro's artwork asks to spend time on the spectatorship and question it.

Even though the artwork has a scientific foundation, it cannot be characterised as an inscription, but a three-dimensional one. First of all, it is not flat and printed, which according to Latour is the first characteristic of an inscription.[85] It is not mobile as it cannot be transported conveniently and has a risk of damage when moved. Nevertheless, this artwork is based on the inscription, which makes it differentiate from the general field of sound art that concentrates on sound production rather than its visualisation. Significantly, this creation of three-dimensional inscription includes the same events done beforehand and instead resulting in an object, not an inscription. Moreover, it is presented to the eye and is a part of a written text.[86] What does it mean

[85] Latour, 1990, pp. 19-20.
[86] Ibid.

to examine an inscription or this artwork? To elaborate on it, I have to reflect on the previous representation. 'Next Industrial Revolution' shares similarities with the SoundCloud example I discussed in the first chapter. The green light following the audio on the visual is similar when the song is followed by a line on the sound inscription. Thus, the SoundCloud could potentially be a visual inscription for this artwork, but with a different sonic background, focusing on music. As I discussed in Chapter 1, the movement on the visual is the gesture. It is also applicable for this three-dimensional depiction. The spectator first recognises a still image of a sound wave, which depicts the past. When the sonic is included, the spectator is brought in the present moment. Unlike for the sound installations, where the creation of the artwork is for specific time and space, this inscription and artwork combine both tenses together, and with gesture signifies the presence of audio. When Azzaro's visual sculpture is being looked at as it is in Figure 6, it signifies the past in the present, furthermore, adding another layer with the gesture when the laser light is noticed as in Figure 7, the existence of the sonic at the moment. While sound art and installations bring the sound to the present for the body to experience, this artwork experiences it within the object and presents itself to the spectator.

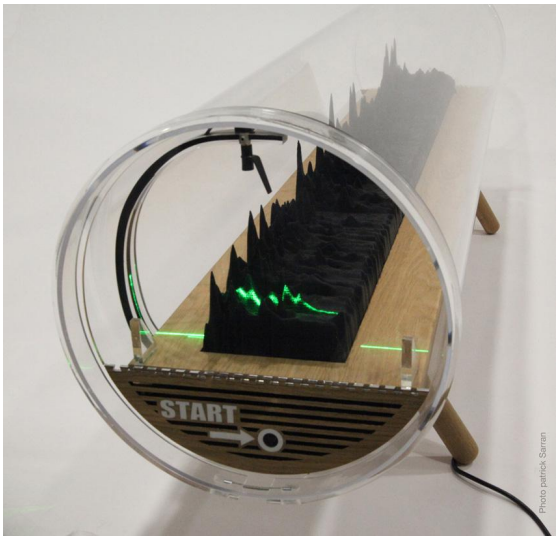

Figure 7. Gilles Azzaro, 'Barack OBAMA - Next Industrial Revolution' (2013), photography: Patrick Sarran.[87]

For the example of SoundCloud, the gesture was the line moving to the right on the visual. In the 'Next Industrial Revolution' it is the same. But what is the difference if it is seen on a screen

[87] *Gilles Azzaro* [online image], http://www.gillesazzaro.com/pages/en/printing3D.htm, (accessed on 27 Apr 2020), photo credit: Patric Sarran.

or as an object right in front of the subject? In both cases the movement is the icon, it signifies the existence of time and presence of the unrevealed sonic. However, SoundCloud is used with the audio simultaneously, unlike the artwork. Here the spectator will look at it first and search for its meaning, consequently searching for the audio due to the interaction. Only then it combines the gesture together with the audio simultaneously. The gesture supports the artwork, signifying the endurance of time and encompasses elements necessary for the further understanding of it. It traces to the audio and text.

Figure 8. Us, 'I Will Never Change' (2012).[88]

Before I continue to analyse the intermediality, I want to present another artwork which is similar to Azzaro's 'New Industrial Revolution' when it is still. 'I Will Never Change' (2012) by the British artist duo Us depicts a song by the dubstep musician Benga in the form of a sound wave, that has been inspired by the visuals on SoundCloud (Fig. 8). The artwork consists of 960 vinyl records and depicts the sound wave for a specific song from SoundCloud. The artists were interested in visual form for music, creating it tangible.[89] The collection of vinyl are creating a sound wave that has been placed on a metal bar. While Azzaro's voice sculpture involves further interaction and audio, this is the final product. Both artworks visually similar and depict a visualisation of a sound wave. Even though depicted is a speech by Azzaro and a song by Us, the

[88] P. Kirn, Visual Music: A Waveform Made of Vinyl Records, Benga Single, Inspired by Seeing Sound, *CDM* [online image], 2012, https://cdm.link/2012/05/visual-music-a-waveform-made-of-vinyl-records-benga-single-inspired-by-seeing-sound/, (accessed on 29 Apr 2020).
[89] Ibid., para. 1-4.

difference is scarcely noticeable. Benga uses vinyl as the material for the creation that connotes the music as the background, yet very briefly. Despite the fact it includes a full sound wave that is horizontally symmetric, it does not signify more due to the lack of the movement in their visualisation. This example is a simple, visual material of a song, whereas Azzaro's has supplementary audio. The title describes it, as well as it requires interaction with the spectators. In contrast, Benga's artwork is defined by its title, the same as for a simple inscription of a sound wave with an additional title.

