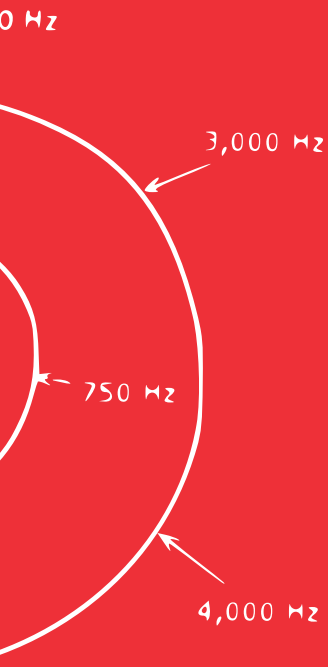
SANDRA BOSS

TUNING THE EAR

Exploring Conditions and Conceptions of Hearing



PhD Dissertation
Faculty of Arts
Aarhus University

Tuning the Ear – Exploring Conditions and Conceptions of Hearing
By Sandra Boss
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2018

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CONTENTS

Prefatory Matters

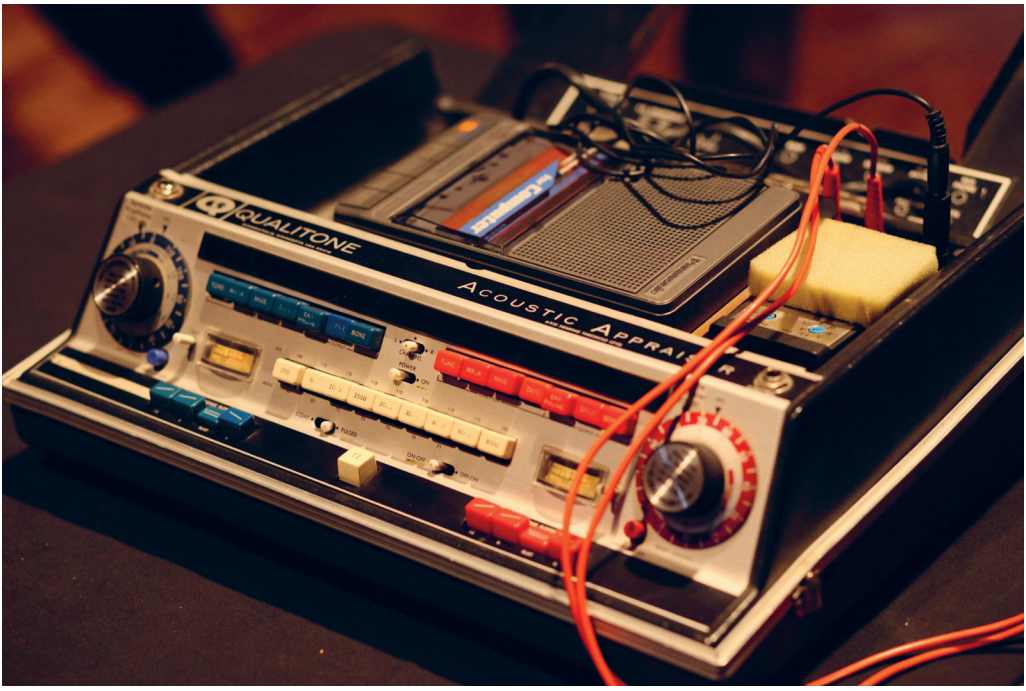
This dissertation is written in fulfilment of the doctoral degree programme conducted at Audio Design, the Graduate School of the Faculty of Arts, Aarhus University. It takes the form of a methodological experiment which employs academic writing, sound, objects and hearing tasks. Three sound works have been developed in conjunction with the writing of this dissertation. They will be presented in the form of documentation and reflexions and will be performed live as part of the formal defence of this dissertation. The complete collection of accessories related to this dissertation is available for the assessment committee and can be provided by contacting the author.

TUNING IN

Find box #1

Place earplugs in ears

SOUND WORKS


QUALITONE
Acoustic Appra

CONCEPT, COMPOSER AND PERFORMER:
Sandra Boss

PERFORMANCES:
Aarhus Kunsthal, Aarhus, DK, 2016
Lydhør på en søndag, Aarhus, DK, 2017
Gallery X & Beyond, DK, 2017
LUFF Festival, Lausanne, CH, 2017
Detritus, Athens, GR, 2018
KRAAK Festival, Brussels, BE, 2018
Fritt Fall, Oslo, NO, 2018

SOUND OBJECT:
Qualitone Acoustic Appraiser (est. 1980ies, USA). The audiometer is a two-channel portable audiometer originally intended for conducting hearing tests. The audiometer comes with a tape machine and a tape that contains a speech test (in German). Each channel can be controlled independently with duplicate controls for tone, masking, microphone and tape. Frequency range 125 Hz to 8000 Hz. Pulse generator, hold and slope functions (the latter is out of function).

DOCUMENTATION:
http://sandraboss.dk/projects/media-art/the-acoustic-appraiser/


HAR DET
SØRG DEN
BARE

MASKINEL TERAPI - Exploring The Imaginary Ear

CONCEPT, COMPOSER AND PERFORMER:
Sandra Boss

PERFORMANCES:
Christianshavns Beboerhus, Copenhagen, DK, 2016
HAUT theatre, Copenhagen, DK, 2016
MIIT House, Osaka, JP, 2017
Super Deluxe, Tokyo, JP, 2017
SOTO, Kyoto, JP, 2017
Paradise Air, Matsudo, JP, 2017

SOUND OBJECTS:
14 pc Meridian Tuning forks: A set of 14 tuning forks bought through Ebay. Shipped from India. According to the seller Tuningforkspro, each tuning fork correspond to 12 major meridians and 2 central vessels. The tuning forks are also useful for 14 major organs and organ systems. In balancing with tuning forks, the vibration of the fork should bring the vibration of the internal meridian or organ group back into the correct vibration to achieve homeostasis.

Marsona 1200 sound conditioner/sleep aid device: A vintage noise generator produced by Marpec. Patented 1978. To be used in order to "neutralize and modify sounds that are typically distracting" and "to promote much needed sleep". The Marsona unit comes with four settings: "Surf I" – a steady wave pattern, "Surf II" – a random wave pattern, "Waterfall" and "Rain". Furthermore, adjustable knobs for tone, volume, surf rate and surf range. There is an onboard speaker, or the sound can be amplified through the 1/4"output.

Vintage Marpec Sleep Mate: A vintage white noise machine consisting of an adjustable fan. Originally produced in the 1960ies. Description from Marpec.com: "Whether for sleep, privacy, concentration, relaxation, or tinnitus relief, Marpac has your sound-masking needs covered."

Electroform Muscle Stimulator Medical 12: Produces electronic vibrations and pulses in order to massage the body. The pulses are amplified and turned into sound signals using the incorporated outputs.

KTK Transcutaneous Muscle/Nerve Stimulator: A device that uses electric current to stimulate the nerves for therapeutic purposes or to treat pain. The unit usually connected to the skin using two or mode electrodes.

Waveform Generator FG 205: A home build function generator. Date of production unknown. Found in a flea market. Originally use is most likely as electronic test equipment. In this setting, it is used to simulate wave therapy. Generates different types of electrical waveforms over a wide range of frequencies, such as sine, square, triangular and sawtooth shapes. Both AM and FM available.

DOCUMENTATION:
http://sandraboss.dk/projects/maskinel-terapi/


2. GÅ UD TIL ET AF DE FEM UDVALGTE STEDER
3. SÆT DIG NED PÅ SKAMLEN
4. LYT, RÅB ELLER LÆS
PERFORMANCES
10. SEP. 2017
KL. 12.00 & 15.00
17. SEP. 2017
KL. 12.00 & 15.00
OM SLIPSHAVNEN
OM NATUREN

SHOUTING OUT LOUD! - Exploring the Mediated Ear

CONCEPT & IDEA:
Sandra Boss, Ina Hjort Jacobsen, Katrine Würtz Hansen

COMPOSER:
Sandra Boss

PERFORMERS:
Sandra Boss, Jonas Olesen, The Naval Home Guard, audience

PERFORMANCES:
Slipshavn, Nyborg, DK, 2017

SOUND OBJECTS:
5 hearing horns made of aluminium, 5 stools

DOCUMENATION:
http://sandraboss.dk/projects/shouting-out-loud/

Remove earplugs from ears

Listen with your own ears

INTRODUCTION

Audiological instruments such as audiometers, sound therapy instruments and hearing horns have been invented in order to explore the faculty of hearing, to diagnose its efficiency, to enhance it or even to cure any malfunctions it might have. The limited sonic material of the audiometer, the carefully selected tones of the sound therapy instruments and the hearing horns' physical enlargement of the ear all introduce a potential for approaching the ear on a concrete and tangible level beyond subjective measurements and cultural preferences. For me as a composer, sound artist and researcher, my interest in these particular instruments has been lit by their promise of approaching the ear in a direct, physiological sense. In these artefacts, I have found a conception of sound as vibrational force that can *tune* the ear.

In this thesis, I will present an investigation into the ear through the many questions that an artistic exploration of selected audiological instruments has generated. Operating audiological instruments within an artistic practice reveals new sonic potential in the technology.[1] However, my aim with this operational research approach has been different. It is not only a question of *hearing* new sounds through the audiological instruments, but rather of exploring *how* this particular technology tunes the ear, that is, how it lets us *hear* and how it produces conceptions of *hearing*. It is my hypothesis that the tuning of the ear appears as the audiological instruments impose not only physical constraints on the hearing sense, but also social demands, imaginary ideals and aesthetic principles.

Within the field of audiology, audiological instruments have been used to present a notion of *hearing* as the quality of pure physical capability. Within this thesis, I will initiate a further investigation into *hearing*. I will trace how *hearing* has been articulated historically across scientific platforms – from audiology and acoustics to musicology and sound studies and I will account for the rather passive and static conception of *hearing* which not only resides within audiology, but also within the field of sound studies. Sound studies is a fairly new and interdisciplinary field of research that does not hold a uniform conception.[2] Yet, one markedly tendency within sound studies has been to propose specific ways for attending to sound and deducing meaning from sound. Scholars such as Pierre Schaeffer, Barry Truax and Salome Voegelin, who represent a specific tradition within sound studies that covers aesthetic-theoretical and epistemological concerns of

1 This approach to technology may recall the intention of early electronic music, where composers such as Pierre Schaeffer, Edgar Varese and John Cage used technology such as record players or reel to reel tape machines as decidedly musical instruments in order to obtain a spectrum of sound that exceeded the canon of conventional instruments.
2 Sterne has proposed a broad characterization of sound studies as a field that "takes sound at its analytical point of departure or arrival". He has also argued that sound studies aims at re-describing "what sound does in the human world, and what humans do in the sonic world". Sterne (2012), p. 2. This very open definition of sound studies should be seen in the light of the research field's interdisciplinary character. Karin Bijsterveld and Trevor Pinch have noted that sound studies touches upon fields such as of acoustic ecology, sound design, urban studies, cultural geography, media and communication studies, cultural studies, the history and anthropology of the senses, the history and sociology of music, and literary studies. See Pinch & Bijsterveld (2011), p. 8. They argue that the various fields have led to "competing definitions of what should be studied". Pinch & Bijsterveld (2011), p. 5.

sound production and sound perception, have presented *listening* as a specific analytical auditory attention that has appointed the ear as a critical, aesthetical and philosophical threshold. In contrast, *hearing*, has mostly been considered as "a necessary precondition for *listening*", as marked by Sterne.[3]

Instead of following the tradition within sound studies that focuses on the act of *listening*, one of the main purposes of this thesis will be to propose a new attention towards the act of *hearing*. The point of departure for exploring *hearing* will go through my artistic operation of selected audiological instruments. Placing these audiological instruments within an artistic framework has created a basis on which to pose questions relating to the conditions and conceptions of *hearing* which technology has produced. This thesis will set out to find answers to these questions by initiating a further investigation into how *hearing* has been articulated historically across scientific platforms – from audiology and acoustics to musicology and sound studies. It will trace a narrative of *hearing* which will depart from research into the discourses on *hearing* that the audiological instruments have fostered. It will present auditory preferences of both the past and the present and it will challenge any intent of reaching standardized conceptions of the ear. The research into the audiological instruments' histories and discourses will not present a conception of what *hearing* is. Rather, it will characterise shifting conditions of *hearing* and point out how these conditions affect conceptions of *hearing*.

However, this thesis is by no means a purely historical inquiry. I will also initiate an investigation into the methodological grounds for doing research on *hearing*. I will explore selected audiological instruments through different methodological positions that take practice as an outset for making epistemic claims. I will use these positions to place a strong emphasis on the act of producing sound and *listening* to sound as a basis for producing knowledge regarding *hearing*. Finally, I will use this thesis to explore an alternative format for presenting research on *hearing*. The written text will be supplemented with an auditory track consisting of a series of hearing tasks in which the reader is momentarily asked to listen to her own *hearing*. These periodically interruptions will target a critical physical sensation of the ear that will propose an alternative research format to the field of sound studies, which traditionally has presented research on sound exclusively through the written word.

Three Sound Works

It is the experience of operating selected audiological instruments in order to create three sound works which has formed the basis for the investigation presented within this thesis. Each of the three sound works has evolved through an investigation into the inherent logic of these audiological instruments. At no point have I followed instruction manuals or audiological prescriptions. I have studied the operative means of the instruments closely in order to become acquainted with their functions and reactions. I have pushed buttons, turned knobs and formed materials in order to explore the full sonic content of the instruments, and I have enhanced particular sounds and acoustical characteristics and omitted others. A short description of each sound work follows.

3 Sterne (2003), p. 96

The first sound work, *The Acoustic Appraiser,* unfolds within a concert format. It departs from a sonic excavation into an obsolete audiometer (hearing test machine). The audiometer is an analogue machine which dates from the 1980ies.[4] In this piece, I have investigated into the sonic material and the performative circumstances surrounding a hearing test. I have explored the intentional sounds of the audiometer, such as the fixed sine tones, the masking tones (noise) and the speech tape, but additionally I have exposed the unintentional sounds such as the inconsistent frequencies, the sudden noises, the variational amplitudes as well as the mechanical sounds that it produces when it is operated. I have incorporated all these sounds into a sonic narrative that moves between an actual hearing test situation and a musical performance. The narrative takes its point of departure from the test situation, but by gradually exploring the apparatus as a decidedly musical instrument, small melodies, rhythms and floating drones appear. However, the musical narrative is frequently disturbed as the sounds of the operating machines are a constant element. The malfunctioning sounds of the audiometer, as well as the general musical exposure of the apparatus, challenge the ideal of retrieving a diagnosis of the ear's efficiency. Accordingly, this work has raised questions regarding the ambition of reaching what I have termed *the otologically normal ear* – an ear that seeks to approach sound beyond any associations and reflections in order to be defined as "normal".

The second sound work with the title *Maskinel Terapi,*[5] takes form as what I will describe as a performance-installation. It comprises strong visual statements as well as musical and narrative elements. Here I have experimented with the physical and psychological effects of sound producing instruments belonging to the sphere of sound therapy. The setup consists of instruments that can be characterised as sound therapy instruments, i.e., acoustic and electronic instruments that are used primarily within alternative practices to affect the body and mind with sound in order to enter into therapeutic states.[6] The setup features tuning forks, sleep machines, massage apparatus, bells and tone generators amongst other. Many of these objects are unfamiliar to most people, and some does not even belong to a therapeutic practice. They only imitate and simulate characteristics that pertain to therapy. The uncertainties regarding the machines' purposes and contexts are exploited in order to support the imaginary potential of the instruments.

The sound work proceeds around a specific setup imitating a sound therapy session. All objects are placed in a circle on the floor. The performers are placed in the middle of the circle, from where they control the different instruments and objects. The audience are encouraged to sit on the floor on the outside of the circle. The sonic material is obtained through an examination of each device's inherent sonic characteristics, resulting in a structure of sine tones, noises or pulses. I have especially enhanced the shrill, impinging high frequencies as well as the deep, vibrating low frequencies and buzzing, repetitive pulses. This specific sonic material has the ability to create a physical reaction in the listener that can question the abilities of sound to not only create music, but also to affect the body and mind physically and psychologically. Consequently, creating a new sonic narrative which both relates to the field of sound therapy and to the field

4 The title of the work is derived from the name of the model of the audiometer.
5 *Maskinel terapi* was made in collaboration with the sound artist Jonas Olesen.
6 A further definition of sound therapy will follow in the chapter *The Imaginary Ear.*

of (electronic) music, has raised questions regarding the epistemic as well as aesthetic potential of what I have termed *the imaginary ear*, which reflects an auditory attention which is constantly confronted with the imaginary properties that sound in general can be assigned to, both within sound therapy and music.

The last sound work takes on a quite different character from the former two. In *Shouting out Loud!*,[7] I have worked with a series of hearing horns which are basically reconstructions of antique hearing horns. The horns were originally produced as part of an art project that encouraged an auditory exploration of a specific and desolate area in Denmark, and therefore this sound work can be characterised as a site-specific performance. The horns were to be carried out into the landscape and as they were placed to one ear at a time the auditory dimensions of the landscape were captured.

The horns are made of aluminium and thereby function as acoustical resonators. The size and form of the horns has an amplifying effect on all incoming sounds which allow for so-called eavesdropping on sonic features that may appear at a great distance. Furthermore, the aluminium acts as a filter that colours the timbre of the sound. In a very simple fashion, this piece demonstrates a point which was also stated by the two other works: The hearing horns tune the ears as they act as concrete physical constrains that both reinforce sounds as well as isolate and manipulate the physical ear. These simple remedies make the listener hear new things. The auditory attention which I have found evoked through working with the hearing horns has raised questions as to the epistemic as well as aesthetic potential of what I have termed *the mediated ear* – an ear that entails a new awareness and sensitivity concerning the basic act of perceiving sounds.

Common for all three sound works is that they evolve around an exploration of the aesthetic dimension of the audiological instruments. Initially, I have focused on the aesthetic dimension as being of particular material interest.[8] This interest pertains to my artistic practice originating in the fields of music and sound art. However, I have also conceived the aesthetic dimension in relation to the philosophical tradition of reflecting upon the nature of art, and in particular to Baumgarden's notion of aesthetics as a sensory circumstance which is cultivated in the meeting with art[9] and to Wolfgang Iser's conception of aesthetics as an attitude one can choose to approach an object or a situation with.[10] Accordingly, I have conceived the aesthetic dimension of the audiological instruments as a sensory experience and an intentional aesthetic contemplation of sound which has become a basis for discussing the audiological instruments' epistemological possibilities, that is, a means by which knowledge of the ear can be accessed and

7 *Shouting out Loud!* was a collaborate piece which was made with architect Ina Hjort Jacobsen and visual artist Katrine Würtz Hansen for a former military harbor in Funen, Denmark. The piece was part of the festival Mod.Strøm 2017.
8 Kyndrup accounts for the tradition within the field of art that operates with an instrumental conception of aesthetics that is attached to a specific art genre (literature, visual arts, music etc.). He notes that aesthetics as a philosophical discipline traditionally has had an "intricate" relation to this conception, as it regards itself raised above it. See Kyndrup (2010), pp. 1-2
9 Baumgarden defines aesthetics as a science concerned with sensory recognition (scientia cognitionis sensitivae) which must be seen in contrast to a logical recognition. For Baumgarden it is central that aesthetic is not art, but science. See Kyndrup (2010), p. p. 14
10 Iser's conception of aesthetics withholds to a notion of "modeling operations" which covers a conception of how a given object is conceived through a particular operation, i.e. a perception, which gives it meaning. See Kyndrup (2010), p. 9

explored using audiological instruments.[11]

Exploring the aesthetic dimension of the audiological instruments has formed an entry for constructing a new narrative on *hearing* which takes *hearing* beyond the passive position it has partaken within the field of sound studies so far, but also beyond the fixed sense-characteristics and ratios it has occupied within the field of audiology. The aesthetic dimension has not enabled me to reach a pure conception of *hearing* beyond subjective assessments, but it has made the epistemic claims concerning the ear become audible, and thereby it has presented an entry for investigating into how conceptions of *hearing* are constructed.