2.3. Intermedia and the Gesture.

By basing the artwork on Barack Obama's voice fragment, Azzaro creates a strong link to intermediality, even when the sound is muted. The additional information provided around the artwork, and the gesture of it, besides vision, activate other senses. Same as for the inscriptions, also three-dimensional objects can be supported with text, that describes the visuals.[90] The title of the artwork 'Barack OBAMA - Next Industrial Revolution' gives a hint towards the meaning of the artwork. Due to the person in the title it signifies the owner of the voice. I may take it for granted that the spectator would be aware of Obama by recognising the name on the title. However, I believe if an individual is attending an exhibition that portrays sound sculptures by important voices of the century, I am confident the visitors must have a basic knowledge of it. Now the spectator is aware of the author of the voice and understands the sound in combination with the image, which is a bridge to the next stage of the cognition process. Since voice can be translated into text, it becomes a symbol. It creates a direct link, explaining what the depicted sound wave is. In a combination with the title, it defines the artwork and constructs the meaning. If Azzaro's artwork without the sound is an icon for it, then the information provided around it encloses indexial qualities instead. Due to the additional information and clarifications the spectator is supplied with, the meaning is obtained, in a result the sound wave becomes an index for the speech. This links back to the sound waves used in the music production, as they are transformed from an icon to an index, and in this case it is comparable. Nevertheless, the text and the speech is in English and the spectator must be aware of the language in order to understand the message.

[90] Latour, 1990, p. 19.

2.4. Tactile Sound.

'This is Joy' (2014) is another work of Azzaro, which is an object materialising the word 'joy'. It is a 3D print from the sound recording of spoken words 'this is joy', thus, according to Azzaro, it is the first attempt ever visualising the word.[91] The spectators are allowed to touch this sculpture in order to feel the sound, as well as feel the materialisation of the voice. Additionally supported is a QR code on the artwork, which provides the ability for the visitor to scan it and hear the actual voice recorded.[92]

On a relatively small square black box the sound waves have been 3D printed in black colour, again connoting the sound behind the artwork, which is significant and necessary to mention due to the tactility, and the reason why it differentiates from most of the visual sound sculptures. What are the consequences if the interpreter has the ability to touch and feel the visualisation of sound? Since the visualisation itself is complicated as it is an invisible phenomenon, Azzaro offers a unique experience. However, as a photograph is analysed, the tactility must be perceived through the visual.

Through the image (Fig. 9) the detailed lines and forms are seen, that portrays the tactility. This artwork includes aural and tactile. From its title it is understood it is a materialisation of the word 'joy', and the sound of it is easily comprehensible. The text is the symbol again, which can be seen in its tactile element. Additionally, it also identifies the artwork.

In the text '*Tactile Communication*' by the American social scientist Lawrence K. Frank (1890-1968), the necessity of tactile experience is addressed in order to orientate the body in the environment. By feeling through the tactile it becomes the organ of communication, through which the body perceives warm, cold, wind. By the touch the infant learns textures, shapes, sizes etc.[93] Frank states that our first sensory experience is based on tactility, which further is validated and discovered by the ear and eye.[94] Even though the text is focused on communication through the tactile, how the body operates, responds and learns by touching, it states the importance for the tactility as the touch itself, which Mitchell does not elaborate on. On the contrary, Mitchell investigates the tactile through vision, what the interpreter can see during the spectatorship, to be more specific, how one can see the methods with the brush on a painting, even with no

[91] *Gilles Azzaro* [website], http://www.gillesazzaro.com/pages/en/joy.htm, (accessed on 22 Feb 2020).
[92] Ibid.
[93] L.F. Krank, 'Tactile Communication', *ETC: A Review of General Semantics*, vol. 16, no. 1, 1958, pp. 43-52.
[94] Ibid., p. 54.

background knowledge about the medium.[95] It is not allowed to touch a painting, yet 'This is Joy' is made to be felt through the fingertips. The spectator can see the texture of the sculpture and can auralize the sound depicted due to the symbol of the sound.

Based on Frank's idea, the spectator can touch objects and learn the tactility. However, in this case offered is a unique experience, where it will not be remembered and it will not help the interpretent to operate in the environment later, because to my knowledge there are no such other objects as the visual sound sculpture 'This is Joy'. Frank never states the necessity of the touch in order to explore or investigate new objects but focuses specifically on how we construct the world around us based on the frequent tactile sensory perceptions. Thus, I am confident 'This is Joy' provides the viewer to enter a new dimension of intermediality, that allows touching the unfamiliar and undiscovered. And even by looking at the image and seeing the tactile, it is perhaps more influential visually, than if it was experienced through the touch. Is the tactile remembered as powerful as the visual? Which sense affects the interpretant more significantly? These could be questions asked after a phenomenological experience of the artwork.