The Research Lab

Within this thesis, I have chosen to describe the audiological instruments that I have operated as exactly *instruments*, instead of for example technology, tool or even media.[12] I use the word *instrument* in order to denote the practical, epistemological and aesthetical implications that my research approach holds, where I have not only considered the sound works as artistic objects, but indeed also as methodological objects for asking questions to the epistemic claims and the auditory attention which are attached to these specific audiological instruments. This conception relates to the etymological outset of *instrument* (from Latin: *instruere*) that covers the act of arranging, preparing, set in order, and literally "to build".[13]

Furthermore, I have used the word *instrument* as an attempt to familiarise or simplify the audiological instruments' function and status. As emphasized by Lewis Mumford, the word *instrument* denotes something that is operated by hand,[14] and, as such, it places an emphasis on modes of operation which do not require unique skills. This conception stands in contrast to the conventional approach to the audiological instruments which has been largely restricted to trained personnel.

My emphasis on *instrument* also serves to denote the artefacts' ability to operate within an ambiguous space extended between science and art. Instruments have played an essential role within the natural sciences since the 17th century, where they were implemented in order to construct what scientist Robert Boyle called *facts*, referring to arguments that could not be modified because they had a strong hold in praxis.[15] However, the word *instrument* obviously also has musical connotations which

11 By epistemology, I refer to the philosophical tradition concerned with studying the nature and the conditions of knowledge.

12 Jonathan Sawday has argued that the term *instrument* predates a conception of technology, see Sawday (2007), p. 2. Later in this thesis (see p. 206ff), I will return to a conception of the audiological instruments as a technology in the Heideggerian sense, and I will argue that these audiological instruments enforce a specific "en-framing", which supports Heidegger's understanding of technology's driving force as located in the way it orders us to understand the world. See Heidegger (1977), p. 12

13 OED (2018)

14 Mumford (1963), p. 10

15 From 1660-62 Boyle presented a series of results based upon experiments with an air pump which became essential to the experimental paradigm in the natural sciences. Boyle used the air pump to prove the existence of non-material entities, which went against a plenistic world view in which the universe was considered full of material. Even though the air pump leaked and had several technical shortcomings, Boyle maintained that it was an essential instrument, which not only generated hypotheses regarding facts but rather produced these facts, as its operation directly staged connections and causes. Boyle' s instrument became an "epistemic resource" and a guarantor of knowledge beyond human subjective assessments. Furthermore, Boyle used the experiments with the air pump to generate new philosophi-

I have explored by approaching the audiological instruments as if they were musical instruments. I have investigated their timbral, dynamic and narrative content by playing on the audiological instruments. By revealing the musical aspects of the audiological instruments, I have found an entry point for posing questions regarding the scientific status of the audiological instruments and for listening to the instruments anew.

As these considerations may already reveal, the process of operating selected audiological instruments as part of this research project has functioned as my research laboratory. Within scientific practices the laboratory has often been described as a controlled area which allows for a studying and experimenting with things beyond their natural environment.[16] By placing the audiological instruments within an artistic framework, I have detached them from their natural environment. This reframing has allowed for an experimentation beyond the original conventions of the instruments' usage. However, it does not constitute a truly objective setting for research, as the audiological instruments have immediately been subordinated to new rules and conventions. These conventions necessarily shape the conception of the audiological instruments, and they turn each sound work into a laboratory for experimenting with "recipient appeals".[17] Accordingly, the artistic settings in which I have placed these audiological instruments have foremost emphasized the artificial and performative character of any research lab.[18]

It is through my operation of the audiological instruments within this extended lab, as well as by listening to the sounds they produce that my main research questions have emerged:

How does technology tune our ears, that is, how does it let us hear and how does it frame our conception of hearing?

And how can the simple act of operating and listening to specific audiological instruments become an epistemic activity?

My research questions partly depart from a technology criticism, as I wish to address the problems arising when technology is used to determine or manifest a standardized representation of *hearing* (in audiology often referred to as the hearing of an *otologically normal person*[19]). Operating obsolete or reconstructed technology in a contemporary artistic setting makes a comment in relation to the validity of the technology. Listening to the sounds of these instruments in operation evokes a new critical sensation from the ear, as the many unintentional noises and malfunctioning parts stand in contrast to contem-

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cal potential. See Shapin & Schaeffer (1985), p. 4

16 Koskinen et al. (2011), p. 55

17 Stougaard (2012), p. 276

18 In *Laboratory Life: The Construction of Scientific Facts*, sociologist Bruno Latour has mapped the artificial character of the research lab. Here he presents an anthropological study of a scientific laboratory at the Salk Institute where he points out the routine practices of the scientists which lead to the construction of scientific facts. See Latour (1979)

19 The International Organization for Standardization (ISO) defines an "otologically normal person" as a subject in a normal state of health who is free from all signs or symptoms of ear disease and from obstructing wax in the ear canals, and who has no history of undue exposure to noise, exposure to potentially ototoxic drugs or familial hearing loss. ISO 226:2003. I will return with a further elaboration and critical perspective on this notion in the chapter *The Otologically Normal Ear*.

porary auditory demands for "high fidelity".[20] Listening to the sounds of obsolete or reconstructed audiological instruments in a contemporary artistic setting necessarily challenges the instruments' original scientific claims of diagnosing and treating impairments of hearing. Yet, my motivation for engaging with these instruments goes beyond merely criticising and revealing the limits of older technology. In many respects, my conception of these obsolete instruments relates to the field of media archaeology[21] where obsolete technology is explored in order to reveal historical ideals but also to create a new awareness towards as to how these ideals are transported into contemporary preferences and habits. I have found that when listening to obsolete audiological instruments we not only hear the sounds they produce and reproduce but moreover, we hear the sound of the reproduction in itself because it differs from contemporary ideals of sound reproduction. When listening to the sound of the medium in operation we become aware of the medium's intermediary function as a maker of meaning.

The Structure of the Thesis

The structure of this thesis does not deliver a linear progression leading to a single argument concerning the audiological instruments' ability to reach *hearing*. Rather it emphasises that the complexity of *hearing* can only be exposed by including a variety of perspectives. I have divided the thesis into three major perspectives which reflect different entries for considering how the ear is tuned, that is, how conceptions and conditions of *hearing* are produced.

After a further introduction to the methodological and theoretical positions which this thesis applies, I will present the first perspective on what I have called *the tuned ear*. This perspective explores the ear by tracing terminological differences between the two terms most commonly used to describe the act of perceiving sound through the ears, namely *hearing* and *listening*. Here, I explore how the field of audiology and the field of sound studies have used these two terms to distinguish particular auditory attentions in order to define the ear as an epistemic basis. Furthermore, I turn to phenomenological analyses in order to pursue an extended notion of *hearing*.

The second perspective on *the tuned ear* investigates the relationship between the ear and technology. Here, I pursue a discursive media archaeological approach, where I explore commercials, newspapers, manuals, photos, webpages, chat fora, sales material and not least historical representations. In this section, I include research into the historical circumstances concerning both early hearing technologies and hardness-of-hearing as it has been presented by scholars such as Mara Mills, Emily Thompson and Jonathan Sterne, but I also present Danish sources and archives, amongst others the history of Danish hearing aid manufacturers, the history of Danish Deaf culture and the development of the field of acoustics in Denmark.[22] These entries enable a counternarrative to the otherwise Anglo-American research on this field. Furthermore, my historical re-

20 High Fidelity, or Hi-Fi, refers to high quality reproduction of sound. The term was originally developed as part of a marketing strategy during the 1950s.

21 I will make further reference to media archaeology later in this introductory section. See p. 34

22 The international distribution of Danish produced audiological and acoustical equipment, such as Oticon, Widex and Brüel and Kjær, has fostered a rich tradition of acoustical research in Denmark.

search follows the wandering of discourses on the ear into contemporary settings of both audiology, acoustics, sound art and sound studies. This emphasis on contemporary discourses within my analyses will serve to illuminate how ideals and imaginaries of reaching standardised conceptions of *hearing* are not only a tendency of the past but indeed apparent in our own time.

The second perspective on *the tuned ear* will also outline three technology-dependent ears which I name *the otologically normal ear, the imaginary ear* and *the mediated ear*: The notion of *the otologically normal ear* is developed by exploring the history of audiometers and hearing tests. Here I introduce John Drever's conception of the auraltypical which enables me to critically discuss the ideal attached to the audiometers of reaching *hearing* as a standardised conception of sound perception. The notion of *the imaginary ear* is presented through histories surrounding hearing cures and sound therapy apparatuses. Here I turn to Eric Kluitenberg's conception of *imaginary media* and Erkki Huhtamo's notion of *the topos,* which I use to designate how sound therapeutic instruments and practices have produced ideals of normalising *hearing.* Finally, I develop a conceptualization of *the mediated ear* through histories of hearing technologies – from hearing horns to cochlear implants. Here I will contrast the histories of these hearing technologies with the theories of mediation presented by Marshall McLuhan and Don Ihde which I use to investigate into ideals of optimising *hearing* through technology. These idealized conceptions of *hearing* are counteracted by phenomenological and post-phenomenological analyses which I use in order to propose extended conceptions of *hearing*.

The third perspective on *the tuned ear* treats the relationship between the technology, the ear, and the operator. I evolve this perspective by describing my own personal experience of operating the obsolete audiological instruments within an artistic setting. As such, this part takes the form of a methodological clearing and of a discussion of the epistemic potential of doing research on sound. I include perspectives from a variety of individual sonic researchers such as Pythagoras, Helmholtz and Lucier, and also from disparate research fields such as media archaeology, phenomenology and object-oriented ontology in order to discuss how the obsolete audiological instruments used within the sound works *actually* let us *hear,* how they tune the ear. Whilst not criticising *listening* as an analytical tool, the account of my practical experiments with these audiological instruments does not only serve as a critique of the act of *hearing* as an impossible ideal, it will also allow for the introduction of a new function performed by the audiological instruments, one which exceeds the aim of standardising, normalising or optimising sound perception.

TUNING INTO TUNING

The term *tuning* has already appeared indiscriminately throughout the opening pages of this thesis. I will now make a tentative consideration of its appliances within this thesis where it will cover concrete ways of affecting the ear's perceptual perspectives, and where it will also appear as a metaphor for a specific research practice. As such, this section will form a terminological clearing but also a further theoretical and methodological designation.

The Tuned Ear

I have found tuning appropriate as a repeating figurative term within this thesis because it is already part of the scientific discourses which this research project relates to – from acoustics and musicology to media archaeology and phenomenology – and, as such, this term invites discussion across scientific fields. Etymologically, tuning departs from a musical notion, referring to a melody or *tune.*[23] However, the word has a variety of connotations covering, for example. tuning into a radio station,[24] tuning a moped or tuning an instrument into a specific pitch. Tuning is also used to describe the behavioural patterns of electronic circuits and digital units and furthermore it is a colloquialism which is applied to describe human mental states or frames of mind.

The many semantic meanings and appliances of tuning all seem to share a basic notion of entities affecting each other in order to reach an ideal state. This notion echoes an acoustic conception of tuning that covers the meeting between two frequencies. Two tones are said to be *in tune* if their frequencies are alike. If two frequencies are just a few cycles apart it will cause *beatings,*[25] where the volume of the sounds alternately interfere constructively and destructively. Physiologically the interference between two slightly similar frequencies will cause an excitement of hair cells in the inner ear that are within the same critical bandwidth along the basilar membrane, which the brain will interpret as a sensation of dissonance or *detunedness.* Thus, tuning must not just be considered a physical phenomenon but also a physiological state.

Within this thesis, I have transferred the physical and physiological notion of tuning into an understanding of how technology imposes physical and physiological constraints on the ear. However, I have also pursued a notion of tuning as imposing perceptual ideals on the ear. This conception of tuning relates to the objective of many

23 OED

24 Ernst has emphasized that a contemporary application of the word tuning is tied to outdated actions, which can be exemplified in the expression *tuning into a radio station*. This expression covers the actual action of turning a knob on an analogue radio in order to reach the correct frequency band of signal representation. As this operation is nowadays digitized, he argues that tuning as a term becomes an anachronism.

25 In acoustics *beatings* covers the physical phenomenon of interference between two sounds of slightly different frequencies, which causes a perception of a tremolo effect, that is a small vibrato.

tuning systems in Western music tradition. Taking one of the first known tuning systems as an example, the *Pythagorean scale* was to reflect an ideal relationship between simple whole number ratios.[26] Based upon his own examinations into perfect number relations, Pythagoras is said to have concluded that "intervals in music are rather to be judged intellectually through numbers than sensibly through the ear."[27] The result of this method was however a scale where the last interval was a quarter semitone too low in comparison to the prior intervals. As such, the scale was constructed upon a fault, which was sensed *false* by the ear.[28] The tuning system structured listening by detecting reference points, however these reference points were challenged as they did not manage to live up to their own precepts.

Today, we do not hear the impureness found in the most common contemporary scale of the equal temperament. Our ears have adjusted to this scale, they are accustomed to this tuning and they have accepted the inconsistencies and imperfections that this tuning system is constructed upon.[29] On the contrary, listening to the Pythagorean scale or the later scale of just intonation with contemporary ears will appear with a pureness and clearness that we no longer recognize and therefore will dismiss as being *out of tune*. Consequently, confronting the differences of tuning systems of the Western music tradition emphasises a conception of tuning not only entailing the function of tuning sound into ideal states but also of tuning the ears to perceptual ideals.

Within this thesis, the acoustical, psychoacoustical and musical conceptions of *tuning* will be related to a broader notion of *the tuned ear*, which is a concept I have found reflected in the writings of the German physician and physicist Herman von Helmholtz. In his influential publication on acoustics: *On the Sensations of Tone as a Physiological basis for the Theory of Music*, Helmholtz designates the ear as an instrument that can be tuned. According to Helmholtz, the listening subject is characterised by its ability to inhabit different attitudes which enables it to move indiscriminately between demands from both the psyche and the physical body.[30] However, through practice and habit, the ear is trained into ignoring essential elements of a sound's character:

> "We are, indeed, not only unpracticed in observing these subjective phenomena of the senses, but we are even extraordinarily practiced in doggedly abstracting from them, because they would disturb us in the observation of the outside world."[31]

This habitual listening mode makes Helmholtz describe the ear as generally fallible and unreliable - even deaf.[32] But Helmholtz points towards a specific listening strategy that can bring the ear out of its passive state. By incorporating instruments, such as organ

26 It was constructed by the succession of pure fifths and octaves because these intervals (3:2 and 1:2) were considered the purest relations. See Bibby (2010), p. 15
27 An octave contains 1200 cents, and a fifth 702 cents. Departing from C major scale and taking succeeding fifths up, the last interval going a fifth up from B will result in a note that lies between F and G, but which is smaller than a semitone. See Wood (1975), p. 182
28 This fault has later been named *The Pythagorean comma*. To avoid this fault, melodies were to avoid the last interval.
29 For trained persons or persons with perfect pitch it is possible to detect the impurity of the equal temperament. See Cook (2001), p. 189
30 Helmholtz (1954), p. 4
31 Helmholtz cited in Steege (2012), pp. 103-104
32 Steege (2012), p. 81

pipes, tuning forks and sirens in the actual listening act the ear can be activated so as to pave the way for a sonic perception that can shed new light on the construction of accepted aesthetic norms. Hence, the instruments used in Helmholtz' experiments serve as sonic microscopes that amplify or intensify the sensation of sound and thereby activate the ear out of its passivity.

Helmholtz' exploration of systems of tuning and tuning instruments has inspired me to approach the ear as an instrument which is tuned as it enters into a relation with audiological instruments. The ear is both tuned physiologically, as the sounds of audiological instruments impose physical constraints on the ear, as well as it is tuned by cultural ideals, amongst others the ideal of pertaining to a standardised conception of what *hearing* is and should be. This conception of tuning will be denoted throughout this thesis, where tuning will occur as a term to illuminate the many transitional states the ear enters into through its relation to audiological instruments. Tuning will appear in order to accentuate how the ear alternates between conscious and unconscious modes of perceiving sound and it will also be applied to connote the aim of reaching an impossible ideal which, in the case of audiological instruments, is the aim of reaching and affecting the performativity of the ear through objective means. I will trace historical tunings of the ear by exploring the history of these audiological instruments and exposing the ideals of *hearing* that these histories entail. But I will also account for my own experiments of tuning the ear with audiological instruments, which I have carried out within the framework of the three sound works of this research project.

Tuning as a Methodological Stance

Beside tracing tunings of the ear through the histories of the audiological instruments and through an exploration of their aesthetic dimension, tuning will cover the general methodological approach which has governed this research project. I will argue, that this research project has been developed just as much as a methodological experiment as well as a historical and perceptual inquiry, as I have deliberately pursued a kaleidoscopic perspective for studying these instruments. I have related particular aspects of the audiological instruments to different methodological and theoretical positions. However, I have not used these fields to present comparative analyses of different theoretical positions, nor to valorise one theory over others. Instead, the positions have appeared sequentially according to their relevance for enlightening the isolated perspectives of the audiological instruments. Accordingly, my methodological approach can be characterised as a way of tuning, as I have used the audiological instruments as prisms through which different theoretical and methodological statements have been reflected and tested.

Common to many of the fields which I will tune into in order to enlighten certain aspects of the audiological instruments and thereby certain aspects of *hearing*, will be that they prioritize a specific methodological stance for doing research, where the act of doing, of entering into a practical dialogue with a specific material, forms a way of thinking. I will tune into the perspectives of the audiological instruments through the phenomenological research methodology of Martin Heidegger and Maurice Merleau-Ponty, and through the post-phenomenological approach of Don Ihde, where the

act of using an object forms a particular kind of knowledge production.[33] I will also turn to methodologies linked to fields such as audiology, media archaeology, sound studies, sound art, aesthetics, object-oriented ontology and artistic research, as well as to the methodologies of individual practitioners such as Pythagoras, Helmholtz and Alvin Lucier, that all encourage for practical explorations of objects in order to form new epistemic claims. These positions align with my own scientific practice, which takes its point of departure from the act of creating the three sound works discussed in this thesis. Within this research project, I have not only considered the sound works as artistic objects but also as methodological objects for asking questions relating to the epistemic claims and the auditory attention which are attached to these specific instruments.

As a consequence of my research approach of tuning into many different research fields in order to investigate into the many questions that working with audiological instruments within an artistic setting has brought about, the theory and methodology of this research project will appear as intertwined throughout this thesis. However, some theoretical and methodological positions will appear repeatedly, and I will therefore offer a further introduction to these fields in the following.