Even when the visual is validated by the eye, it is still uncertain and, perhaps, misunderstood. In this case, Mitchell's idea is to notice the tactility in the visual material - the black lines throughout the artwork depicting the sound wave. Consequently, if the interpreter is present, it is felt bodily with Frank's idea. Nevertheless, it stops there. It communicates the word 'joy' on a different level. Words rarely can be experiences in this format, I would say, it is one of a kind experience of a sound that has been transformed into a tangible substance, which is the reason I have stated this artwork is important. As this artwork is based on an inscription, it transforms the tactility from two-dimensional to three-dimensional perception. When one is looking at an inscription, no tactile senses are activated. The three-dimensionality stimulates more sensory perceptions, as the object asks for the attention of the spectator.

[95] Mitchell, 2005, p. 259.

Figure 9. Gilles Azzaro, 'This is Joy' (2014).[96]

[96] *Gilles Azzaro* [online image], http://www.gillesazzaro.com/pages/en/joy.htm, (accessed on 22 Feb 2020).

Chapter 3: When the Sound Wave Becomes the Object II

The sound waves can not only be visualised in different ways, but also used for the creation of the artworks, still depicting it scientifically. Due to the fast pace of technology development nowadays, countless visualisations can become unfamiliar to the human eye. Then it requires a detailed investigation of the visual in order to search for the sound. The selected artworks I will analyse in this chapter have been created by recording regular sounds from daily environments, which are transformed with software that depicts these sound waves in an extraordinary approach.

3.1. Denotation of the Artwork.

Cylinder (2003) is a series of artworks consisting of eight 20-40cm tall visual sound sculptures by Andy Huntington in collaboration with Drew Allan. Huntington is an interaction and sound designer and in the past has focused on software and product development, as well as prototyping. Besides Huntington's work with software, he develops sound toys and composes music. The eight sculptures, or as authors call them - data sculptures - are representing the sample of time for particular sounds.[97] In order to create the artworks, a recording of an acoustic accessible to the human ear from a natural environment was recorded. It was created by capturing the time and frequency that allowed the creators to work with a peculiar software made specifically for this purpose, to result in printing a prototype. Same as Azzaro's voice sculptures, *Cylinder* were 3D printed and transformed into the three-dimensional objects.

'Breath' (Fig. 10) and 'Market' (Fig. 11), similarly as 'New Industrial Revolution', is materialising the sound, yet it is portrayed differently. It is not depicting a sound wave, on the contrary, a recorded sound, where the sound waves have been used in order to construct the distributed sculptures. Both visual sound sculptures are cylinder form objects in white colour, with strange forms around the diameter and sharp surface. The surface around the cylinders is layered with vertical sections in different lengths and outer lines, overlapping one another, resulting in creating the unique form. Despite the innocent aesthetic, it has a rough and rigid texture. These data sculptures are visually notable due to the fragile aesthetic, hiding sound successfully.

[97] *Andy Huntington* [website], Para. 1,3,5, https://andyhuntington.co.uk/about/, (accessed on 2 May 2020).

Figure 10. Andy Huntington and Allan Drew, 'Breath' (2003), copyright: Andy Huntington.

Figure 11. Andy Huntington and Allan Drew, 'Market' (2003), copyright: Andy Huntington.[98]

[98] Both photos retrieved from *Andy Huntington* [online image], https://andyhuntington.co.uk/2003/cylinder/, (accessed on 2 May 2020).

Cylinder is depicting a software prototype, not the sound wave itself. Therefore, I have to state the reason it is still relevant to discuss this artwork. Azzaro's voice sculptures take the sound waves of a particular voice and materialise it in the same way, most precisely - the visual outcome is half of the actual sound wave. Both 'Breath' and 'Market' are a validation that the sound waves can be used in order to create a different version of them, and this, in fact, does not change the authenticity or value of the artworks. In my mind, it has the intrinsic values of sound as long as it roots within the scientific. In this case, it is the recording of the sound where the sound waves are collected and later transformed into the necessary visuals. *Cylinder* is a series of objects portraying flexibility of the sound waves. It does not signify the sound itself visually, but it encompasses the vibrations that have been transformed and materialised in a different approach due to the use of technology. It has included the long process of the recording, adjusting and editing sounds and digital sound waves by the use of the platform, and, finally, 3D printing, which resulted in the visual sound sculpture. This kind of depiction is more abstract, because it is new, unique and unseen to the human eye before.

'Breath' and 'Market' do not share visual similarities with the basic inscriptions of sound. While Azzaro's voice sculptures are similar to the images of sound waves and transform the objects in the same manner, Huntington and Allan move further. The first visual attempt is by using white colour instead of black to depict *Cylinder*. Furthermore, the vertical layers are turned around to horizontal and individual sections remind of an illustration of a sound wave. Perhaps it is the only sign of the sound as the background of *Cylinder*, in that way the artists have turned the sound wave around to successfully manipulate even more with the interpreter. The combination of both aspects and the use of the cylinder as a form, creates a mystery of the sound and asks the spectator to investigate it more in depth.

Before I continue, I want to refer to another example where the artist has twisted the sound waves around in order to create an object. The Colombian, London-based designer Matthew Plummer-Fernandez investigated 719 sounds and consequently created a sound wave that visually reminisces of a chair. After transforming the sound wave in a tangible form by using polythene, Pummer-Fernandez created 'Sound/Chair' (2007), which is a collection where a single unit costs £3950 (Fig. 12).[99] In this instance, the same as *Cylinder*, the sound and accordingly the sound

[99] E. Orensten, 'Matthew Plummer Fernandez: Sound/Chair', *Cool Hunting* [website], 2008, para. 2, https://coolhunting.com/design/matthew-plummer/, (accessed on 29 Apr 2020).

waves are used in a flexible way for the creation of the object. Nevertheless, the spectators never find out the sound behind both artworks, especially for 'Sound/Chair'. Instead, materiality and practicality have been placed in the foreground. *Cylinder* reveals the sound with the titles, which I will elaborate on later.

Figure 12. Matthew Plummer-Fernandez, 'Sound Chair' (2007).[100]

3.2. The Visually Tactile Sound.

After discussing the visual elements of the sculptures, it raises the question of intermediality. All artworks a part of *Cylinder* are visually fascinating, but how can one see more? How can the

[100] *Plummer Fernandez* [online image], https://www.plummerfernandez.com/works/sound-chair/, (accessed on 29 Apr 2020).

spectator see what is hidden behind the visual layer if it may seem to be purely visual? When no background information is known for these two artworks, it indeed is an object to be inspected visually. However, the relief and sharp surface forms signify the tactility. According to Mitchell it is one of the aspects for the analysis of the mixed media. While Azzaro's 'This is Joy' is made to be touched and felt through the fingertips, this artwork is only enjoyed through the spectatorship. The interpreter can see the tactility without touching. The vertical layers creating the unique shapes around the cylinder are the visual signification that makes 'Breath' and 'Market' valuable artworks. The tactility is seen on the sculptures directly and does not seek for the meaning of it. On the contrary, it asks to observe the artwork and notice a complete selection of the slight details of the surfaces and elements that are in combination creating the tactile sensory activation. Unlike 'This is Joy' by Azzaro, the selected artworks of *Cylinder* visually connote the touching is forbidden, both visually seem too fragile for it, therefore can be enjoyed only by observing the tactility of the sound visualisations.

The titles of the artworks hide another layer for understanding the meaning of the artworks. If visually 'Breath' and 'Market' are objects, then by reading the title, it gives a great deal of meaning and is a stepping stone for the cognition process. Now the two different sounds are known, and significantly, they are understood by two single titles. After seeing the word 'breath' and the artwork as the visualisation of it, it becomes the symbol for the sound of breathing, which furthermore points to the object. The sounds used for the *Cylinder* are from the daily environments and are familiar to, I will dare to say - everyone, who understands the meaning of the words itself. The spectator does not need to hear the audio used for the creation of the sculptures, because they can be easily auralized in the imagination. But how does the text link to the visual of the data sculpture? How can one see the sound when the sculptures are inspected in silence? The titles are an essential layer for the cognition as they link to the sound and thus also to the object. Thus, the object visually is tactile and links to the sound after the title is recognised.

The Scottish musicologist Morag Josephine Grant (1972) writes on semiotics based on experimental music and includes a broad definition of the specific genre. In the text 'Experimental Music Semiotics', Grant states that experimental music often includes daily sounds people react to, for instance, a church bell or a phone ringing, which is followed by an action by the subject, because the sound is familiar individually.[101] Grant argues that all experimental sounds are

[101] M. J. Grant, 'Experimental Music Semiotics', *International Review of the Aesthetics and Sociology of Music*, vol. 34, no. 2, 2003, p. 184.

indexical due to an action followed by hearing a sound. If a phone rings, the owner will understand it is their phone and will pick up the call. And this action takes place only because of the familiarity of the sound and the object it has a direct link. Despite the fact that the idea stresses the aural senses, it must be applied to this example. I am suggesting to step away from the artwork and think of the sound of breathing. According to Grant, the sound is immediately understood due to past experience and memory. Because breathing is a natural process, it is interpreted directly. This association is necessary in order to tie it together with the artworks - the text symbolises the sound, which is the artwork. As it is not a symbol for the object but for the sound, which is so recognisable and has imagined indexical qualities, the interpreter can continue the cognition process and understand the object and the sound behind it. However, I find it difficult to agree with Grant and suppose that breathing as a sound is an index, but on the other hand, it is impossible to argue that it is an icon instead. In this case, it is hardly distinguishable, and according to Turino, this is a frequent dilemma in musical semiotics.

3.3. The Hidden Gesture.

Due to the peculiar sounds used, it is challenging to define the visual gesture. While the previously discussed versions include the voice, captured movements from the performance and Agamben's idea on the gesture as the movement itself, these artworks have been made based on daily sounds, the definition must be adjusted or expanded in order to fit this example in. I could argue that the sharp surface captures the gesture motionless and portrays it in the artwork. Comparing it to the inscriptions of sound I elaborated on earlier, the amplitudes and frequencies can signify a few characteristics of the sonic angle also for these visual sound sculptures. Nevertheless, this assumption would be too vague and incorrect. It varies when the sound used is as ordinary as in *Cylinder*, because there is no gesture what has been discussed in this paper so far. The gesture does not reflect the movements of the instruments played, it is not the voice and a person speaking the words, as well as music. Instead, used are sounds from environments that are accessible daily.