Tuning to Audiology

As I already stated in the opening lines of the introduction, my artistic argument for working with audiological instruments stems from a fascination of the approach to sound and *hearing* that audiological technology entails. The audiological perspective contains a specific epistemological conception, where sound and listening are considered the basis for reaching knowledge. Here sound is used as physical impulses to create a reaction from a listening subject which allows for measurements of *hearing*. Another reason for my interest in audiological instruments stems from the fact that audiological apparatuses reflect an essential epistemic dilemma. As emphasized by Sterne, everything that is known about the natural state of *hearing* is a product of an interaction between technology, sound and the ear.[34] Audiological instruments are used to reach a common ground for approaching a notion of *hearing* in relation to fixed parameters which in turn allows for a generalised and comparable conception of sound perception. Thus, our access to *hearing* will always go through some kind of mediation.

An introduction to the field of audiology is pivotal for constituting the scope of my research. Audiology is an interdisciplinary field which includes medicine, psychology, acoustics and even pedagogy. It deals with *hearing* and its impairments and it operates across a wide branch of scientific fields such as acoustics, anatomy, physiology, psychoacoustics, medicine and neuroscience. Within audiology, the act of *hearing* is approached through studying the physiological, mechanical and psychological processes that appear when sound enters the ear. Audiology strives to represent an "objective assessment of

33 Heidegger's "hammer-example" stands as the most iconic example of the tradition within phenomenology which has placed an emphasis on practical engagements. Here the hammer and its practical uses open up an exploration of the meaning of being. Later in this thesis, I will return with a further description and discussion of this example and how it reflects Heidegger's general research approach. Merleau-Ponty's phenomenology builds upon examples where the phenomenological concepts of *epoché* and *reduction* amongst others are carried out in praxis amongst other in specific physiological situations and in the praxis of art.

34 Sterne (2015), p. 116

hearing",[35] which is pursued through statistical behavioural tests and physical measurements of the ear. Behavioural tests are based upon a test person's response to incoming sound stimuli and his or her ability to detect, discriminate and identify the stimuli.[36] The reliance on the test participant's subjective interpretation constitute the main limitations of reaching an objective assessment of *hearing*. In order to overcome the inadequacy of the behavioural tests, contemporary practices of audiometry have turned to physiological tests using electrophysical measurements, most commonly known through otoacoustic emissions for example.[37]

The historical origins of audiology are directly linked to the introduction of new technological means for exploring and combatting hearing impairments – a development that Mara Mills has outlined in her research on disability studies.[38] Until the turn of the 20th Century, hearing loss was generally considered as unwanted as it was related to diminished intelligence.[39] Hearing impairment was something to combat or even ignore. New technology introduced novel means for examining and treating the ear and thereby overcoming any deviances. Furthermore, the technology introduced the possibility of reaching a standardised conception of *hearing*. However, the implementation of different technology – from organ pipes to audiometers – has led to very different conceptions of *hearing* and a static notion of a standardized ear must, even today, be regarded as an ideal. I will return to this notion throughout this thesis.

My take on audiology within this thesis will depart from the perspective offered by the technology, and thereby the industry, rather than from the patient's perspective. Even though there is no doubt that audiology has contributed immensely to the recuperation of hearing impairments and has made a significant contribution to combatting the social stigmatization of deaf individuals,[40] the benefits or disadvantages of specific audiological instruments for the individual remain outside of the scope of this thesis. I do not seek results applicable for doing audiological research, rather my approach to the audiological field is primarily historical and perceptual, as I focus on how *hearing* has been articulated within this field over the course of history and how these audiological instruments open up specific auditory experiences. I will reflect upon the methodology used for obtaining knowledge of the ear where sound is considered a research material and an epistemic resource and I will turn attention towards the ideals of *hearing* that this methodology has fostered.

35 Hall & Swanepoel (2016)
36 Poulsen (2016), pp. 180-81
37 Otoacoustic emissions are low-level sounds emitted by the cochlea either spontaneously or evoked by an auditory stimulus. These sounds can be measured with a sensitive microphone in the ear canal. Otoacoustic measurements are primarily used to test for hearing defects in newborn babies and in children who are too young to cooperate in conventional hearing tests. See Gelfand (2016), p. 315.
38 Mills (2010, 2011a, 2011b, 2011c, 2011d, 2015)
39 Mills (2012), p. 46
40 The audiological instruments' role in the social stigmatization of deaf individuals is ambiguous, as noted by Mills. On one hand the technology has allowed communication between people with and without hearing loss, however the technology has also been used as an advocate for oralism and thereby poses a threat to sign language and the culture surrounding this form of communication. See Mills (2012)

Tuning to Aesthetics

On one level, my artistic argument for entering into an exploration of audiological instruments can be seen as part of a larger tendency within *sound art,*[41] where sonic material is explored through a close tie with the natural sciences. Many sound artists have turned to the field of psychoacoustics for example, wherein the psychological effects of the physical impact of sound is explored. The psychoacoustic effects of the sonic material form an aesthetics, in the sense that they propose a specific material for artistic expression which leads to a particular sense situation.[42] It forms a sonic aesthetics which is concerned with staging entries for new perceptual relations between the sound and the listener, rather than an aesthetics which is preoccupied with offering a transcendental valuated production of insight. The sound work is not a container that emits beauty or truth in an ancient conception of aesthetics, neither does it represent a privileged recognition transported from an artist via the artwork and out into the world, as in the Modern conception of aesthetics.[43] Instead it is a basis for staging perceptual relations.

Artists such as Alvin Lucier, Maryanne Amacher and Jacob Kirkegaard have worked extensively with psychoacoustic phenomena, such as *beatings* or *combination tones*.[44] They have incorporated fundamental acoustic phenomenon and knowledge regarding reaction patterns in the ear within their sonic works in order to raise a physical awareness of sound which exceeds traditional musical expectations of, for example, harmonious progressions or melodious narratives.[45] I will return to the practice of these artists later in this thesis in that their work incorporates a specific conception of aesthetics which places an emphasis on physical aspects of sound and physiological aspects of sound sensation through an exploration of audio technology. Their work has a strong kinship to the sound works I present within this research project, where sound is also presented as a concrete physical force and where I am interested in exploring how an aesthetic staging

41 Sound art is not a uniform field referring to a specific sound material or a specific listening setting. Even the term sound art entails many different interpretations. Douglas Kahn suggests the term "sound within the arts", which serves to point towards the fact that the term sound art is a fairly new. However, the act of using sound within the arts holds a longer history. Kahn ("The Art of Sound and Music", date unknown). Rune Søchting has also pointed out that sound art is still considered a rather new phenomenon despite the fact that sound has appeared as an integrated part of art since the 1960s and even before. He accounts for two different traditions of sound art, one connected to the German concept of klangkunst and another connected to the English notion of sound art. Søchting argues that klangkunst appears as genre with specific formal requirements, whereas sound art appears as a more open concept which is associated with theoretical determinations of sound as a phenomenon. See Søchting (2015)

42 This definition recalls my introductory conception of the aesthetic as related to both a particular artistic engagement with objects, as wells as to philosophical traditions which place an emphasis on the perceptual and relational circumstances evoked in an artistic setting.

43 Amongst others this conception of aesthetics departs from Hegel and his lectures on aesthetics from 1817-1829. See Kyndrup (2010), p. 21

44 *Beatings* are caused by an amplitude modulation which occurs when two tones close in frequency are sounded simultaneously. The perceived pitch is the average of the two tones, and there is an audible vibrato or *beating* at the difference frequency between the two tones. *Combination tones*, also known as Tartini tones, are a phenomenon occurring when an additional tone or tones are artificially perceived when two tones sound at the same time. They are generated by the frequency differential of two pitches or the sum of their frequencies. Their discovery is credited to the violinist Tartini.

45 Alvin Lucier's work is closely tied to scientific practices. His composition *Music for Solo Performer* (1965) featured sounds generated by brain waves in a live performance. In *Crossings* (1982), tones play across a steadily rising sine wave producing interference beats. *Still and Moving Lines of Silence in Families of Hyperbolas* (1972) works with the interference tones between sine waves. Maryanne Amacher worked extensively with a set of psychoacoustic phenomena known as auditory distortion products, where sounds generated inside the ear are clearly audible to the listener. Likewise, in the piece *Labyrinthitis* Jacob Kirkegaard has worked with otoacoustic emissions generated by the artist's ears in order to produce otoacoustic emissions in the ears of the listeners.

of acoustical phenomena can create a new auditory awareness.

However, listening to any of the apparatuses which are part of my sound works immediately reveals that something else is also at stake. The performative and sonic appearance of the machines undermines any intent of reaching a purely physiological sensation or psychoacoustic staging of the ear. For example, pushing a button on the Qualitone Acoustic Appraiser, an audiometer produced in the 1980s, activates fluctuating frequencies and rattling mechanical parts, which drowns the machine's inherent epistemic claims of reaching the efficiency of the ear through pure tones. Similarly, the unsteady rhythms and interfering noises of the vintage sound therapy instruments appear as almost naive attempts to stimulate the ear through physical vibration. Even applying a hearing horn to the ear, which physically enlarges the pinna, leaves the physiologically sensation of sound entangled in a metallic timbre instead of facilitating an untainted amplification of incoming sounds. Despite the fallible character of the apparatuses, I will still argue that they *tune* the ear. They activate a specific auditory sensation where epistemic claims concerning *hearing* become audible.

Many of the instruments which appear in my sound works are obsolete or mimic auditory preferences of the past through their reproduction qualities, materials and visual design. The audiometer is an instrument used to perform audiometric tests in the 1980s. The sound therapy instruments are a collection of objects which have either been used within sound therapy practices or mimic our imaginary notions of what a sound therapy instrument might be. Finally, the hearing horns which I use are inspired by the form and design of ear trumpets as they appeared from the 18th to 20th century. My interest in the technology of the past stems from a fascination with their immediate appearance: Their design, their sounds and their means of operation represent an approach to sound which stands in stark contrast to the digital mode of sound representation governing our present time. Admittedly I have approached these technologies with a nostalgic perspective. However, my interest in specifically obsolete audiological devices goes deeper, as their operative design is constructed upon an immanent reliance on sound as an epistemic tool. The devices have all been used to judge the efficiency of hearing or effect the hearing sense according to a set of carefully selected tones or materials. Yet, applying these devices in a new context immediately deconstructs their authoritative status as scientific tools, as we now hear the inconsistencies and noises of their operational design: We hear the ideals of the past sounding out in a contemporary setting and, in that moment, we also hear our contemporary ideals in relation to sonic representations.

My focus on obsolete media is part of larger tendency in both art, academia and everyday life, where old media reappears. Our sonic past has in many respects reached a larger and more audible position in our time, as evidenced by the revival of interest in the physical objects historically associated with the reproduction of sound, such as the vinyl record and the cassette tape, and in the simulating of the mediated timbres of the past, as demonstrated by apps and plug-ins that mimic tape filtering or record hiss.[46] The

46 An example of this tendency is the *Delitape App*, which "transforms the iPhone into a retro Walkman". When a song is played, the app "simulates the hisses of an old cassette tape." (Delitape 2018). Another example is the app *Vinyl – The Real Record Player*, which turns an iPad into a virtual record player by offering the characteristic sound of seven different record players. The app allows for listening "to your music the old-fashioned way, while enjoying a crisp design" (Vinyl

thematisation or "retrofication" of the sonic preferences of the past, is also apparent in the contemporary art scene, where artists such as Aura Satz, Christian Marclay, Morten Riis and Vinyl Terror & Horror reinterpret the sonic technologies of the past by incorporating them within new settings or operating them in new fashions. In the *Dead Media Project* produced by Bruce Sterling this tendency of engaging with sonic objects or sonic articulations of the past is accounted for as a reaction to the continuous appearance of new sound formats and new sound technologies, where one medium replaces another medium before the first one has not yet settled.[47] Another reason for this focus on obsolete media may be, as the artist Paul DeMarinis notes, that we live in a time where we "experience our own archaeology on a daily basis,"[48] because technology quickly decays as new technologies constantly enter the arena.

Tuning to Media Archaeology

I will argue, that the tendency of exploring obsolete sound media constitutes itself as a discipline that goes beyond any transient trends or *retromania*.[49] It is a means for evoking a new mode of critical listening which explores the essence of sonic authenticity. Within this thesis I have turned to the research field of media archaeology in that it offers an entry point for exploring the media of the past which supports this argument.

Media archaeology is a research discipline that takes its point of departure from Michel Foucault's notion of archaeology as described in *The Archaeology of Knowledge* (1972). From Foucault's perspective, archaeology becomes a way to treat the past by focusing on the mistakes, faults, shortages and deviations that have been left behind. The excavation of the past is obtained through discourse analysis, which is a methodology for rewriting or transforming what has already been written and for determining what has been omitted. Discourse analysis breaks with the reiterative process, where a set of meanings are constantly reaffirmed. It indicates how one particular statement appeared rather than another.[50] By looking at ruptures, breaks, mutations and transformations - including marginal or forgotten discourses – a new understanding of the production of knowledge can occur.

The research discipline of media archaeology adopts Foucault's method of discourse analysis. Media archaeology has been developed by authors such as Wolfgang Ernst, Erkki Huhtamo, Siegfried Zielinski and Jussi Parikka, who all accentuate that media of the past entails the possibility of analysing and presenting aspects of media that would otherwise escape the discourse of cultural history.[51] With the media archaeological frame in mind, my exploration of obsolete technology entails the possibility of presenting alternative or neglected media stories. More importantly however is that the media archaeological approach allows consideration of the audiological equipment as sedimented and layered. These technologies are not just artefacts of the past but contain close ties to

– the real record player, 2018).

47 Sterling (1995)

48 DeMarinis (2011), p. 211

49 In his book, *Retromania*, Simon Reynolds examines the "retro industry" where objects from an immediate past, such as vinyl records, are cultivated. Reynolds (2011)

50 Foucault (1972), p. 27

51 Ernst (2011), p. 240

the technology of our own time. Marshall McLuhan once noted that any medium contains another medium,[52] and in media archaeology this statement is updated in the idea that new media remediate old media.[53] Thus, the media archaeological approach offers the possibility of further exploration of obsolete media as more than a "nostalgic cabinet of rare media".[54] It entails the possibility of unfolding a cyclical approach to history, where technological development is not only considered as a line of constant progress but rather as an interchange between historic and contemporary modes of thought.[55]

There is no general agreement on methodological approaches or a specified research field of media archaeology.[56] Yet, the term has indeed inspired historically tuned research, which also characterises my work within this thesis which is concerned with using history to point out aspects surrounding our contemporary relation to technology. As such I follow Ernst's way of thinking about history as "present in our culture".[57] Despite being a relatively small field of research, two distinctive approaches within media archaeology can be characterised, which Huhtamo and Parikka have designated as "a socially and culturally oriented Anglo-American studies and the techno-hardware approach of German scholars".[58]

The first approach has close ties with Foucault's discourse analysis as we here find an emphasis on words, libraries and archives. Huhtamo evolves this media archaeological concept through a tracing of *the topos* which he describes as "a stereotypical formula evoked over and over again" expressing cultural desires and influencing the development of media culture.[59] Huhtamo derives the term *topos* from the theory of rhetoric in classical antiquity, where topoi (plural) were "storehouses of trains of thought" or "clichés".[60] Identifying the topos can explain the cultural logics that condition their wanderings across time and space. Another socially oriented approach to media archaeology is conducted by Eric Kluitenberg, whose approach reflects an attempt to shift attention somewhat away from a history of the apparatus in order to focus on the imaginaries and "histories" surrounding technological media.[61]

The second approach valorises a practical exploration of media. This approach to media archaeology adopts the work of Friedrich Kittler and Wolfgang Ernst,[62] who have emphasised a material consideration of media objects, which opens up a new approach for doing research and specifically for doing research on sound. Kittler argued for "the need to adjust Foucault's emphasis on the predominance of words and libraries to more media-specific ways of understanding culture"[63], and he urged particular con-

52 McLuhan (1967), p. 22
53 Bolter & Grusin (2000), p. 45
54 Ernst, (2011), p. 240
55 Zielinski (2006), p. 7
56 As underlined by Huhtamo and Parikka in their introduction to *Media Archaeology, Approaches, Applications and Implications* (2011)
57 Parikka's description of Ernst's notion of history in Ernst (2013), p. 3
58 Huhtamo & Parikka (2011), p. 8
59 Huhtamo (2011), p. 28
60 Huhtamo (2011), p. 29
61 Kluitenberg (2006) p. 48
62 Ernst has adopted Kittler's emphasis on "media materialism" (Parikka 2013), however Ernst is not a directly follower of Kittler. Ernst's background as a classicist and historian has formed his approach to media theory.
63 Huhtamo & Parikka (2011), p. 8

sideration of the material nature of a "techno-historical event".[64] Ernst also distances his conception of media archaeology from the mere intentions of redeeming "forgotten or misread media of the past" or reconstructing "the crude beginnings and prehistories of technical media". [65] Ernst calls for a decidedly close reading of media objects through a tactile investigation of media.[66] He notes that even though the outside world of the media may have vanished, their "inner world" is still operative, which potentially entails the ability to "undo historical distance simply by being present".[67]

Within this research project the media archaeological field has added methodologies for exploring the cultural conditions surrounding audiological instruments but also the perceptual modes that an engagement with obsolete media can evoke. The media archaeological approach has enhanced a comprehension of how obsolete media not only reveal the ideals of the past but also create a new awareness as to how these ideals are transported into contemporary preferences and habits.

Tuning to Phenomenology

Whereas the media archaeological approach has enabled me to research further into both the cultural context and temporal matters of the audiological instruments, the field of phenomenology has supplied me with further methodological means for investigating the auditory attention produced by the audiological instruments. Furthermore, the phenomenological approach has proposed a language for describing the perceptual dynamics evoked by the audiological instruments. As this thesis will draw from several approaches within the phenomenological tradition, such as the phenomenology of Husserl, Merleau-Ponty and Heidegger, as well as the post-phenomenological approach of Don Ihde, I will introduce some of the core phenomenological principles in this section.

Since Edmund Husserl's foundation of phenomenology as a philosophical position, the ambition of phenomenology has been to describe phenomena as they appear through our relation to them. As such, phenomenology already suggests a different methodology for approaching the ear than either the audiological or the media archaeological approach as it does not focus on exploring phenomena as epistemological sources, that is as objects that can lead to knowledge of a present and independent world or to a theory which can present a uniform definition of experience. Phenomenology seeks to uncover the structures of consciousness, as it is from consciousness that the world appears. The exploration of consciousness departs from the subject's perspective on the world. This departure differs markedly from the research approach of audiology for example, which operates with an empirical subject which turns the subject into an object in the world.

Husserl argues that phenomenology has to position itself in relation to the models for recognition presented by the natural sciences. The natural sciences have produced accepted truths, which Husserl determines as *the natural attitude.*[68] *According to*

64 Kittler (1999), p. 229
65 Ernst (2013), p. 56
66 Ernst (2013). p. 185
67 Ernst (2011), p. 241
68 Husserl (1999), p. 17

Husserl, the natural attitude is necessarily challenged when a deeper reflection concerning knowledge is initiated.[69] Husserl's ideal is to reach a motivated knowledge which can go against the biased presumption that the pre-philosophical life is constructed upon. The strongest of such presumptions is that there resides a reality which is independent of consciousness, that is, a reality which we are part of but whose existence appears independent of us. In order to avoid metaphysical as well as scientific prejudices like this, Husserl argues that we should turn against the world as it appears and be governed by what is actually there, hence his maxim: To the things themselves!