At first, it may seem as if that both artworks are excluding the aural or visual, physical gesture out of the visual depiction. Even though the gesture must be as part of the creation of the artworks, with the object, the sounds are brought to the forefront in an abstract way. Firstly, both sounds of breath and market involve the body for the recording process. The gesture of the 'Breath'

can be the physical movement of the body during an inhale and exhale. Same as for the 'Market', if there is any sound at the place, it requires bodies moving, purchasing, exchanging money, talking - and where the materials meet, the sound is created. I have now presented the physical gestures, but the sounds include the sonic gestures as well - the breaks, pauses, pace, dynamic, or even the difference between the sound of an inhale and exhale is the sonic gesture. The sound of breathing is monotonous, depending on the state of the body. This being said, the sharp edges on the surface of the artwork 'Breath' can possibly connote the harmonious breathing sounds. Since the artwork is a sample of time, it does not include one particular inhale and exhale but an enduring time of breathing. Therefore, the process of it has been transformed into a sound wave, presenting the whole gesture in the object. Accordingly, it becomes the *representamen* of the gesture, that can be both - the physical and the sonic movements, as both are necessary for the sound.

I have argued that the title is the symbol for the sound that points to the object. As 'Breath' and 'Market' visually are inscrutable and do not signify the existence of sound behind it unless the titles are read, it is difficult to point out the icon and index. As a result of this analysis I am confident that the objects of 'Breath' and 'Market' independently can be both an icon or index, as the sounds are known by the symbols, but more a general idea around the sound than a specific one. The chosen artworks from *Cylinder* visually connote the complexity, at the same time flexibility of the sound waves, also representing the gesture.

Chapter 4: When the Sound Wave Becomes the Object III

I will continue with analysing the last example of the visual sound sculptures and discuss artworks that have included sound waves in the process of creation of the objects. Even though this artwork does not depict an immutable mobile, by using nature, it manages to portray it differently and unusually.

The Japanese designer, architect and contemporary artist Tokujin Yoshioka (1967) is one of the leading Japanese designers and artists today. Throughout the career he has been interested in nature and its elements, making artworks with natural materials and light. In the creation of the artworks, Yoshioka uses technology, science and nature, using materials such as glass, paper, and polyester in a careful investigation. Yoshioka's artworks have been exhibited in prestigious museums such as MoMa in New York, Musée national d'Art moderne in Paris and the Victoria and Albert Museum in London.[102] Yoshioka has designed the Tokyo Olympics 2020 torch, which visually resembles a sakura flower - the national flower of Japan.[103]

Figure 13. Tokujin Yoshioka, the crystal sculpture of *Swan Lake* (2013), photo © MOT / Museum of Contemporary Art Tokyo.[104]

[102] 'TOKUJIN YOSHIOKA The Laws Of Nature: On The Art of Light and Space With Japan's Leading Contemporary Artist and Designer', *Champ Magazine* [website], 2018, para. 3-5, https://champ-magazine.com/art/tokujin-yoshioka/, (accessed on 22 Apr 2020); *Tokujin* [website], para. 3-5, https://www.tokujin.com/profile/?l=en, (accessed on 22 Apr 2020).
[103] A. Pownall, 'Tokujin Yoshioka Reveals New Pictures of the Tokyo 2020 Torch', *De Zeen* [website], 2020, para. 1-2, https://www.dezeen.com/2020/02/10/tokujin-yoshioka-reveals-new-pictures-of-the-tokyo-2020-torch/, (accessed on 22 Apr 2020).
[104] K. Spirou, 'Tokujin Yoshioka Grows Mesmerising Crystal Colonies For His "Crystallize" Exhibition', *Yatzer* [online image], https://www.yatzer.com/crystallize-tokujin-yoshioka-mot, (accessed on Feb 22, 2020)

Figure 14. Tokujin Yoshioka, the crystal 'painting' of *Swan Lake* (2013), photo © MOT / Museum of Contemporary Art Tokyo.[105]

In 2013 the Museum of Contemporary Art in Tokyo was hosting Yoshioka's solo exhibition *Crystallize* (2013) that between other crystal artworks included a series of crystal 'paintings' and sculptures under the title *Swan Lake* (2013). These artworks were made by the vibrations of Tchaikovsky's composition for *Swan Lake* (Fig. 13 & Fig. 14).[106] Before I discuss details of the exhibition and the chosen artworks it is necessary to introduce to the music that has been used to create a series of artworks. *Swan Lake* is a ballet that premiered in 1877 where the music was created by one of the most successful Russian composers - Pyotr Ilyich Tchaikovsky (1840-1893). Despite the failure of the premiere in Moscow's Bolshoi Theatre, it has become the most played ballet in the world today.[107] Tchaikovsky's inspiration for the soundtrack was the Neuschwanstein Castle in Bavaria, often called the 'swan castle', and the mysterious death of the Bavarian king at that time - the King Ludwig II, who drowned himself in a lake next to the castle.

[105] Ibid.
[106] Noorata, 2013, para. 4.
[107] E. Mackevic, 'All you need to know about Tchaikovsky's Swan Lake', *Reader's digest* [website], 2017, sec. The Origin & The Premiere, https://www.readersdigest.co.uk/culture/music/all-you-need-to-know-about-tchaikovskys-swan-lake, (accessed on 24 Apr 2020).