In this maxim lies the central pillar of the phenomenological approach which builds upon the concepts of *epoché* and *reduction*. Epoché covers a methodology for reaching a new type of experience, thinking and theorising for philosophy, which moves beyond any dogmatic or prejudiced approach to the world. Epoché covers the act of setting all habitual thinking aside. It does not aim at ignoring or excluding that part of the world which one moves within but rather to avoid a dogmatic approach to the world. This unbiased approach to the world can lead to new philosophical mindsets and, as such, epoché provides room for a new meeting between the subject and the world. Epoché is part of a functional unity with the notion of *reduction*. In reduction we are to concentrate on the way things appear to our consciousness. Instead of focusing on external things, reduction encourages a focus on how we are conscious of something. *Reduction* thus becomes a specific kind of reflection which emphasises how certain things appear to our consciousness. By entering into this kind of reflection we are led to the departure point for perception as such.

By performing reduction subjectivity becomes a condition for any kind of manifestation. Any object will always manifest for someone and thus the world is dependent upon a subject in order to manifest. Where *epoché* liberated us from *the natural attitude, reduction* exposes our *transcendental subjectivity,* [70] which hitherto had been hidden for us.

By incorporating the subject and its experiences it becomes clear that it is *for* consciousness that anything appears. Therefore, it is necessary to turn to this consciousness that perceives the world, because it is only here that the objects appear as they are.[71] But what is consciousness according to a phenomenological mindset? Husserl argues that consciousness is what characterises human beings. Consciousness is determined by a particular kind of focus, which he calls *intentionality*. Husserl accentuates that the subject will always be conscious about something, that is, consciousness is characterised by its way of *intending* an object. Husserl emphasises that the appearance of things depends upon the relationship it enters into, that is the relation to the subject that perceives it. The appearance of things is thus related to a body, as the body is the absolute basis of any experience. The body is characterised as being part of every perceptual act. It is from the body's placement in the room and through its movements and actions that any perceived object is related. Any experience of the world is communicated through the body and made possible by the body.[72]

Within this thesis I will often return to the concepts of *epoché, reduction, the natural*

69 Husserl (1999), p. 17
70 Husserl (2012), p. 315
71 Zahavi (2011), p. 22
72 Zahavi (2011) p. 146

attitude and *intentionality*. I will use these concepts to analyse the auditory attention that the audiological instruments evoke and to explore an extended notion of *hearing*. In sound studies and musicology there is already a strong tradition for turning to phenomenology in order to explore how sound objects are perceived, and as I have already noted in the introductory lines of this thesis,[73] phenomenology has been used to propose *listening* as an epistemological term. I will take account of this tradition but my intention in implementing phenomenological and post-phenomenological analyses will not be to create a new awareness of the sound object but rather of how we can become conscious about how we perceive sound and how our perception is formed by technology.

Tuning to Artistic Research

Phenomenology has a strong hold in the field of sound studies – a matter that I will return to later in this thesis. However, in recent years, new approaches for doing research on sound have emerged, which add many new entry points for approaching sound and listening as epistemic resources. The researcher, artist and media archaeologist Shintaro Miyazaki performs sonic analytics based on listening to computational algorithms related to software-induced breakdowns of distributed networks, where the sound of the operational technology is approached as a rhythmical language.[74] Another artist and media archaeologist, Morten Riis performs *alien phenomenology* in order to reach an understanding of how the technological objects in his sound art piece *Opaque Listening* listen.[75] The electro-acoustic composer Cathe van Eck operates devices that convert sound waves into electricity and back (microphones and speakers), in order to examine the alleged transparency of these technologies.[76] Common to these artistic engagements with sound technologies are that they introduce new ways of operating technology which in turn raise new philosophical questions which opens up a discussion of the technologies' epistemic claims.

These methodological approaches are aligned with the contemporary field of artistic research. Kathrin Busch has characterised artistic research as a constant negotiation between academia and artistic practice.[77] She notes that artistic research is not aligned to a specific theory or methodology, rather it is a field which contains many different methodological approaches which nonetheless all use artistic practice as a basis for producing new knowledge. As such artistic research shifts the status of the art work within academia as it is transformed into a methodological object rather than an object of analysis. However, this creates new demands on the artistic process. Critical voices have argued that artistic research signals a shift in the very nature of producing art which has led to its academisation.[78] Others have argued that the fusion between art and research reflects an attempt to enter into a new knowledge economy.[79] The preservation of the authority of the art work in an academicized context is thus particularly apparent

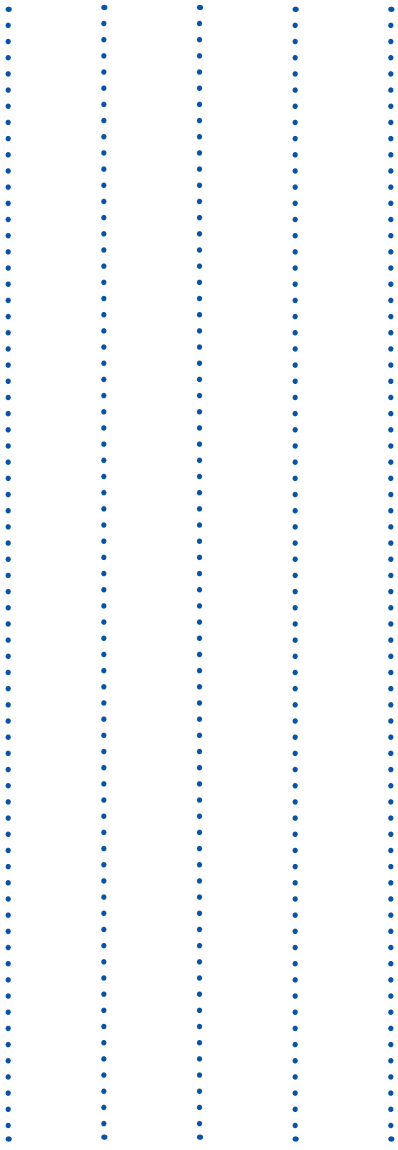
73 See pp. 18-19
74 Miyazaki (2012)
75 Højlund & Riis (2015)
76 van Eck (2013)
77 Busch (2009), p. 1
78 Schwab & Borgdorff (2014), p. 9
79 Schwab & Borgdorff (2014), p. 9

in the literature concerning artistic research.

In many respects, artistic research forms the departure point for this research project. However, the artistic research of this project is foremost characterized by its refusal of attaching to one methodology only. The artistic research of this project lies in its practical and aesthetical exploration of the audiological instruments, which has formed an outset for exploring a wider contextual frame of *hearing*. Within this research project my interest does not lie in discussing the authority of the art work. Instead I am looking to approach artistic research through some of its problematic issues and to ask when can artistic research be considered scientific, does it acquire a specific approach to the work of art or a specific process and can an artistic practice of engaging with audiological instruments within an aesthetic setting form epistemic arguments?

THE EAR

What do you *hear*?
Write it down



THE EAR

> "How can we explain the different sonic experiences? Sound can generally be defined as a stroke which the air passes through the ears to the brain and blood and is passed on to the soul. The movement that the stroke causes, and which begins in the head and ends in the area around the liver, is the faculty of hearing."
> (Plato, *Timaios*, 29b)[80]

Reaching a conception of how sound is sensed and perceived has been at the central concern for philosophers since ancient times. Commonly the act of perceiving sound through the ears has been articulated through the two words *hearing* or *listening* which denote different epistemological bases for the functioning of the ear. In this section, I will propose a possible conceptualisation of these two terms which will serve to open a further investigation into how standardised and ideal notions of the ear have been cultivated through discourses found primarily within the fields of audiology and sound studies. I will point out a distinction in auditory sensitivity which I have found attached to each of the two terms. Additionally, I will expose how phenomenology in large part has been used to relate the act of *listening* to an epistemic potential. Through further phenomenological explorations of the act of *hearing* I will propose a re-evaluation of the epistemic potential of the ear.

My conceptualisation of *hearing* and *listening* is meant as an introductory take on a general issue concerning a discursive or non-discursive approach to sound, which I will return to frequently throughout this thesis. I will use this terminological basis to explore some of the epistemological issues that I have encountered through my artistic exploration of the audiological instruments, but I will also use it to present the methodological concerns that I will argue that any research on sound necessarily must raise – regardless of whether they are audiology, sound studies or as part of aesthetic practices.

The Primitive Ear

The etymology of the two terms *hearing* and *listening* emphasises a clear division in auditory sensibility. *Hearing* has Germanic roots[81] and connotes the action of perceiving sound or "to be aware of something by means of the ear".[82] *Listening*, on the other hand, has its origins in the notion of "paying attention to", underlining the deliberate action of comprehending what is heard.[83] This distinction in sensibility has been emphasised by some authors by looking into the evolutionary development of the ear. In his 1985 essay "Listening", Roland Barthes defines *hearing* as a physiological phenomenon that is

80 Platon (2013), p. 603, translated from Danish to English by SB.
81 The Germanic root of hearing is heran, OED
82 OED
83 OED

oriented by indices. He emphasises that, on this level, nothing distinguishes human from animal as sounds are perceived as alerts.[84] *Listening*, on the other hand, is defined by Barthes as the moment where man is separated from animal, where the ability to interpret and decipher signals into other perceptual territories begins.[85] A similar distinction in human auditory sensibility has been defined by the Canadian composer Barry Truax who also aligns *hearing* to the evolutionary imperative of creating physical orientation, whereas *listening* is characterised by its ability to interpret information.[86] In the thought of Pierre Schaeffer I have also found a notion of a primordial mode of sound sensation, which provides a basis for a further elaboration of *hearing.* Even though Schaeffer's conception of *entendre* is most commonly translated into the English verb *to hear,* it is in Schaeffer's use of the French verb *ouïr* that I find a state of auditory perception which is solely concerned with the registration of sound.[87] In Michel Chion's translation of Schaeffer's *Guide to Sonorous Objects ouïr* is characterized as:

> "being struck by sounds, the crudest, most elementary level of perception; so we "hear", passively lots of things which we are not trying to listen to or understand."[88]

Ouïr covers a mode of auditory perception which remains hidden in our everyday attentiveness to the source and meaning of sounds.[89] Even though Schaeffer's conception of *ouïr* appears as essential for sound perceptions as such, and moreover as a condition for reaching his phenomenologically inspired conception of *reduced listening*, which I will return to later in this chapter, Schaeffer does not offer much attention to this mode of auditory perception. *Ouïr* is passively given and must be contrasted with other, more active forms of attentiveness and intentionality.[90]

In the differentiation between *listening* and *hearing* which I have found in the writings of Schaeffer, Barthes and Truax, I detect an eagerness to isolate the act of *hearing* on a rather basic or even primitive level in order to promote *listening* as a specific auditory attention capable of presenting the ear as a cognitive tool. I attribute this distinction in auditory sensibility to a tendency within the field of sound studies where the ear has been explored in order to appoint a new critical, aesthetic and philosophical departure

84 Barthes (1985), p. 245
85 Barthes (1985), p. 245
86 Truax (1984), pp. 14-15
87 In the *Dictionnaire Français Larousse, ouïr* is translated into *to hear.* However, several translations of Schaeffer's notion of *ouïr* has related it to the English verb *perceive* in order to accentuate Schaeffer's phenomenological intentions. In the 2017 translation of Schaeffer's *Traitise on Musical Objects* by North & Dack *ouïr* is translated into "to perceive aurally". Schaeffer's notion of *entendre* has commonly been linked to the English verb *to hear,* however here *hearing* denotes an intention, a deliberate selection of sounds "in order to make a description" of them. See Chion's translations in Chion (2009), §6. As pointed out by Brian Kane, the French language has the advantage of containing a larger vocabulary for describing a variety of 'modes of listening' than the English language, which only operates with an active and a passive form linked to the verbs of *listening* and *hearing*. The increased number of verbs on *listening* and *hearing* in French has given room for conceptual and philosophical disagreement about the meaning of each term. See Kane (2013). As I am interested in detecting descriptions of the passive state of sound perception, I have linked Schaeffer's conception of *ouïr* to a notion of *hearing.* Later in this chapter, I will return to a more detailed analysis of the different translations concerning the verbs which Schaeffer connects to the act of perceiving sounds.
88 Chion (2009), §6
89 Kane (2014), p. 27
90 Schaeffer (2017/1966), p. 73-79

point.

For Schaeffer the appointment of distinct auditory sensibilities supported his notion of a new musical orientation namely *musique concrète* which he described in *Traité des objets musicaux* (1966). *Musique concrète* incorporated new recording technology in order to introduce everyday sounds, such as the sound of a locomotive or a car accelerating, as musical material. This music demanded a new approach to perceiving sound as such and, by introducing *listening* as an analytical and aesthetic practice,[91] Schaeffer indicated a new direction for European music.[92] Schaeffer was interested in exploring the acousmatic situation[93] introduced by new audio technology, such as the radio and the tape recorder. He accentuated that the new technology enabled a new auditory attention and a new aesthetic conception of sound where the sound object (object sonore) could be approached in itself, beyond its cause and context, "deliberately forgetting every reference to instrumental causes or pre-existing musical significations (…) to deny the instrument and cultural conditioning, *to put in front of us the sonorous and its musical "possibility"*(…)".[94] I will return with a further elaboration of Schaeffer's conception of *listening*, but for now it is suffice to say that Schaeffer initiated a development of *listening* as an analytical tool applicable for supporting new sonic aesthetics which has later been developed by other scholars. In 1984 Truax introduced *listening* as a critical approach for conceiving the impact of the new electroacoustic technology and the "manipulative effects of the media and audio technology".[95] Truax designates new roles for the listener in order to "regain control" and "counterbalance the problems introduced by technology".[96] Within this critical listening approach an aesthetic exploration of sound became essential as Truax introduced the concept of "soundscape composition" as a possible means of evoking a critical reaction from the listener to the "environmental experience."[97]

The contrast between *hearing* and *listening* has in many respects been carried on into the contemporary field of sound studies. A researcher such as Salomé Voegelin defines *listening* in opposition to *hearing* as she sets out "to explore listening, not as a physiological fact but as an act of engaging with the world."[98] She links *hearing* to an a priori perception that "does not offer a meta-position".[99] Voegelin operates with a two-step conception of audition where *hearing* is the initial recognition of a sound and *listening* is the affective reaction towards it.[100] Similar to Shaeffer and Truax, Voegelin's conscious application of the term *listening* serves to form an entry point into an emerging aesthetic field of sound which is further revealed in the subtitle of the book: *Towards a philosophy of sound art.* According to Voegelin, it is in the reflective listening mode that sound

91 Schaeffer (2017/1966), p. 113-114.
92 Schaeffer declares the classical tonal system of European music as broken down or consciously destroyed and the realisation that the European music tradition was only one out of many possible ways of structuring musical as well as sounding elements. See Egebak (1970), p. 89
93 The acousmatic refers back to the pedagogy of Pythagoras, where students were to listen to his teaching from behind a curtain, reflecting a sense of approaching sound without seeing what causes it. See Schaeffer (2004/1966)
94 Schaeffer (2009), p. 81
95 Truax (1984), p. xiii
96 Truax (1984), p. xvii
97 Truax (1984), p. xvii
98 Voegelin (2010), p. 3
99 Voegelin (2010), p. xii
100 Voegelin (2010), p. 176

can be transformed into an aesthetic object and furthermore institute a philosophy of sound art.[101] *Listening* is not only applied to appreciating sound works but even produces the work of art as it approaches the sound "in its innovative perception."[102] *Listening* is a method of exploration, a mode of "walking through the soundscape/the sound work".[103]

The aesthetic implications of *listening*, which I have highlighted here, emphasise that the act of developing a terminological take on *listening* within the field of sound studies has served to support emerging aesthetic sound practices, whether *musique concrète, soundscape composition* or *sound art*.[104]

The Natural Ear

Leaving the vast field of terminological expositions of *listening* within sound studies behind for a moment, I will turn to another field which provides a further conceptualisation of *hearing* and *listening* as two distinct auditory sensibilities and which offers different approaches to defining sound perception as an epistemological practice.

Within the field of audiology, the differentiation between *hearing* and *listening* is also apparent though not directly as a semantic designation, but rather as a consequence of the methodological approaches applied to exploring sound perception. I will set out to describe these methodological grounds in the following section and attach them to a notion of *hearing*.

Audiology is, as the etymology of the word reveals, the study of *hearing* (Latin *audire*: "to hear"). As a scientific field audiology deals with *hearing* and its impairments and it is constructed around a wide branch of scientific fields such as acoustics, anatomy, physiology, psychoacoustics, medicine and neuroscience. Within audiology, *hearing* is approached through studying the physiological, mechanical and psychological processes that appear when sound enters the ear: The pinna collects sound from the outside world and leads it through the auditory canal that further guides the sound waves to the eardrum. The eardrum excites vibrations in the cochlea that are converted into nerve impulses that travel along the auditory nerve toward the brain. Each of the many underlining processes which is contained within this larger process of perceiving sound constitutes the field of study of audiology.

Audiology emerged as a scientific field in the 18th and 19th centuries as new technology allowed for inspection of the ear and new audio technologies re-evaluated the position of sound and sound perception as epistemic sources. In his historical exploration of sound production technologies Jonathan Sterne outlines how the emergence of the fields of audiology and psychoacoustics created a specific conception of *hearing* as an object of knowledge. These fields aimed to present *hearing* as a purely physical capability. Sterne traces the presentation of *hearing* as pure faculty, "in its supposed state of

101 Voegelin, (2010), p. xiv
102 Voegelin (2010), p. 4
103 Voegelin (2010), p. 5
104 These terms do not reflect distinctive musical genres, but foremost different attempts of naming art practices focusing on sound.

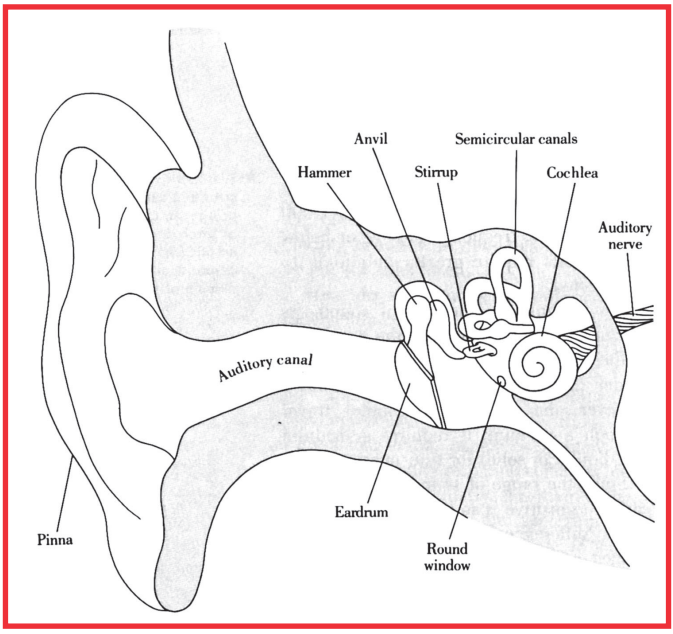


Fig. 1: Illustration of ear anatomy, Science Source (2013).

nature",[105] back to the modern era where audiology and psychoacoustics took form as new scientific disciplines which approached the ear as "objects and tools for scientific exploration."[106] The ear was studied as a "discrete object",[107] which literally separated the ear from both the human body through dissection and in turn introduced a mechanical understanding of *hearing*. Sterne also points to the fact that measurements, such as the decibel and the normal frequency response, originally arose in order to separate *listening* from *hearing*.[108] These measurements, which are also pivotal within modern audiology, introduced a common ground for approaching *hearing* in relation to fixed parameters which allowed for a generalised and comparable conception of sound perception.