I will not present the details of the plot of the ballet, but it is important to mention some of the aural characteristics of the music. Tchaikovksky was firstly characterised as too 'noisy' and 'symphonic'.[108] The four hours long musical composition for *Swan Lake* sounds precisely like the tragic story itself. The dramatic overture signifies that the story will not have a happy ending. Tchaikovsky's combination of different tempos and melodies creates sudden shifts in aesthetics. Despite the failure at the premiere and being criticised as being too noisy, Tchaikovsky's *Swan Lake* has been described as a simple musical artwork, that is flexible and easy to work with when it comes to directing a ballet play.[109] The continuous omnipresence of *Swan Lake* has made Tchaikovsky a valuable composer throughout centuries due to the inspirations for Hollywood film and the soundtrack usage in films.[110]

4.1. Denotation of the Artwork.

In the middle of the light exhibition room, where the series of artworks are placed, is the sculpture, whereas the crystal 'paintings' are on the side walls (Fig. 15). In order to grow the crystals, it required a process of the duration of six months when the soundtrack was continuously repeated.[111] Yoshioka never explains the process precisely, yet states it as a fact in the texts supported for the visitors of *Crystallize*. The artworks on the images of Figure 13 and Figure 14 are aesthetically unique, depicting fragile and beautiful forms of crystals, portraying not nature specifically, but an element of natural processes. Yoshioka confidently validates the fact it is a grown crystal, by depicting it so. The artificial layers are the glass frames and the tank filled with liquid, which are necessary for the exposure of the artworks.

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[108] 'САМЫЙ РУССКИЙ БАЛЕТ – «ЛЕБЕДИНОЕ ОЗЕРО»', *V Mire Muziki* [website], para. Предыстория «Лебединого озера», https://vmiremusiki.ru/balet-lebedinoe-ozero-petra-chajkovskogo.html, (accessed on 24 Apr 2020).

[109] R. Mulready ,'Composer Piotr Illyich Tchaikovsky', *Australian Ballet* [website], para. Talking Tchaikovsky, https://australianballet.com.au/education-resources/swan-lake-the-music, (accessed on 29 Apr 2020).

[110] The soundtrack has been used in movies such as 'Phantom of the Opera' (1925), 'Dracula' (1931), 'The Mummy' (1932), and has been an inspiration for 'Black Swan' (2011), which won 5 Oscar Nominees in 2011; Mackevic, 2017, sec. The Legacy.

[111] Ibid., para. 2.

Figure 15. Tokujin Yoshioka, *Swan Lake* (2013), installation view, photo © MOT / Museum of Contemporary Art Tokyo.[112]

All artworks from *Swan Lake* have the same character and aesthetic, due to the authenticity of crystals, which fits the light, spacious room. This aesthetic and characteristic visually has been observed in Yoshioka's work generally. The nature of the material has been left untouched. That includes the colour, as well as the forms, diverse lines and shapes. Similar to the visuals of 'Breath' and 'Market' it is impossible to search for an indication, linking visually to the soundtrack of Swan *Lake*. Nevertheless, the lines of the crystal reminisce of the sound wave, it is perhaps a sign I am searching for, not something that Yoshioka wished to depict with the artworks. As stated earlier, his goal is to depict nature as it is, not focusing on the visualisation of the sound, but rather the material and creative process. The artist's idea of this concept is that the artworks from the exhibition *Crystallize* create a connection between human and nature. Depicted is the energy of nature where the crystal animates the forms itself.[113]

Since the artworks do not include the visuals of a sound wave, the interpreter has no awareness of the sound behind it. If previously in the research I presented how a sound wave can be readable by the familiarity with its amplitudes, frequencies and tempos, in this instance, they are not depicted, on the contrary, used in order to create the artworks. Thus, visually, one can see these dynamical characters of a sound wave converted in the crystal which would require knowledge of the material and the growing process rather than the sound waves.

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[112] K. Spirou, 'Tokujin Yoshioka Grows Mesmerising Crystal Colonies For His "Crystallize" Exhibition', *Yatzer* [online image], https://www.yatzer.com/crystallize-tokujin-yoshioka-mot, (accessed on Feb 22, 2020)
[113] *Tokujin* [website], para. 2-3, https://www.tokujin.com/works/2013-crystallize/?l=en, (accessed on 22 Apr 2020).

While an inscription of sound provides the basic characteristics of the sonic, *Swan Lake* presents with aesthetics of it. The light colour, sharp forms and delicate structure inform about the aesthetics of the ballet and the soundtrack. The colour and material bear the coldness of the ballet, yet the beautiful sounds and calm tempos whereas the sharpness and fragileness connote the tragedy and louder parts of the music, moreover, the noise and symphony. The material used for the creation of *Swan Lake* creates similar shapes and forms to the sound waves. As I have already proposed, the crystal surface visually resembles the amplitudes and frequencies, perhaps the pitch, but in an unusual way. In this example, the movements in the substance while the crystals were growing can be defined as the gesture. With the resulting crystal forms, it is captured and presented in an abstract way. Potentially this visual of *Swan Lake* signifies more about the sound than a single inscription of sound.