The picture of *hearing* that Sterne outlines through his historical survey emphasises that a semantic discussion of the difference between *hearing* and *listening* also lays at the foundation of audiology as a scientific field. However, it foremost points towards the fact that audiology and psychoacoustics, through specific methodological studies of the ear, presented an idealised notion of *hearing* as something "quantifiable, and separable from subjective experience".[109] The reason why the audiological notion of *hearing* remained an ideal can be found in the argument made by Sterne, who calls attention to the fact that measurements were based upon results derived from the interaction between individual ears and the new scientific technology. The scientific aim of presenting *hearing* as an objective description of the functioning of the ear was carried out through "the subject's highly cultured act of listening."[110]

Sterne's historical approach to the concept of *hearing* accentuates recurring issues within the contemporary field of audiology. Here *hearing* is still approached as a highly measurable unit. *Hearing* is defined by determining parameters such as the minimal or upper audible levels, temporal summation, intensity, frequency levels and so on. These parameters are obtained through quantitative studies of auditory perception, where statistical relationships between acoustic stimuli and sound sensations are used to define *hearing* as a sense by which sound is perceived. However, in contemporary audiology, the concept of *hearing* has also taken new directions. In audiological textbooks the term *hearing* often appears as connoting "normal hearing", which is the state where *hearing* performs "entirely normal auditory processing at all levels of the auditory system from the cochlea to the cortex (…)".[111] This notion of *hearing* is time and again explored through the dichotomy between applying measurement methods relying on so-called "objective audiological tests" and the subjective conceived "behavioural tests".[112]

Behavioural tests have traditionally constituted the main means for obtaining a standardised conception of *hearing* within audiology until new technology introduced new methodological approaches. Behavioural tests are based upon a test subject's re-

105 Sterne (2015), p. 120
106 Sterne (2015), p. 113-114
107 The ear became a discrete object through dissections, anatomic research into the form of the ear, and physical research that implied instrumentation, such as speculums and auriscopes. Human ears were used as part of experiments. See Sterne (2003), p. 51-57
108 Sterne (2015), p. 115
109 Sterne (2015), p. 114
110 Sterne (2015), p. 120
111 Hall & Swanepoel (2010), p. 2
112 The citations are based on terminology derived from Hall & Swanepoel.

sponse to incoming sound stimuli and his or her ability to detect, discriminate and identify the stimuli.[113] It incorporates threshold tests, word recognition tests, tone decay tests, brief tone tests, loudness balance test, intensity difference test.[114] The responses gained from the test subject may take forms such as raising the hand when a sound is heard, repeating a test word, judging which of two sounds are louder.[115]

In contemporary audiology, behavioural tests are considered time consuming and unreliable.[116] An awareness of the uncertainties that a behavioural tests entail is a general issue within audiology as it challenges the audiological approach of obtaining objective measurement of *hearing*:

> "We must also be aware of the nature of the measurement being made and its limitations. (…) we need to know that how a person responds is affected by more than whether she did or did not hear the stimulus sound. Responses are often affected by confounding influences that are built into the testing approach (e.g., how the last response affects the next one) and the criteria employed by the person taking the test (e.g., how sure she must be before saying "yes").[117]

The reliance on the subjective interpretation of the test subject constitute the main limitations of assessing *hearing* as constituting an objective sensation of sound. The audiometric methods contain "serious limitations",[118] as they do not take account of the patient's personal history, the general communication between patient and examiner and the examiner's bias.[119]

In order to overcome the inadequacy of the behavioural tests, contemporary practices of audiometry have turned to physiological tests using electrophysical measurements such as otoscopic examination[120], tympanometry,[121] acoustic immittance assessment,[122] otoacoustic emissions assessment,[123] or electrocochleography.[124] These technologies are essential in order to obtain "objective assessment of hearing" as stated by Hall and Swanepoel.[125] However, they do not erase the human interpretative role. Final audiometric results are obtained by cross checking electrophysical measurements,

113 Poulsen (2016), pp. 180-81
114 See Gelfand (2016), pp. 273-301
115 Gelfand (2016), p. 70
116 Poulsen (2016), p. 20
117 Gelfand (2016), p. 70
118 Seewald & Tharpe (2010), p. 660
119 Seewald & Tharpe (2010), p. 660
120 Otoscopic examination is a visual observation of the ear canal and tympanic membrane using a hand-held otoscope, which contains a lens and light source which magnify the image of the ear canal. See DeRuiter and Ramachandran (2010), p. 24
121 Tympanometri involves measuring admittance while varying pressure in the ear canal relative to atmospheric pressure. Tympanometry is performed using an immittance meter, which consists of an air probe, a tone generator and a microphone and measures pressure in the inner ear canal. See DeRuiter and Ramachandran (2010), p. 48
122 The acoustic reflex is a contraction of the stapedius muscle which occurs in response to loud sounds, which can be measured using an immittance meter. See DeRuiter and Ramachandran (2010), p. 71-95
123 Otoacoustic emissions are sounds that are elicited by the ear either in response to signals presented to the ear or spontaneously without any stimulation. These sounds can be measured with a sensitive microphone in the ear canal. See Gelfand (2016), p. 315
124 Electrocochleography consists of measurements of electrical potentials that are derived from the cochlear hair cells and the auditory nerves. See Gelfand (2016), p. 305
125 Hall & Swanepoel (2010), the citation is derived from the title of their book.

behavioural tests and patient histories. Furthermore, as noted by Hall and Swanepoel, these findings must be analysed incorporating a "variety of listener variables", such as: Age and development, neurological immaturity, cognitive factors, language, attention and state of arousal and motivation.[126] Accordingly the examiner is left to interpret the total of collected data in order to reach a final assessment and conception of *hearing*.[127]

The implementation of this new technology emphasises that the ideal of presenting *hearing* as a quantifiable phenomenon is a presiding goal within audiology. It also points towards the fact that the differentiation between *hearing* and *listening* which I initially referred to within the field of sound studies, is also apparent within audiology, where it is constituted as an emphasis on separating objective assessment of sound perception from its subjective interpretation.

The Pathologically Disturbed Ear

My presentation of *hearing* through audiological practices opens vast potential for criticising the ideal of reaching the ear through objective assessments. Sterne has already articulated this critique in his entry in *Keywords in Sounds*, where he notes that not only audiology but also sound studies ascribe *hearing* to an assumption "that we have direct, full access to our own hearing" which reproduces a specific epistemic history of "overcoming subjectivity".[128] Even though a conception of *hearing* as a purely objective assessment of sound perception will most likely remain an ideal, I would like to pursue it for a while. I am interested in grasping further characteristics of *hearing* as a possible particular auditory attention, which aligns it to a non-discursive epistemological practice towards sound. Thus, in order to reach an extended notion of *hearing*, I will investigate the audiological situation as a particular example of the phenomenological approach to studying perception.

Audiology's attempt to stage a perception of sound which avoids any bias in both the listener and the examiner, echoes the phenomenological idea of epoché, which I have already introduced. Epoché proposes a method for approaching the world anew beyond any prejudices or accepted knowledge and it can be seen as an equivalent to the audiological ideal of encouraging the hearing test subject to set aside any habitual approaches of assigning meaning to a sound. In the hearing test situation, the listener is required to solemnly focus on registering sound, not interpreting it. However, a phenomenological conception of *hearing* will necessarily differ markedly from an audiological notion in that phenomenology is concerned with presenting a methodology for becoming aware of one's own natural attitude. We might assume that an audiologist would not prefer a phenomenological approach to the audiological situation because it would encourage an activation of a deliberate consciousness concerning the act of *hearing*, a reflection upon how *hearing* in this particular situation occurs.

Within audiology *hearing* is, as I have already accounted for, in large defined by marking thresholds, but *hearing* is also defined through detecting impairments or deviations. Historically, the constitution of "normal hearing" has been a consequence of

126 Hall & Swanepoel (2010), p. 4
127 Seewald & Tharpe (2010), p. 661
128 Sterne (2015), p. 115

studies into the impaired ear (a circumstance I will return to later in this thesis[129]). The mapping of the anatomical parts of the ear, as it appeared during the 17th century,[130] and later physical measurements as well as contemporary electronically induced inquiries, have provoked more granular theories of the ear which have all contributed to a definition of *hearing* in opposition to its impairment.

If we are to follow the methodology of audiology it is when the act of hearing does *not* perform according to expected standards that we become aware of what *hearing* should be. Thus, the disabled ear may form a potential path for a further characterisation of *hearing* as a distinct auditory attention. In order to further investigate the disabled sense situation as a point of departure for reaching an extended characterisation of the pure sensation which *hearing* has already been aligned to through other sources I will make a detour into the phenomenology of Maurice Merleau-Ponty in which a possible path may be found for appointing a particular moment in time where an apprehension of *hearing* can take place.

The phenomenologist Maurice Merleau-Ponty is concerned with describing perception through the basic phenomenological concept of *reduction*, which points towards the coherence between the subject and the world. Merleau-Ponty describes *reduction* as an astonishment of the world,[131] but he considers it as an ideal circumstance which is practically unreachable:

> "The most important lesson which the reduction teaches us is the impossibility of a complete reduction."[132]

According to Merleau-Ponty the problem with the notion of *reduction* is that it will always prompt a thematisation of an ego. Reduction remains on a level of reflection, a verbalisation, which prevents obtaining a *direct* perception of the world. The difficulties of obtaining *reduction* resonate with the main problems found within audiology, where *hearing* is to be approached beyond subjective judgement. Even though a sound may hit the listener as a genuine astonishment, it will always undergo an interpretative process of comparing reactions patterns derived from both human responses and other datafication of hearing stimuli.

Despite his scepticism towards *reduction* Merleau-Ponty appoints a possible path for reaching *reduction.* Where Husserl aligns the phenomenological perception of the world to a transcendental subject, Merleau-Ponty wishes to reach a reflection on the pre-reflective perception of the world. This goal seems contradictory because how does one reflect on something which is prior to reflection itself? Merleau-Ponty investigates this schism by placing the human body at the centre of attention. For Merleau-Ponty there is no distance between consciousness and the body. He thereby breaks with Cartesian dualism in which the body is considered a tool of the rational consciousness.[133] Merleau-Ponty does not acknowledge this way of thinking which he claims turns the

129 See the chapter *The Otologically Normal Ear.*
130 Mills (2015), p. 46
131 Ibid.
132 Merleau-Ponty (2005), p. XV
133 Husserl had already paved the way for a break with this dualism. Dualism places the consciousness independent of the body as it considers consciousness a "thinking thing" and the body as "an extended thing". Thøgersen (2010), p. 46

body into "a handmaid of consciousness".[134]

> "Consciousness is being-towards-the-thing through the intermediary of the body. A movement is learned when the body has understood it, that is, when it has incorporated it into its 'world', and to move one's body is to aim at things through it; it is to allow oneself to respond to their call, which is made upon it independently of any representation."[135]

Accordingly, consciousness is not detached from the body. We act, perceive and understand the world and the frames of perception which it sets through the body. It is important to note that Merleau-Ponty does not reduce the human being to pure corporeality. On the contrary, one of Merleau-Ponty's central arguments is that consciousness is an integral part of a bodily existence and this existence stands in relation to a perceived world which appears before reflection. Consequently, within the phenomenology of Merleau-Ponty, the body is designated pre-reflective.

The positioning of the body as central within the phenomenology of Merleau-Ponty emphasises a new departure point for examining the essence of *hearing*. It suggests a framing of *hearing* as a decidedly physical condition which contains the ability to perceive before any consciousness about this perception is obtained.

In order to reach a further conception of "the lived body",[136] as the vector of pre-reflective perception, Merleau-Ponty turns to a study of the pathologically disturbed body. He explores sciences such as psychology, neuro-psychology and gestalt psychology in order to reach physical and psychological conceptions of the pathologically disturbed body as he finds that it is in the degraded functions of the body that *the lived body* appears for phenomenology. In physiology the phantom limb is described as a retention of a physical sensation in a limb which is no longer there. The phantom limb is considered a repression of a stimulation.[137] In psychology the phantom limb is considered as a memory and an imaginary presence. Merleau-Ponty argues that the phantom limb is neither:

> "The phantom arm is not a representation of the arm, but the ambivalent presence of an arm."[138]

Through descriptions of the phantom limb Merleau-Ponty finds a set of deeper layers of consciousness upon which the body operates. By observing the behaviour of the phantom limb it is possible to obtain an insight into a level of consciousness that appears before reflection.

> "The will to have a sound body or the rejection of an infirm one are not formulated for themselves; and the awareness of the amputated arm as present or of the disabled arm as absent is not of the kind: 'I think that . . .'"[139]

134 Merleau-Ponty (2005), p.161
135 Merleau-Ponty (2005), p. 159-161
136 Merleau-Ponty, (2000), p. 31
137 Merleau-Ponty (2015), p. 95
138 Merleau-Ponty (2015), p. 94
139 Merleau-Ponty (2015), p. 94

The pathologically disturbed body is assigned to an action-oriented level and the phantom limb becomes an analogy for how to practice the pre-reflective condition.

In Merleau-Ponty's focus on the pathologically disturbed body I find a new departure point for grasping the essence of *hearing*. Where Merleau-Ponty studies the pathological disturbed body through explorations of the phenomenon of the phantom limb, the impaired ear becomes an entry point for studying the specific perceptual grounds of *hearing*. Merleau-Ponty's investigation of the phantom limb provides a basis for a further characterisation of *hearing* as a pre-reflexive layer, which may allow us to identify the specific moment where sound perception does not follow habitual patterns. When *hearing* does not perform according to expectation we become aware of *how* we hear. Furthermore, it suggests that *hearing* does not only operate from its actual position. *Hearing* is not only what the human hearing sense is able to process in a specific moment, but rather it is the sum of processual functions and instances across time and place. *Hearing* is constructed upon two distinct layers: The habitual ear and the present ear. This division of the ear reflects Merleau-Ponty's conception of the habitual body,[140] which he aligns to all the habits the body operates upon. However, Merleau-Ponty emphasises that the habitual body also exists in the present body.

> "The phantom arm is not a recollection, it is a quasi-present and the patient feels it now, folded over his chest, with no hint of its belonging to the past."[141]

I can outline a similar picture of *hearing:* Even though I may not be *hearing* well in a current moment, I consider my former experiences of *hearing* as part of my habitual body. The body applies its habits – even though they may be ineffective. Merleau-Ponty notes that the known situation can result in pain connected to the limb which was once there. This phantom pain appears at the intersection between the lost limb and the present body and this specific point is emphasised in the phenomenology of Merleau-Ponty. It is only when habit is interrupted that we have the direct possibility of feeling the unity between body and consciousness and thereby our existence. Within phenomenology phantom pain becomes a picture of the basic schism of the phenomenological methodology, as we here see a concrete example of how habits and preconceived knowledge are cut off but still live on in the body.

Applying the phenomenological approach to a notion of *hearing* opens a perspective in which *hearing* now appears as a conglomerate of instances and habits which are activated in the specific moment in which *hearing* does not perform as expected. In situations where we are suddenly not able to hear an expected sound, we approach *hearing* in its essence.

Where audiology suggests an approach to the understanding of *hearing* by appointing measurable parameters, the phenomenological approach to *hearing* suggests a different approach to apprehending the ear in its natural state. Even though the phenomenological approach to *hearing* does not suggest a more *objective* conception of *hear-*

140 Merleau-Ponty (2015), p. 95
141 Merleau-Ponty (2015), p. 98

ing than audiology, it allows for further exploration of how and when a non-discursive notion of *hearing* presents itself in the actual act of perception. The phenomenological approach provides the basis for an extended notion of *hearing* as the essence of a bodily experience of sound because it contains all former acquaintances with sound in a single astonishment precipitated by the sound's appearance.

The Trained Ear

My conceptualisation of *hearing* as a decidedly non-discursive approach to sound emphasises an implication of the term *hearing* which refers to the act of detecting sound as such and does not attribute any meaning to this sound beyond the fact that it is either heard or not. This is outlined in my phenomenological take on *hearing*, but also in my initial exploration of audiological assessments of *hearing*. Although my exploration of the field of audiology by no means is exhaustive, I have noted that a non-biased relation to sound is cultivated within audiological textbooks. Some of these advise that test subjects should not be acquainted with the specific sonic material beforehand and others encourage the employment of "non-specialist screeners" in order to avoid judgments based upon habitual approaches.[142] Even though these preconditions are practically impossible, and are also acknowledged as such by audiologists, this approach allows me to investigate further how the ear has been idealised as either natural and fixed or as cultural and malleable.

Contrary to the audiological goal of reaching an objective assessment of *hearing* that goes beyond any subjective biases, many positions regarding sound perception within the field of musicology and sound studies have suggested a decidedly trained ear. I have already touched slightly on this in my initial explorations of the term *listening*, but I will now proceed further in this direction in order to reveal how *listening* has been developed as a concrete practice.

Pierre Schaeffer's theory on sound is cast in explicitly phenomenological terms however *listening* is presented as entailing a pure relation to the heard. Schaeffer introduces the concept of *reduced listening*. Schaeffer's development of *reduced listening* shares basic similarities with my audiological assessment of *hearing*, as it covers a concept of listening to "the sound as such".[143] However, Schaeffer's *reduced listening* differs markedly from the audiological take as it has a clear aesthetic purpose. *Reduced listening* discloses a new domain of sounds which Schaeffer names *objets sonores.*[144] *Objets sonores* do not lead back to the detection of an instrument or a medium, nor even a specific state of mind. Instead they entail an ideal of reaching sounds prior to the signification and sense that such sounds have accrued through musical and cultural usage.

In order to achieve *reduced listening*, Schaffer proposes four specific listening categories: *ouïr* (to hear), *entendre* (to hear something), *écouter* (to listen closely) and *comprendre* (to understand).[145] Each category entails a specific auditory attention towards sound. *Ouïr* means to perceive aurally and covers the constant condition of always being surrounded

142 Hall & Swanepoel (2010), p. 136
143 Schaeffer (2009), p. 77
144 Schaeffer (2009), p. 79
145 Schaeffer (2017), pp. 73-102

by sound. *Entendre* covers the act of detecting a specific sound, but the interpretative stance towards sound first appears in the category of *écouter* which covers a concentrated act of listening to something in order to deduce information from sound. Here listening becomes a specific way of focusing, beyond the immediate sound itself, on the content of the sound. The final category, *comprendre,* covers the act of understanding a sonic input by virtue of precise signification.

Schaeffer himself marks his listening categories as "exercises" and even "acrobatics",[146] which is suggestive of the clear pedagogical intention which is inherent in these categories. The listening modes suggest specific practices in which the ear is trained to notice and employ the different auditory sensibilities it possesses. They become, as Schaeffer also notes, a way of familiarising ourselves with sound in order to avoid "a fall back into classical ways of structuring music."[147]

Many other researchers within sound studies have followed Schaffer's methods by proposing listening categories which at times have pointed towards other, even more specialised auditory attentions. Michel Chion operates with three listening categories that cover "the heterogeneity of levels of hearing".[148] His categories reflect an influence from Schaeffer in that *causal listening* covers the act of "listening to a sound in order to gather information about its cause (or source)", *semantic listening* refers to "a code or a language to interpret a message" and *reduced listening* focuses on "the traits of the sound itself, independent of its cause and of its meaning".[149] However, Chion emphasizes that *reduced listening* is practically unnatural and it indeed needs a new language in that "present everyday language as well as specialized musical terminology is totally inadequate to describe the sonic traits that are revealed when we practice reduced listening on recorded sounds".[150]

Barry Truax also suggests different listening categories such as *listening-in-search*, which involves a conscious and active search of sound cues and *listening-in-readiness* that depends on "associations being built up over time so that the sounds are familiar and can be readily identified" and *background listening,* which covers the act of perceiving sounds without adding any deliberate attention them.[151] The Canadian composer R. Murray Schaefer offers numerous listening exercises in his music education booklets which are addressed to school children.[152] Amongst them is the exercise of *ear cleaning,* where the listener is taught to respect silence. The tape recorder is emphasized as a useful adjunct in performing these exercises as they can remind the ear of details in the soundscape that have previously gone unnoticed. Furthermore, it can be used to preserve sounds that are threatened with extinction.[153] These exercises support an implementation of a

146 Schaeffer (2017), p. 276
147 Schaeffer (2017), p. 280
148 Chion (2012), p. 48
149 Chion (2012), pp. 48-50
150 Chion emphasises that recorded sounds mostly don't lead to *reduced listening,* as argued by Schaeffer, but rather the opposite, as the absence of the sound source intensifies *causal listening* where the listener searches for to identify the cause of the sound. See Chion (2012)
151 Truaux (1984), p. 19-21
152 In the book *A Sound Education. 100 exercises in Listening and Sound-Making* (1992), Schaefer stresses that the listening exercises were made as a response to reactions he had received from teachers stating that the listening ability of students had worsened.
153 Schaefer (1977/1994), pp. 208-209

larger project, which Schaefer himself considers "a revolution" among fields of sonic studies, namely *acoustic ecology*, where significant aural culture is to be retrieved by the new trained listeners, called acoustic designers.[154]

Of course, these trajectories concerning the intention of training the ear within sound studies underline a conception of the ear as generally malleable. I will argue however, that they also point towards a broader culturalisation of the ear which has appeared in conjunction with the advent of new audio technology. Audio technology has not only introduced new ways of reproducing sound, but also radical perceptual challenges and new scientific possibilities. Retrospectively, all of these listening categories must be seen as a reaction towards the appearance of new audio technology which in several instances have forced the listener to enter into a new relationship with sound.[155] The technology has demanded guidance for new ways of perceiving sound.

The training of the ear has not only appeared within the arts, but can be viewed as a larger tendency. During the 19th and 20th centuries, new technologies such as the telephone, the phonograph and the telegraph introduced new social constructs which demanded new listening strategies. Sounds were separated from their sources which required what Sterne refers to as *physical education*. The professional training of telegraphists was undertaken and common people were also educated in new listening strategies through repeated and shared radio listening.[156] Sterne uses the notion of *audile technique* to cover these specialised practices of *listening* which appeared in conjunction with new audio technology. *Audile technique* relied on a process of translation where, for example, the phonograph's sound or the sound of a heartbeat became a sign to be interpreted. Sterne marks *audile technique* as an articulation of the ear to logic.[157] It became not only one way of knowing or experiencing among others; it separated the hearing sense from other senses. In some cases, it even privileged the hearing sense as a highly trained and even virtuosic skill related to particular activities. Such was the case with telegraphists, telephone operators and, not least, with the use of the stethoscope by physicians, which introduced the specific listening technique of *mediate auscultation* allowing doctors "to hear what they could not see".[158]

I will stop for a moment and reflect upon the perspectives on *listening* that the practices of mediate auscultation and audile technique introduce. They are clear examples of how *listening* has been developed as a specific skill across disciplines and they support a conception of *listening* as a directed, learned activity contrary to *hearing* as an instinctive, sensorial reaction. Furthermore, they reveal how the training of the ear is part of a larger epistemological project. The many listening exercises emphasise the goal of introducing *listening* as an epistemic tool which challenges an existing sensory regime relying on visiocentrism as the primary means for constituting explorations of perception. Sterne's exploration of the many listening practices, which have been an essential part of industrial, medical and natural scientific practices, underlines how *listening* actually appears alongside the visual gaze, which is otherwise considered the primary de-

154 Schaefer (1977/1994), p. 208
155 See Schaefer (1977/1994), Chanan (1995), Egebak (1969), Adorno (2002), Sterne (2003)
156 Sterne (2003), p. 92
157 Sterne (2003), p. 95
158 Sterne (2003), p. 127

parture point for diagnosis and rational thought. By focusing on these trained listening practices, a counter narrative to Romantic or naturalistic accounts appears, where "sight is no longer the only sense of intellect."[159] Likewise, within the field of sound studies, the introduction of *listening* as a trained skilled reveals an effort to introduce an epistemic shift. This epistemic shift has been accentuated time and again within sound studies and can be noticed in the widespread approach of introducing *listening* as a means of acquiring knowledge in opposition to the visual domain.[160] Some authors support their argument for *listening* as a specific epistemic activity by retrieving the historical foundations of sound culture.[161] Others appoint new listening strategies based upon a deliberate decentering of visualism. The latter strategy is performed by the phenomenologist Don Ihde who does not wish to replace vision with listening, but rather to present a phenomenology of sound which moves "toward a radically different understanding of experience".[162] Likewise, Voegelin forms her sonic phenomenology as a condemnation of the saying that *seeing is believing* and suggests that a new sonic sensibility can augment a visual philosophy.[163] By proposing *listening* as a specific perceptual mode that demands an effort from the listening subject to reflect upon the heard, a new interpretative process appears which provides a basis for what Voegelin has termed "a rethinking of existing philosophies of perception".[164]

According to Sterne, the attention offered to the act of *listening* as an epistemic activity that can be nurtured and trained departs from an *audio-visual litany*, where a cultural analysis of sound marks a termination of differences between an auditory field and a visual field.[165] Sterne argues that this litany idealises *hearing* "as manifesting a kind of pure interiority." Such an idealisation is indeed apparent and is exemplified by a statement from the media theoretician Walter Ong, who characterises sight as something that "isolates" and "situates the observer outside what he views" in contrast to sound which "incorporates" and "pours into the hearer".[166] I follow Sterne's designation of an audio-visual litany and I will return to this later in this thesis, however I will argue that the audio-visual litany has been used by certain authors to develop a notion of *listening* in order to support emerging aesthetic as well as scientific fields. It accentuates the historical perspective of the development of *listening* as a distinct term within sound studies and underlines how the development of strategies for enhancing the ear's analytical capacity has served to constitute sound perception as a genuine approach to knowledge production. Today, however, many contemporary researchers within sound studies distance themselves from this litany as it appears as a simplification of both visual as well as auditory practices. Some contemporary scholars have turned to a multisensorial approach to sound which accentuates the importance of addressing both the physical and

159 Sterne (2003), p. 127
160 Schaefer (1994/1977), Erlmann (2010), Friedner & Helmreich (2012)
161 For example, Schaefer points towards both Christianity (before the renaissance) and Zoroastrian religion, where an emphasis on sound and listening used to rule. (Schaefer (1977/1994, p. 10)
162 Ihde (2007), p. 15. Ihde emphasizes that approaching an auditory phenomenology is not without problems. The notion of an auditory dimension challenges the basic phenomenological concept of conceiving the body as a unit, where perception cannot be approached through separate parts of the body. Ihde (2007), p. 43
163 Voegelin (2010), p. xiii
164 Voegelin (2010), p. 5
165 Sterne (2003), p. 15
166 Ong (1982), p. 72. See also McLuhan (1962) and Voegelin (2010) for similar dichotomies.

perceptual aspects of sound sensation, as well as the affective and non-representational background.[167]

The Instrumental Ear

My investigation into the wider aspects of the term *listening* within the field of sound studies leaves an impression of *listening* as a critical analytical tool and *hearing* as a passive receptor. As sound studies has already provided a large vocabulary for approaching the many perceptual processes at stake when *listening,* I would like to proceed to an elaboration of an extended notion of *hearing* which can disclose a critical potential of this term. Therefore, I will draw attention to a final example of a specific training of the ear that takes *hearing* as a foundation for making new epistemic claims.

In the book *On the Sensations of Tone as a Physiological basis for the Theory of Music (1863),* the German physicist Hermann von Helmholtz proposes a training of the ear which can uncover "a pure sensation of sound"[168] - a sensation of sound that goes beyond any intervention of the intellect. This aim echoes the purposes of the audiological approach to sound which I have already accounted for. However, surprisingly enough, Helmholtz recommends that this sensation is to be obtained through the study of music. In an audiological context this approach would seem ineffective or even contradictory as any training of the ear, not least training which departs from the discursive setting of music, leads to a biased encounter with sound. Nevertheless, Helmholtz believe that music has a more "immediate connection with pure sensation" than other art forms,[169] and music therefore holds the key for conducting scientific study into sound sensation:

> "In music (...) tones and the sensations of tone exist for themselves alone, and produce their effects independently of anything behind them."[170]

Helmholtz turns to the study of musical instruments in order to gain knowledge of how sound acts and is perceived by the human ear.[171] The musical instruments used in Helmholtz's experiments not only serve to investigate the production and propagation of musical sounds but, by transferring his investigations of musical instruments into an understanding of the ear, the instruments provide new insights into the relation between sound and the ear. For example, Helmholtz reassigns an examination of resonance phenomena found in organ pipes to an understanding of the ear. The ear, he argues, functions just like an organ pipe, where vibration is set in motion as air molecules

167 A multisensorial approach to sound accentuates the importance of addressing not only the physical and perceptual part of listening, but also the affective and non-representational background. See Højlund (2017), Pallasmaa (2005), Rocchesso & Serafin (2009), Griffero & De Sanctis (2014)

168 Helmholtz (1954), p. 3

169 Helmholtz (1954), p. 3

170 Helmholtz (1954), p. 3

171 One of the most common instruments used in Helmholtz's experiments was the organ - or more precisely individual organ pipes. Helmholtz used organ pipes to study how musical tones propagated as air streams through a hollow material - an acoustical principle that had been studied since ancient times. Operating the organ, Helmholtz figured out that the more upper partials found in a sound the more dissonant the sound was perceived, whereas if he constructed a simpler sound it was perceived consonant. The organ thus held the potential to offer a closer look into how sound was perceived as either consonant or dissonant or, as Helmholtz put it, as either music or noise. Helmholtz (1954), p. 7

and enters the ear canal. Thus, the ear is basically a simple resonator which organises the vibrations that it receives and transforms them into the very sensation of sound.

Helmholtz's experiments with instruments lead him to regard the ear as an instrument. This notion is developed further in an analogy to the function of a piano: The ear acts as strings on a piano, where each string corresponds to a specific nerve fibre inside the ear. When a piano string is struck, it immediately results in an excitation of a corresponding nerve fibre.[172] This circumstance leads Helmholtz to conclude that if many nerve fibres in a small area are excited at the same time it creates a dissonant sensation that resembles the dissonant sensation appearing when piano keys close to each other are struck. Although this comparison between the nerve fibres inside the ear and the strings on a piano is rather simplistic it demonstrates the fact that the sensation of sound is reflected on the basilar membrane according to frequency bands. The ear is thus acting as a simple frequency analyser.

Although the objective of Helmholtz's theory is not to outline a particular epistemology of either *hearing* or *listening*, his research into and application of musical instruments as appropriate tools for investigating the physiological ear serves the purpose of conceiving two separate sensations of the ear which resemble these two terms. Helmholtz outlines characteristics of what he refers to as a "mental ear" and a "material ear".[173] The mental ear is characterized by its ability to mask activities through habits and thereby pacify the analytical work that the material ear performs. According to Helmholtz, it is the mental ear that mostly leads to severe misinterpretations or just stands in the way of a more detailed understanding of sound sensation. Helmholtz emphasises that the ear is trained to take on a passive attitude that ignores the many perspectives of a given sound. He encourages activation of the material ear in order for it to come out of its passivity. To support the material ear, the instrumental training of the ear becomes important. The instruments function as concrete sonic microscopes that can amplify and intensify the physical sensation of sound.[174] By incorporating instruments the ear is trained to take on a new approach to the accepted norm concerning sounds. Helmholtz argues that the instrumental approach to the ear can shed a new light onto the construction of accepted aesthetic norms within Western music tradition.

The division of the ear, which I have found reflected in the writing of Helmholtz, recalls similar notions of the ear that I have found within sound studies and audiology. However, with his instrumental approach and training of the ear, Helmholtz emphasises the clear intention of enhancing a comprehension of the "material ear", which I have adopted as a motivation for promoting *hearing* as a critical sensation. Through his instrumental understanding of the ear, Helmholtz proposes a new listener who can choose and analyse objects at will and thereby make perceptions of its own. His main intention was to challenge the conclusion that Western music theory was based on a natural phenomenon, a physiological reaction in the ear. However, I will argue that his thought reaches even further. In Helmholtz's instrumental notion of the ear lies a possible entry point for developing my phenomenological take on *hearing*. Helmholtz's incor-

172 Helmholtz (1954), p. 129

173 Helmholtz cited in Steege (2012), p. 57

174 This methodology resembles the concept of *microtemporality* outlined by Wolfgang Ernst, which I will explore in the section entitled *Technology, the Ear & the Operator.*

poration of instruments to enhance the sensation of sound demonstrates the phenomenological act of double-sensing as it has been presented by Husserl and others. Husserl distinguishes two central bodily experiences: The perceiving body and the perceived body – the subjective body and the objective body. However, according to Husserl, the perception of the objective body is not part of our original bodily consciousness. Rather the perception of the objective body departs from a self-objectification, a kind of double perspective in which we are at once sensing and conscious of our way of sensing. Husserl provides an example which demonstrates this kind of double-sensing in the act of a left hand touching a right hand. In this act, the right hand becomes both the object of the perception as well as the perceiving subject that senses the touch of the left hand. Helmholtz's notion of the instrumental ear forms a similar kind of self-objectification, as the instruments allow the listening subject to both *hear* and become aware of the "touch" of *hearing* as a specific bodily reaction towards sound.

The Articulated Ear

I have now approached *hearing* and *listening* by aligning them to a broad set of ideas, practices and approaches. I have presented *listening* as a concrete example of how sound perception has been aligned to an idealised set of practices aiming at promoting a specific epistemic shift. The act of *listening* depends on a specific cultural framework, a reflective practice and often even a specific technological setup. Contrary to this, I have presented *hearing* as relating to a specific scientific code of conduct and a pre-reflexive sensation of sound. I have exposed how *listening* and *hearing* not only cover distinct auditory attentions towards sound, but also particular discourses that have served to provide a specific language or practice for presenting knowledge. These discourses entail a collective understanding of how the particular topic of sound perception has been constituted historically. Thus, *listening* and *hearing* not only cover two different ways of understanding sonic experience, but also a set of ideas that have been used to support the constitution of the particular fields of sound studies and audiology. However, the two terms depart from two different discursive logics. *Listening* operates on what I will term a deliberate constitution of discourse. Within sound studies the term *listening* has been developed in order to appoint a specific language for relating the act of perceiving sound to the act of knowledge production. Contrarily, the discursive logic of *hearing* is centred around a disregard for or dismissal of discourses. Within audiology the non-discursive take on the ear has been nurtured through the implementation of technology which has been used to reach *hearing* beyond any cultural and subjective context. However, this non-discursive take on the ear has also been uncritically reproduced by the field of sound studies. As noted by Sterne, the field of sound studies has embraced this conception of *hearing* in order to constitute *listening* as a primary epistemological tool:

> "When writers in sound studies ascribe to hearing the quality of pure physical ability and to listening subjective intention they mobilize the same epistemic history"[175]

175 Sterne (2015), p. 115

My deliberate segregation of the terms *listening* and *hearing*, both throughout this chapter and throughout this thesis as a whole, can be interpreted as supporting a continuous discursive battle. Nonetheless, I do not wish to suggest an alternative to the *audio-visual* litany, where discussion is centred around which kind of sensation contains a more truthful basis for knowledge. Rather my excavation of *hearing* and *listening* is meant as a general inquisitive exploration of the epistemological potential of sound sensation and sound perception.

In this chapter, my discursive investigation of *hearing* and *listening* have shown that the phenomenological method contains a potential for revealing the specific epistemic value of sound perception. I have found that the phenomenological method has been used time and again to designate *listening* as covering the mental act of deducing meaning from sound. However, the many auditory phenomenologists which I have presented in this chapter have not outlined a uniform conception of *listening*. Schaeffer has promoted the concept of *reduced listening* as a phenomenological listening approach which attends to appoint a new aesthetic material by exposing the sound apart from its source. In this phenomenological listening approach, the implementation of technology is essential, as a recorded sound enables the sound object to be liberated from its original source. A similar approach has been suggested by Truax, with the main difference being that *listening* is here used to evoke a critical sensation of not just the cultural significance of sound, but of technology in itself. In the acoustic ecology project of the Canadian composer Schaefer the development of *listening* as a phenomenological tool has also appeared as a reaction to the advent of new audio technology. However, here technology does not primarily serve an aesthetic purpose, but rather aims at facilitating a *listening* that can preserve extinct aural cultures. In Voegelin's auditory phenomenology, technology does not appear as essential for performing *listening*. Here *listening* is to a greater extent related to an individual mental practice of approaching sound through a reflective and interpretative process which in the end constitutes the work of art.

The many listening categories are certainly neither complete nor immune to criticism. Nor do they present a uniform conception of how sound is perceived by humans. Despite these qualifications they have the great merit of presenting a language and a methodology for addressing sound objects. Furthermore, the many different designations of *listening* as a particular phenomenological auditory state all seem to emphasise that the ear is characterised by its ability to inhabit different auditory attitudes. Helmholtz accentuated a similar point. However, according to Helmholtz, it is exactly the eagerness to attain meaning or truth from sounds which stands in the way of reaching a full sensation of sound.[176] Helmholtz's argument invites a critical exposition of the methodology of the auditory phenomenologists whom I have accounted for in this chapter. From Shaeffer to Voegelin I have found a persistent focus on reaching and reducing the sound object. In their focus on defining perception in relation to an object I will claim that they have left *hearing* on a very basic level, aligned to either an instinct or a type of inattentive audition or, at best, as an aspect of a listening practice.[177] They have unfolded an exploration of auditory perceptual behaviour in relation to an object "out

176 Helmholtz (1954), p. 4

177 Both Shaeffer, Chion and Truax approaches aspects of *hearing*, when they appoint listening modes that appear as inattentive or unconscious ways of capturing background sounds.

there" instead of exploring an "in here", that is, exploring the bodily resonance which appears as sound enters the ear canal. I will argue that, as such, the auditory phenomenologists have set aside an exploration of the bodily experience of auditory perception which phenomenological practice otherwise invites for.

Within this chapter, I have turned to the field of audiology in order to reach an extended notion of *hearing* which has served to relate it to a wider perceptual potential. My presentation of *hearing* through audiological practices has vast potential for criticising the ideal of understanding the ear through objective assessment. However, by implementing a phenomenological analysis of the audiological situation, I have found a basis for presenting a further elaboration of the concept of *hearing* which accentuates the bodily experiences of sound.