4.2. The Hidden Invisibile/Intermedia.

Unlike Azzaro's voice sculptures, *Cylinder* and *Swan Lake* visually does not reminisce of a sound wave. The innocent depiction signifies natural forms of *Swan Lake*, elements and character and due to its fragile aesthetic, it is explicit the artworks are forbidden to touch. While tactility is a sense activated while observingt the photograph of the artworks, the sound is not connoted. At first *Swan Lake* does not depict the potential to be defined as a visual sound sculpture, because the sound cannot be seen in its visuals. Besides the text, there is no visual movement or any sign that could provide a hint towards a musical analysis. If a single scientific sound wave is an icon for the sound, *Swan Lak*e successfully hides the illustration of an immutable mobile behind it, and therefore the sound is muted. It does not have a scientific character, however, it has been created based on a scientific foundation. This again links back to the inscriptions.

According to Latour, inscriptions are the visual validation of the scientific procedures done beforehand.[114] It is evident *Swan Lake* is not a graph, a print or any other version of a decent inscription. Yet, it is a visualisation by the vibrations used for its creation. Even though it argues against the definition of inscription, in my mind, it becomes a three-dimensional form of one, same as Azzaro's 'New Industrial Revolution' discussed in Chapter 2. The series of artworks represent the procedures; it is the final product, in the form of a visual sound sculpture. And

[114] Latour, 1990, p. 15.

perhaps this kind of abstract visualisation signifies more of the sonic aesthetics than a single sound wave is capable of.

One of the characteristics for inscriptions is the possibility to add the text that describes them.[115] The title and the text that describes *Swan Lake* becomes the identification of the artworks. The symbol identifies the sound and, thus, the object itself. According to Turino and the confident statement the symbol is only presented through the linguistic layer, *Swan Lake* becomes the symbol for orchestral composition as well. Because the visuals of the crystal 'paintings' and sculptures visually do not indicate the sound, again the text has considerable importance that links closer to the meaning. While Azzaro bases the visual sound sculptures on scientific ground, Yoshioka allows nature to visualise the sound itself, which is significant not only in this thesis but also generally in the sound art field.

4.3. Presenting vs. Representing.

Swan Lake is the linguistic layer identifying the artwork and allowing the spectator to decode what they see. Generally, it is another attempt in representing music with signs or visualisations, which is further away from the common understanding of the visuals for the sound. I want to elaborate on the representational aspect due to the fact the sound waves were involved in the creation process. As a part of Grant's statement about indexical qualities for experimental sounds, she also suggests that 'experimental music and many other forms of music' *presents* rather than *represents*.[116] The indexical qualities link immediately to the objects these sounds represent, even if these objects exist apart from themselves independently.[117] After searching the definitions for both words, the following answers were found. The word '*present*' is related to the time and includes an object being present. The word '*representation*', on the other hand, from the French term *représentation* translates as something lacking the urgency, the object is rather imagined than here and now, according to the German philosopher Edmund Husserl (1859-1938). These two terms are not always contradictory, and a visual object can often be defined as both.[118] Continuing

[115] Ibid., p. 19.
[116] Grant, 2003, p. 183.
[117] Ibid., p. 184.
[118] J. Dokic, 'représentation' in B. Cassin (ed.), *A Dictionary of Untranslatables. A Philosophical Lexicon*, Princeton, Princeton University Press, 2014, p. 893.

with Grant's suggestion for this division, after not defining experimental music, she adds other genres applicable for this suggestion, that I believe is vague, yet useful. Before I move on, I would like to suggest getting rid of genres and instead use sound or music terms, simply because I am confident that Grant's idea is suitable to sound generally, not only to experimental music. I suggest that music alone presents itself when there is no object in relation to it, as it would be for any sound. It brings any sound to the present moment and creates the sonic icon or index qualities depending on the interpreter, based on Peirce's triad. When a song is being played, it is a medium that presents it to the listeners and it, in fact, is present. It may represent the author of the composition or the musician, yet the music stands for itself confidently, and any other sound as well.

Even though the previous examples I have analysed could be applied to this definition and argument, I believe that in this case, the significance is the transformation process that also must be considered. The examples including Winamp, SoundCloud, sound waves with or without text and visual sound sculptures are representing the sound, where it visually is emphasised and accompanied. They represent a song, a sound or a voice as a result of translation to the pictorial form. Due to the attempts of transformation from aural to visual and basing it on a scientific image that already exists - the sound is not presented, but represented. Nevertheless, *Swan Lake* is different in this sense. Yoshioka allows nature to interfere with the sound waves in the substance and excludes the technology involvement remarkably, only leaving the speakers. In Chapter 1, I executed a distinction between analogue and digital sound waves, arguing that most of the images are digital ones, as it involves technology. Tokujin Yoshioka manages to allow the sound wave to exist as it is and as a result, create the crystals that are presenting the particular sound at the exhibition space. Therefore, the artwork is analogue to an extent, and presents the sound waves, as there is no transformation involved and they can be considered as being present. The author did not use the visualisation of the sound that is scientifically validated and excluded the sound waves from the artwork, on the contrary, allowed the sound to visualise it, depicting it in a natural way, thus presenting the sound in a visual form as it is.