The phenomenological approach has suggested a framing of *hearing* as a specifically physical condition which contains the ability to perceive before any consciousness about this perception is obtained. Through the thoughts of Merleau-Ponty, I have presented *hearing* as reflecting the pre-reflexive bodily encounter with sound which contains the sum of human acquaintance with sound across time and place. The phenomenological approach of Merleau-Ponty has also led me to suggest a specific moment for exploring the bodily facets of *hearing*. In the pathologically disturbed *hearing* situation we can potentially reach a new understanding of *hearing*. When *hearing* no longer lives up to its habitual norms, our attention is directed to the body's attempts to perform its habitual approaches to sound.

I have also indicated other specific moments and situations which can allow for a further exploration of *hearing*. In Helmholtz's experimental research into the physiological sensation of sound I have found a method for enhancing the sensation of *hearing*. By using instruments to amplify the physiological sensation of a sound a new awareness of our encounter with sound can be obtained which can challenge basic listening habits as the instruments not only allow the listening subject to *hear*, but also to become aware of how this *hearing* proceeds. I have related this incorporation of instruments into the exploration of sound sensation to the phenomenological act of double-sensing, as described by Husserl and others.

Henceforth, I will refer to the phenomenological act of doublesensing as a *listening-to-hearing*. The concept of *listening-to-hearing* will cover a phenomenological notion of becoming aware of the natural attitude of *hearing*. *Listening-to-hearing* will represent a notion of the phenomenological reduction however it is a reduction which differs markedly from Schaeffer's or Truax's *reduced listening* for example. *Listening-to-hearing* will encourage a focus on how we can become conscious about the bodily and pre-reflexive aspects of sound sensation, instead of how the sound object appears for our consciousness. It will denote a specific kind of reflection that demands a concentrated listening act, however it will concentrate upon how sound is sensed by the ear or, we might even say, how the ear reacts physically to the "touch" of sound. Accordingly, the concept of *listening-to-hearing* will set out to explore the possibility of the phenomenological concept of double-sensing, where we are both *hearing* as well as "feeling" this *hearing*, and becoming aware of this *hearing*.

Throughout the course of this thesis, I will continue to use *listening* and *hearing* in conjunction with my conceptualisation of *listening-to-hearing*. Despite the many different implications of *listening* and *hearing*, which I have also accounted for in this chapter, I will

nevertheless propose a simple differentiation. I will use *listening* as a term to refer to a reflective perceptual act which is focused on retrieving sense out of a sound object. Contrarily, I will use *hearing* to represent a bodily basis of sound sensation and it will refer to the initial, instinctive sensation of sound. My continuous semantic differentiation should be seen as an attempt to explore idealised conceptions of the ear rather than supporting them and, furthermore, as an attempt to explore the wider perceptual frames of *hearing.*

In the following section, I will turn to a historical and media archaeological research approach in order to follow the terminological implications of *hearing* and *listening* into a new domain. This research approach will allow me to investigate how technology has been used to reach and present conceptualisations of the ear by tuning the ear to specific sensational modes.

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Listen to the sound on your list

TECHNOLOGY & THE EAR

Tear along the line

Did you HEAR
the paper being torn

THE OTOLOGICALLY NORMAL EAR

Human hearing is commonly regarded as covering a frequency range from 20 to 20.000 Hz. The perception of each frequency depends upon a specific level of sound pressure. Audiological technology such as audiometers have been used to explore this relationship which has been expressed in the curves of *equal-loudness-level contours* which show how the sensitivity of the ear varies with frequency. The International Organization for Standardization (ISO) have used these curves to represent what they have termed "the hearing of an otologically normal person".[178] ISO defines an otologically normal person as a person between 18-25 years, who is "in a normal state of health who is free from all signs or symptoms of ear disease and from obstructing wax in the ear canals, and who has no history of undue exposure to noise, exposure to potentially ototoxic drugs or familial hearing loss."[179] As this description reveals, the definition of an otologically normal person covers a relatively small group of people in practice and the intention of reflecting a general or even normalized conception of *hearing* thus stands as an ideal.

In this chapter, I will make a recursive cut into the history of audiometers, hearing tests and standard hearing curves in order to expose what I have termed *the otologically normal ear*. *The otologically normal ear* will cover historical attempts to use technology to designate a so-called "normal" or "standard" ear. I will use a discursive media archaeological presentation of *the otologically normal ear* to uncover an implicit discourse on *hearing* that entails ideals, hopes and imaginaries of reaching an objective assessment of sound perception. I will present *hearing* as an ideal state which is nurtured through performative traits and specific sets of trained or cultivated auditory skills. As such, my exposition of *the otologically normal ear* will primarily depart from the perspective of the technology and the industry's goal of obtaining standardised representations of *hearing*. However, I will also set out to explore the *hearing* of the test subject through a phenomenological analysis of *the otologically normal ear*. This approach will not serve to propose diagnostic treatments of individual auditory pathologies, but rather it will unfold a conception of the general auditory experience that *the otologically normal ear* activates. The phenomenological perspective on *the otologically normal ear* will provide the basis for a conception of *hearing* beyond cultural idealisations.

Instruments for Testing

My conception of *the otologically normal ear* takes its point of departure from a media archaeological excavation into the many different instruments that have been applied

178 The term *otologically* derives from the term *otology* which is a medical discipline that covers the study into the normal and pathological anatomy and physiology of the ear.
179 *BS ISO 226* (2003)

to test the performativity and efficiency of the physiological ear, that is, of *hearing*. Accordingly, this perspective will introduce my first attempt to develop a cultural-historical conception of *the otologically normal ear* as a specific auditory attention that has been cultivated within the audiological hearing test situation.

Evaluating hearing acuity has a long history that follows the general technological development of instruments for testing the ear. The first charts of the boundaries of the faculty of hearing appeared around 1600 when new instrumentations, such as microscopes and tiny surgical instruments, allowed for finer grained theories of *hearing* and its impairment.[180] These instruments, alongside ear speculums and ear tubes, were used to obtain a closer look into the ear's physical construction and thereby offer differential diagnosis.[181] Around 1700, sound producing instruments were used to conduct the first actual hearing tests. The physicist Joseph Saveur used tuned organ pipes to estimate the upper and lower thresholds of the faculty of hearing.[182] In the 1830s, the physicist Savart constructed large, finely-toothed brass wheels producing frequencies of up to 24 kHz. A card held to the edge of a spinning toothed wheel produced a tone whose pitch varied with the speed of the wheel. Savart also used fans to test the ear and his research led to the conclusion that the minimum audible frequency was 8 Hz, the maximum 24kHz.[183] During the 19th Century, C. T. Tourtual used a watch as sound source for conducting hearing tests.[184] Around the same time, other scientists such as Weber, Rinne, Helmholtz and Koenig used tuning forks in order to test the ear's capacity. Helmholtz reached the conclusion that the lower limits of auditory sensation were 16-32 Hz - a three octave difference from the findings of Savart. In the late 1800s, Francis Galton used a brass whistle to test the upper boundaries of the faculty of hearing. By means of a small screw a frequency could be varied from 6.000 to 84.000 vibrations per second. Galton found that every listener had "his limits" and that "otherwise "perfect" ears were in fact "insensible to high-frequency sounds".[185]

Creating a Continuous Tone

In the beginning of the 1900s the equipment for testing *hearing* shifted from music and acoustical instruments to electrical apparatus. Harvey Fletcher, who worked at Bell Laboratories between 1916-1949, used phonograph records, sound film, condenser microphones, vacuum tube amplifiers and high-speed mirror oscillography for the study of human hearing.[186] Likewise, the physicist Wien used a telephone receiver to measure absolute intensity thresholds and found that the maximum sensitivity was 10^8 times higher for frequencies near 2200 Hz than near 50 Hz.[187] However, it was not until the invention of the audiometer that the first machine specifically designed for testing *hearing* appeared.

180 Mills (2015), p. 46
181 Feldmann (1996)
182 Mills (2015), p. 46
183 Carterette & Friedman (ed.) (1978), p. 9
184 Feldman (1997)
185 Mills (2015), p. 119
186 Sterne (2012), p. 35
187 Carterette & Friedman (ed.) (1978), p. 9

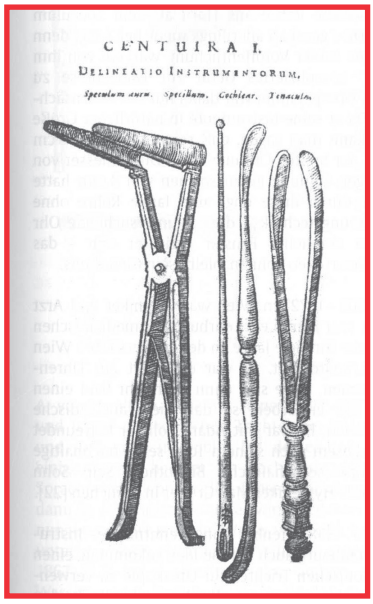

Fig. 2: Ear Speculums of Hildanus, 1646, picture from Feldman (1996)

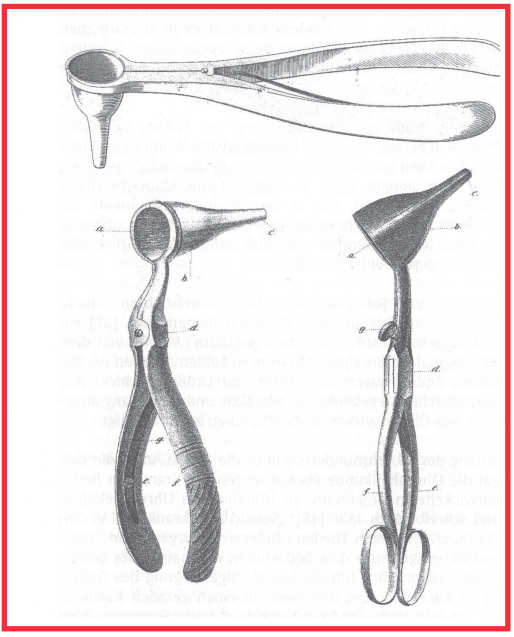

Fig. 3: Ear speculums of Kramer, 1836, picture from Feldman (1996)

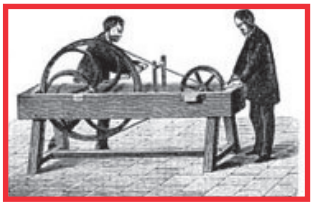

Fig. 4: Savart wheel, picture from *The Popular Science Monthly* (1873).

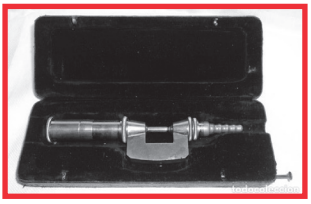

Fig. 5: Galton's whistle, picture from Secor (1920)

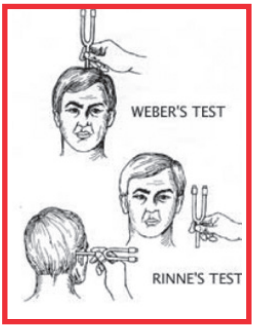

Fig. 6: Drawings of how to conduct Weber's and Rinne's hearing tests with tuning forks. Picture derived from Aarhus University, clin.au.dk, November 2018

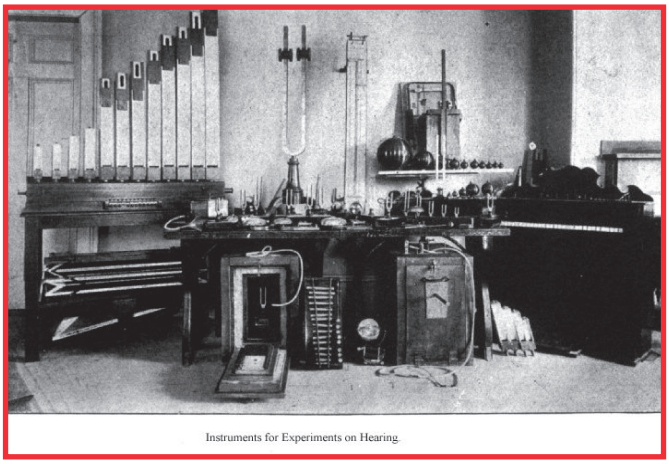

Fig. 7: Instruments for Experiments on Hearing, Hugo Münsterberg, Psychological Laboratory of Harvard University (1893)

Audiometers are used to detect the efficiency of the physiological ear according to a set of carefully selected tones and noises. It is a technology designed for the presentation of calibrated auditory stimuli to transducers. Modern audiometers are electronic instruments that generate sine tones by analogue or digital means. Several types of output transducers are used in modern audiometry such as insert earphones, supra-aural earphones, loudspeakers and bone conduction devices. Circumaural earphones are used for high-frequency audiometry.[188] The buttons and knobs on the control panel of the audiometer are used to select the type of auditory signal presented. Some signals, such as pure tones and noise, are generated by the audiometer itself whilst other signals are generated by external devices, such as tapes, compact disc players or mp3 players (depending on the production date of the audiometer). Live-voice also can be used as an input into the audiometer. Interrupter buttons are controls used to present a signal. The signal is on for the duration that the button is depressed. A "talk forward" switch is used to talk to the patient via a microphone for as long as the button is pressed. By pressing this button, the clinician is momentarily overriding any other settings on the audiometer. This signal is not calibrated. Finally, an audiometer also contains control buttons to decrease or increase the frequency and the intensity level of the signal.[189]

When the technology of the audiometer entered the market during the 19th Century it presented a new approach for reaching the requisite standards of *hearing*. The audiometer electrically generated a continuous tone, a sinusoidal tone, that could vary in pitch and loudness. Following the development of the induction coil in 1849 and audio transducers (as used in telephones) in 1876, a variety of audiometers were invented that allowed for the amplification of small electrical signals which were perceived as pitched tones.

The invention of the audiometer and the associated hearing tests, audiometry, facilitated the creation of a "normal curve" for *hearing*.[190] This curve was reached through the inauguration of numerous hearing tests in the beginning of the 1900s. These tests constituted the first statistical studies of human hearing. In 1925, representatives of Bell Laboratories and the New York League tested the faculty of hearing of more than 4,000 students in New York City schools. The result was, however, remarkably difficult to pin down. As Harvey Fletcher noted: "The results are so inconsistent that it is impossible to differentiate between the normal and hard of hearing pupil."[191] In 1936, the U.S. Public Health Service conducted a nationwide survey in which 9,000 adults of all ages were tested in twelve cities.[192] In 1940, this survey was superseded by "the widest survey of hearing that has ever been made", as H.C. Montgomery noted in The Scientific Monthly, which was carried out at the New York World's Fair and the Golden Gate International Exposition at San Francisco.[193] Here more than a million people undertook a hearing test in a sound proof room.

The surveys were undertaken in order to reach a standardised representation

188 Circumaural headphones are ear cups with pads that cover the ear. They allow the user's ear to be fully enclosed and thereby prevent outside noises to enter the listening space.
189 Gelfand (2016), p. 108
190 Mills (2015), p. 49
191 Harvey Fletcher quoted in Mills (2015), p. 131
192 Montgomery (1940), p.335
193 Montgomery (1940), p. 335

Esbjerg-opfindelse berømt over hele verden

Overlæge Fr. Nielsens og talepædagog Oluf Schultz' høreprøve hidtil den eneste anvendelige til børn

Overlæge Nielsen og pædagog Oluf Schultz i færd med at prøve apparatet. I baggrunden Alfred Allin.

Efter ide af overlæge(skolehørelæge S. Fr. Nielsen, Esbj. over det lykkedes overlægen i samarbejde med audiolog, talepædagog Oluf Schultz, ligeledes Esbjerg, at fremstille et apparat, der løser det vanskelige problem med, hvorledes man får mindreårige børn til at forklare, hvor meget og hvor lidt de hører. Systemet går i store træk ud på gennem høretelefoner at lade børnenes trommehinder påvirkes af rene tonesignaler, dvs. toner, der i modsætning til dem, som frembringes ved sang eller spil, kun har ét svingningstal. Derefter skal børnene på et dertil indrettet stykke papir simpelt hen ved streger og prikker skrive, om de hører de udsendte toner som lange eller korte signaler. I det øjeblik, skrifttegnede er forkerte, kan man med sikkerhed gå ud fra, at barnet ikke har kunnet opfange lyden.

Denne opfindelse skete i 1941, og indtil dato har den været den eneste metode, der med sikkerhed kan benyttes, selv overfor små eller svagt begavede børn. Ved omlægningen til vekselstrøm blev det apparat, man hidtil har haft i brug, uanvendeligt, og en ombygning af det ville koste lige så meget som et helt nyt. Derfor lod man i Sheffield bygge et andet og bedre efter tegninger, der er udformet af overlægen og talepædagogen, og i dag er dette nye apparat ankommet til Esbjerg, hvor det er blevet opstillet i talepædagogens arbejdsværelse på Annexskolen.

Et columbusæg

Når det nye apparat tages i brug, vil det være muligt på een gang at gennemprøve en klasse med 36 elever. Hidtil har man måttet nøjes med 19 ad gangen, hvilket vanskeliggjorde og sinkede arbejdet en del.

Apparatet kan indstilles til svingninger fra 0 til 16284 i sekundet, og dets mindste styrke er helt nede på — 20 decibel (en decibel er den mindste styrkeforskel, det normale menneskelige øre kan opfatte. Det er beregnet til toneaudiometri, til at udsende toner, men kan også, som det står, benyttes til taleaudiometri, hvor opfattelsen af stemmen i forskellig styrke ligger til grund for prøven. Endvidere er det muligt at bruge apparatet solo, blot tilkoblet een hovedtelefon.

Apparatet er leveret af Peters & Son i Sheffield, og firmaets forhandler, Alfred Allin, der har været med til at stille det op, oplyser, at den her anvendte metode er så enkelt og ligetil, at den må betragtes som et rent columbusæg. kis.

Fig. 8: Newspaper article on the implementation of audiometers in the Danish school system, printed in The Danish newspaper Vestkysten, 1951.

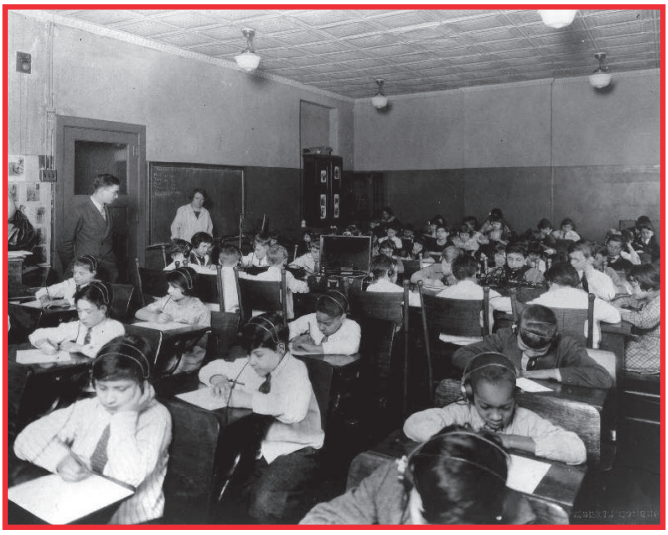

Fig. 9: AT&T testing hearing at a New York Public School, picture derived from Mills (2011d)

Fig. 10: Oticon hearing test conducted with audiometer, the late 1930s. Picture derived from Oticon (2004)

of *hearing*, however the surveys had different outputs which was partly due to the overall state of the audiometers. The audiometers were subject to damage, aging, component malfunction and change due to normal use. This was noted in the *Public Health Reports* of 1969, where a more critical stance towards the audiometer was outlined. Here researchers noticed widespread complaints concerning audiometers that typically had to do with "breakdown, difficulties of service and repair, inaccuracy of output (sound pressure levels), and difficulties of calibration and recalibration".[194] The audiometer "failed to meet standards, primarily in the intensity interval and intensity ranges for air conduction and in the sound pressure output".[195]

One way of overcoming the problems faced by the audiometer in meeting standard acquisitions has commonly been to calibrate it. Calibration is defined as the process of measuring against a known standard. In practice, calibration covers a technological service check of the vital electronic parts of the audiometer. The reason for calibration is to verify that the tones and decibels presented to the client by the audiometer are within the required parameters, i.e. that when 1000 Hz is presented to the client that the correct number of wavelengths are in fact generated.[196] As stated in an audiometry calibration guideline: "Regular *calibration* is vital since an un-*calibrated audiometer* may present inaccurate tones and/or decibels." The ISO standard 8253-1:2010 specifies the requirements and procedures for carrying out basic audiometric tests in which sine tones are presented to the test subject using earphones or bone conduction devices.[197] In this standard the maximum ambient sound pressure levels and the maximum non-ambient sound pressure levels are set in order to secure measuring of the minimum hearing threshold.