Conclusion

A sound is a vibration that the human ear can perceive, and due to physics and the theory of sound, the sound wave is the validated image of it. Apart from other topics, Visual Culture studies critically investigate the constructed images of the invisible and questions it. These images are allowed to be ambiguous and uncertain, yet the vision being hegemonic requires validation, if not scientific then at least culturally lived. 'Visual' in the title does not necessarily mean that images are analysed visually. In fact, different senses can be activated or noticed through visual investigation.

In the research question, I stated the goal for this thesis - to see the sound and its existence in the chosen material based on its visual depictions. With peculiar examples, I have presented that sound can be noticed in visual depictions of sound waves. By pointing out icons, indexes and discussing symbols, and the musical gestures, I highlighted visual details that connote the sound. I demonstrated that the visual elements on the sound waves or artworks can signify the existence of sound. And most importantly, that there are muted sonic materialisations, that requires to explore and investigate. Also, my doubt throughout the thesis confirmed - it is unattainable to understand the sonic completely. However, a few details or characteristics can be perceived by the visual elements of a digital sound wave. Most significantly, the existence of a sound can be sensed through the visual of a sound wave, both scientific or artistic.

In this thesis, I examined aural and tactile visual elements based on W.J.T. Mitchell's theory, including these sensory perceptions through the investigation of the visual. It was necessary to include this theory in order to analyse the possible answers to the research question that seeks to search the sound on the depictions of a sound wave. During the analysis I have stated that a sound wave alone links to the idea of a sound, that activates the aural sense. The tactile visual elements were discussed when examining the visual sound sculptures. Besides Azzaro's artwork, the sound waves were concealed, thus, required searching for tactile details that connote the sound.

By using Perice's classical semiotics as the method and identifying icons, indexes and symbols, I was pointed to the motifs of the visualised sound. The perception of the triad depends remarkably on the interpreter and bearer of the sign. A digital sound wave alone is an icon, as it links to the general idea of the sound. On the contrary, a sound wave tattoo, on a poster or chosen SoundCloud song, is an index, because the bearer is aware of the meaning of the sign. For the

specific software, the sound wave can become an index quickly, as it is learnt and understood through the relationship between the audio and image. With this method, significant visual details from *Cylinder* and *Crystallize* were pointed out, therefore providing possible connotations of the sound waves and validating the possibility of seeing sound on an image. Pierce's triad implemented in musical semiotics by Turino and his definition of the sonic symbol supported the analysis of the linguistic meanings and the imagined sound of the text. Since sound waves alone are icons and are an enigma to an extent, additional text is vital in order to understand the sound, explain, and identify it. Music, sound and voice was decoded through the text and gave an immediate meaning to the examined objects for all artworks in the thesis.

I believed that searching for the gesture in the sound waves will show the aspects of how sound can be noticed visually, through the transformation of the musical gesture into visual detail. I have analysed three types of gestures. The performative - including movements by the musicians; the voice - the sonic dynamics and physical expressions; Agamben's idea of the gesture on a moving image - the movements and shifts themselves or the in-betweens. A sound wave, depending on the sound it represents, encompasses a mixture of the mentioned versions of gestures. It has diverse layers of gestures that are both seen and unseen. Through the amplitudes, frequencies and pitches on the sound waves these gestures are visualised. And through the visual elements on the sound sculptures the gestures are visualized with connotations.

I delimited my choice of empirical material, which departed from the scientific ground. Bruno Latour's theory on inscriptions and immutable mobiles intertwined brought to the scientific discussion when also more artistic visualisations were discussed, including both, digital representations of the sound and the visual sound sculptures. While digital sound waves are signifying the sound directly, the sculptures successfully conceal it. Unlike inscriptions, they require time to observe, read, imagine and sense the sonic. An inscription is a riddle and transformed into a three-dimensional object it immediately adds the visual aesthetic of the sonic what an inscription lacks.

All artists I have examined in the thesis have defined their art differently. Azzaro's voice sculptures, Andy Huntington's and Drew Allan's data sculptures, and Yoshioka's crystal artworks are visually divergent. However, all artworks share similarities. Most importantly, the ideo for the artists' - to visualise a sound, to present it to the spectator and provide a hint to recognise. Azzaro does it unmistakably by visualising the sound wave in a three-dimensional form, *Cylinder* reveals it in the layered surface sections and the titles, whereas *Swan Lake* signifies it the crystal and

additionally the linguistic layer. Each of the artworks has iconic and indexical qualities, which are explained by the symbol. Among other visualisations of sound, scientific or artistic, these artworks visualise it in exclusive approaches, in respect of each sound behind. It is difficult to define which example depicts the sound in a more intrinsic way and in my mind, it is not necessary. It is my priority to find the sound in visuals that are sound waves or sound sculptures. With the artworks, I have proven that sound waves can be transformable and flexible, the depiction can be similar to the inscription, or it can present the sound instead of representing. I concluded that *Swan Lake* is a unique series of artworks that presents the sound of Tchaikovsky's 'Swan Lake'. It excludes the immutable mobile in the visualisation, instead presents it through the crystals directly. This being said, there is no concrete visualisation of sound, and it is ambiguous. It is important to be curious and critical when a sound visualisation is represented or presented.

This research is a start for a typology of visual sound sculptures and can be continued in the future. Since the previous research in this field is not broad enough, the sonic materiality must be investigated visually, and the visual of a sound wave has to be examined from the visual culture perspective.

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Vita

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