However, calibration in itself did not guarantee that the audiometer would meet the specified standards and it did not lead to a uniform conception of *hearing*. This circumstance was pointed out in The Public Health report of 1969 where an evaluation of 100 audiometers revealed that "no screening audiometers passed the tests satisfactorily" and "No audiometer in use was in completely satisfactory calibration for the testing for which it was manufactured".[198] In conclusion, I will argue that not even regular calibrations of the audiometers have been able to secure a standardised conception of *hearing* as the audiometers have not managed to present uniform results.

The Limited Ear

The aim of presenting a uniform and standardised conception of *hearing* has been governed by many different agendas. Originally the aim of testing the ear was to detect deviations from so-called "normal" hearing. Hearing tests were conducted in order to "identify, remedy and even prevent deficiencies in hearing", as Jonathan Sterne has expressed it.[199] Until the turn of the 20th Century, hearing loss was generally considered as unwanted as it was related to deficiencies in intelligence.[200] Hearing impairment was

194 Thomas et al. (1969)
195 Thomas et al. (1969), p. 312
196 Michell (2009), p. 14
197 *ISO 8253-1* (2010)
198 Thomas et al. (1969), p. 324
199 Sterne (2012), p. 59
200 Mills (2012), p. 46

something to combat or even ignore. Testing the ear was used not only to detect the grade of a possible hearing impairment but also to establish better circumstances for the hard of hearing, rehabilitation and, eventually, meticulous school tracking.[201] The interest in detecting hearing impairment and creating better communication possibilities for the hard of hearing grew after World War II as soldiers returned from battle with hearing loss after being exposed to the loud noises of exploding bombs, gun fire and other noises associated with warfare.

The actual driving force of the development of hearing research came in the 1910s and 1920s when both scientists and the industry suddenly gained interest in setting a minimum boundary of *hearing*. A limiting of the scope of *hearing* was incorporated in the design of new sound technology such as the telephone and the phonograph.[202] Sterne has described the dynamics characterising the development of hearing research in the 20th Century, where economic interests more or less defined what *hearing* should be. Telephony and psychoacoustics played a crucial role in promoting *hearing* as a problem of information.[203] Through research into sound and its perception the burgeoning telecommunication industry was concerned with the ears' potential for establishing intelligible sense out of even the smallest, compressed signal. Hearing tests were performed in order to specify the hearing range of an average telephone user and thereby optimise the communication technology.[204] Telephone research increasingly transformed the field of hearing research as the goal was no longer to detect hearing impairment, but to actually make use of the natural boundaries of *hearing* as part of the design. Hearing tests were conducted with a certain expectation in mind, namely to present the minimum detectable auditory sensitivity of the human ear which was required to make sense out of sound. This detection was to lead to the optimisation of the efficiency of communication technology.

As part of the industry's goal of determining the ear's limitations, a series of hearing tests were conducted the goals of which were to determine how humans perceived the sound pressure levels of different frequencies. The aim was to figure out why certain frequencies needed greater sound pressure than others in order to be perceived. Harvey Fletcher and Wilden A. Munson conducted hearing tests in which the subjects were to listen to pure tones at various frequencies in headphones with over 10 dB increments in stimulus intensity. For each frequency and intensity, the listener also listened to a reference tone at 1000 Hz. Fletcher and Munson adjusted the reference tone until the listener made a sign (raising a hand) indicating that the tone was the same loudness as the test tone. The results were marked in a so-called equal-loudness contour which showed that sensitivity of the ear varied with frequency. Fletcher and Munson averaged their results over many test subjects to derive reasonable averages. Yet, their results showed considerable discrepancies compared to later determinations carried out by both Churcher and King in 1937 and Robinson and Dadson in 1956.[205]

In 1962, The International Organization for Standardization (ISO) presented

201 Mills (2011), p. 121
202 Mills (2012), Sterne (2012), p. 41
203 Sterne (2012), p. 19
204 Sterne (2012), p. 41
205 Robinson et al. (1956), pp.166–181.

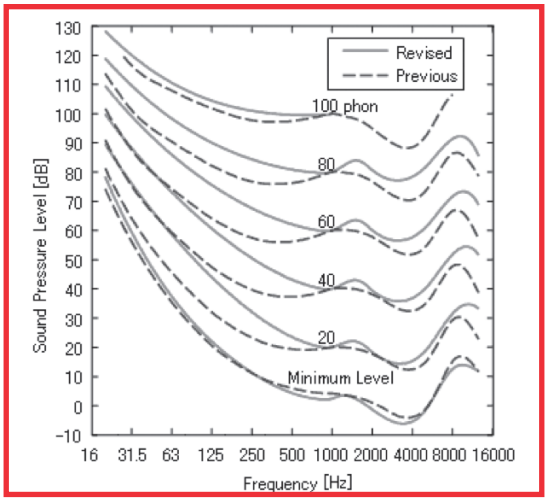

Fig.11: Comparison between charts of equal-loudness-level contours. The blue line represents the contour defined in ISO-226 from 1987. The red line represents the revised chart from 2003. Remarkable differences are observed in the low frequency range. The lowest contour represents the quietest audible tone—the absolute threshold of hearing. The highest contour, the threshold of pain. Graph derived from ISO-226 (2003).

new charts covering the sensitivity of human auditory perception expressed through equal-loudness contours. Since its inception in 1947, ISO has worked to propose several standards relating to the field of acoustics in order to pave the way for comparing research results. However, the results on equal-loudness contours were revised again in 2003 following the claim that "the old ISO 226 involved substantial errors".[206] Large discrepancies of up to about 15 dB for a wide band of frequencies lower than 1 kHz were recognised between the new and the previous standards.[207] ISO expected that the new equal-loudness-level contours would play "a crucially important role" as they would function as the basic data for supporting the development of technologies for high precision audio signal reproduction suited to the digital era, such as techniques for efficiently compressing digital signals of music or for the determination of the optimum frequency characteristics of high-definition audio reproduction systems.[208] The notion of *hearing* that ISO:226 presented has subsequently been applied in the majority of acoustic regulation and practice.[209]

Despite their differences in result, I will argue that measurements of the sensitivity of the ear, as they have been notated in different equal-loudness contours, do not mark an evolutionary change in the human ear do not even imply different notions of *hearing*. Rather, the variety of results accentuate the many attempts to pursue a common notion of *hearing* and, as such, they reflect a will to determine a standardised requisite of *hearing*.

The Objective Ear

In the late 1800s, audiometers appeared as part of the development of the scientific practice of psychoacoustics. In psychoacoustics, experimental methods were used in order to reach a measurable way of "talking about people's perceptions of sound".[210] In Sterne's account of the history of psychoacoustics, he argues that the implementation of electricity and electronic equipment, such as the audiometer, came to play an important role for the emergence of psychoacoustics as a scientific field as it aspired to the condition (and social status) of a physical science.[211] As Sterne explained, the audiometer represented a medium that "combined a physical instrument with a new, more precise and more measurable way of talking about people's perceptions of sound".[212]

As audiometers became basic scientific tools, the hearing aid industry incorporated them as diagnostic tools for detecting hearing loss. In the late 1930s, William Demant, director of the Danish hearing aid company Oticon, quickly adopted the audiometer to perform hearing tests. He imported a machine called an Aurogauge from the U.S. and appointed a young audiometrist to teach his staff to perform hearing tests with it. The audiometer enabled the audiometrist "to reach the individual hearing curve to more closely match people's needs".[213] This description of the audiometer encapsulates

206 ISO 226 (2003)
207 ISO 226 (2003)
208 ISO 226 (2003)
209 Drever (2017), p. 2
210 Sterne, (2012), p. 36
211 Sterne, (2012), p. 35-36
212 Sterne (2012), p. 36
213 Oticon (2004), p. 19.

the discourse evolving around the audiometer. The general apprehension of the audiometer was that it reflected a precise and accurate measurement of ear, which Demant and other hearing aid manufactures took advantage of. In a Danish newspaper dating 1951 the audiometer was described as "an egg of Columbus"[214], which could finally solve the problem of how to reach an objective assessment of *hearing*:

> "An apparatus that solves the complicated problem of getting children to explain how much and how little they are able to hear. The system is basically constructed around the principle of affecting, through headphones, the eardrums of the children by playing pure tone signals, in contrary to tone signals constructed through song and playing. (…) this method is so simple and straight forward (…)"[215]

The hearing aid industry quickly adopted the discourse evolving around the audiometer which presented the ideal of obtaining an objective assessment of *hearing*. Hearing aid users became subject to hearing tests and the results of these tests were used as evidence of the efficiency of the apparatuses which in turn became a significant marketing tool. An advertisement for Wilson' ear drums from 1899 argued that "Thousands testify to their perfection and to benefit derived." Likewise, in an Acousticon advertisement dating from 1920 it was stated that "Inasmuch as 350.000 users have testified to the wonderful results obtained from the ACOUSTICON".

This discourse of the hearing test is reproduced in contemporary commercials. In an advertisement for the Danish hearing aid company Widex in 2016, the argument for buying their new "unique" hearing aid is supported by hearing test results showing that "100% of participants using UNIQUE rated that they were either satisfied (35%) or very satisfied (65%) with the improvement in their hearing."[216] Oticon also applies the same discourse when advertising their new Oticon Opn device. Here it is argued that hearing test results show that "96% heard much better" with the Oticon device, which makes Oticon conclude that their "users experience less effort, better recall and better speech understanding in noise!"[217] It is worth noting that in this discourse it is only the end result which is promoted and the actual basis for the test result is omitted.

Hearing tests have indeed produced data which has been essential for reaching usable knowledge of a patient's hearing acuity and the subsequent means of enhancing it. However, the discourse of the hearing test, as reflected in these few examples, stages a more general discourse of the test which has been described by Trevor Pinch. Pinch has explored testing as a site of research in the sociology of technology. He argues that the test in its generic form[218] stages technology as a substitute for human, subjective judgment. Using technology as part of a test situation provides data that is often thought of as "providing access to the pure technical realm".[219] Pinch further characterises the discourse of the test by describing it as an arena where "expectations are built around a

214 Vestkysten (1951), (Translated from Danish by SB)
215 Vestkysten (1951), (Translated from Danish by SB)
216 Widex (2017)
217 Oticon (2017)
218 Pinch's investigation covers tests of technology in general, not specifically hearing tests.
219 Pinch (1990)

Fig. 12: An example of how quantitative user feedback is applied in marketing in order to promote reliability and satisfaction with a hearing aid. Screenshot from Widex' homepage (2017)

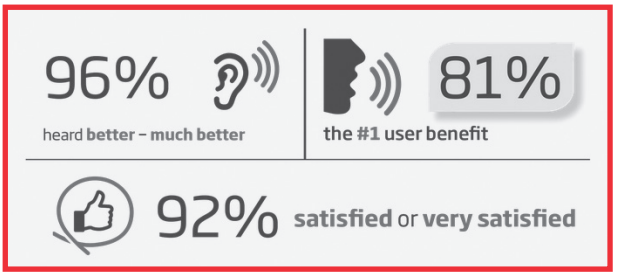

Fig. 13: Another example of how quantitative test results and user feedback are used to promote hearing aids. Screenshot from Oticon homepage (2017)

Fig. 14: Advertisement for Acousticon hearing aid, 1920.

Fig. 15: Advertisement for the hearing aids "Wilson' ear drums", 1899.

certain outcome arising from the test".[220] In many circumstances, test data represents a final check on whether the expert's conception of reality conforms to the physical world.

In the discourse of the hearing test, I have found that numbers, percentages and graphs are indeed applied in order to gain profit. They reflect neutrality, scientifically reliable results and, not least, personal experience. Moreover, the discourse of the test supports my intention in exposing the will to present an objective assessment of *hearing*.

The discourse of the hearing test also allows me to make a preliminary characterisation of my notion of *the otologically normal ear. The otologically normal ear* represents a specific auditory attention which has been cultivated within the audiological hearing test situation. *The otologically normal ear* entails historical and cultural attempts to establish *hearing* as a standardised conception of sound perception. Accordingly, I will claim that *the otologically normal ear* presents a notion of *hearing* as an ideal auditory state that can be measured through the use of diverse instruments. Moreover, *the otologically normal ear* unfolds within the specific discourse of the hearing test, which stages technology as a means for superseding human judgement. This discourse generates a notion of *hearing* as entailing an attempt to establish an objective measure of auditory attention.

The Pure Ear

In the following section, I will pursue a conceptualisation of *the otologically normal ear* which can take *hearing* beyond its historical and cultural idealisations. My entry point for doing so will be through a critical investigation of the sonic material produced by the audiometer.

In contemporary audiology, sine tones are used as a tool to define *hearing.* This specific sonic material is generally conceived as "clearly specified"[221] allowing for "accurate and repeatable"[222] measurements of thresholds. Yet, a new awareness of the artificiality of this specific sonic content is becoming more and more prevalent within contemporary audiometry. Today the WHO emphasizes that "the ability to detect pure tones using earphones in a quiet environment is not in itself a reliable indicator of hearing disability."[223] This awareness is crucial in connection to detecting hearing impairments, as one of the primary complaints of individuals with hearing loss is concerned with the problems experienced with communication background noise. Furthermore, it opens for a change in how a standard in acoustics may regard the concept of *hearing*. I will make an account of why this change appears in the following.

Pure tone audiometry is the classical method of measuring the efficiency of human sound perception.[224] Here the audiometer's wave generators are used to produce

220 Pinch (1990), p.4
221 Gelfand (2016), p. 108
222 ISO:226 (2003)
223 WHO (2017)
224 Pure tone audiometry is a so-called behavioural test, where results are obtained through the test subject's reactions to sound stimuli. Pure tone audiometry is often performed in conjunction with speech audiometry and noise inducements. Noise is used when testing for asymmetrical hearing loss, where it is used to mask pure tones (or speech). The noise is applied to occupy the good ear (non-test ear) while testing the other. Speech audiometry is a diagnostic hearing test designed to test word or speech recognition. It has become a fundamental tool in hearing-loss assessment. In conjunction with pure-tone audiometry, it can aid in determining the degree and type of hearing loss. See Gelfand (2016).

sine tones in order to measure the smallest intensity of sound a person is able to detect. Amongst other techniques, pure tone audiometry forms the basis of the specifications of the equal-loudness-level contours of the ISO standard of 2003. Here combinations of pure tones, in terms of frequency and sound pressure level, are used to test perceived loudness. In pure tone audiometry, the hearing test subject is presented with one sine tone at a time and asked to respond by indicating whether the stimulus was heard ("yes" or raising a hand) or not heard ("no", or shaking the head) after each presentation. The tester controls the level of the stimulus and changes it (e.g., 2 dB at a time) in one direction (ascending or descending) until the responses change.[225]

Pure tones are usually aligned to sine tones, which are tones with simple harmonic motion (no overtones) that have a sinusoidal waveform.[226] A sine tone represents a continuous wave and in its ideal state it is considered the simplest vibration possible. The sinusoids' frequency content is markedly different from most common everyday sounds such as speech and noise. Unlike naturally occurring acoustic phenomena, an ideal sine tone concentrates all energy at one frequency. It can be characterised by its maximum amplitude, its frequency and phase, which specifies the position when the sine wave reaches its peak amplitude.

The acoustical comprehension of a sine tone has its origins in the mathematical conception of the sine wave. The theory of the sine wave originally appeared through an analysis of heat developed by French mathematician and physicist Jean Baptiste Joseph Fourier (1768-1830). Fourier's theory demonstrated "that a finite and continuous periodic motion can always be decomposed into a series of simple harmonic motions of suitable amplitudes and phases,"[227] implying that any manner of complex wave phenomena could be mathematically broken down into an interrelated series of simpler waves for the purposes of scientific examination.

Fourier's conception of the sine wave was adopted by 19th Century acousticians, including Helmholtz. Helmholtz used the Fourier model to perform an analysis of the aural perception performed by the ear, indicating that the ear was able to distinguish musical tones into separate components and simple tones. Helmholtz approached sine waves, or as he called them "simple tones",[228] as the most basic unit of sound and also as the component parts of more complex and meaningful musical sounds. He described this relation through a simple analogy:

> "We can easily compound noises out of musical tones, as for example, by simultaneously striking all the keys contained in one or two octaves of a pianoforte. This shows us that musical tones are the simpler and more regular elements of the sensations of hearing (…)"[229]

The analogy served the pedagogical purpose of supporting Helmholtz's general claim, that the ear was capable of separating the musical tone produced by a musical instru-

225 Gelfand (2016), p. 71
226 Gelfand (2016), p. 108
227 Beyer (1999), p. 44-45
228 Helmholtz (1954), p. 24
229 Helmholtz (1954), p. 8

ment into a series of simple tones. However, it was in his homebuilt instruments, such as the electromagnetically driven tuning forks and sirens,[230] that he found a basis for practical research into the construction of musical sound. He considered these instruments a practical source for creating sustained, regular and simple sounds analogous to the continuous form of Fourier's sine wave.

The use of the sine tone, as found in the experiments of Helmholtz, reveals a progressive shift from observing sound in the temporal domain to the analysis of sound in the frequency domain.[231] This shift has allowed for an analytical focus upon the material aspects of sound. Blamey has emphasised that this approach introduced a new status to sound as it has appointed it as a genuine measuring tool. Sound is no longer considered "ephemeral" and impossible to "quantify"[232] but as "a means for measurement".[233]

However, Helmholtz's approach to the sine tone also radiates a reductive, theoretical, scientific and objective take on sound, which must primarily be considered as an idealised take on how to approach sound perception through objective means. His conception of the sine tone reflects a means for establishing a standardised and objective conception of *hearing*. I will argue that this idealisation is inherent in the general theoretical claims attached to the sine tone, which requires it to consist of an endless repetition of identical periods or cycles of oscillation.[234] Today we are aware that acoustic conditions will always prevent the fulfilment of the strictures of the mathematical curve as any technical sound producing device contains some harmonic content in itself, whether it is a tuning fork or an electrically generated oscillator.[235]

The practical impossibility of the sine tone emphasises that the concept of the sine tone presented nineteenth century acousticians, such as Helmholtz, with an abstract, idealised waveform. This waveform fulfilled a desire to confirm ideas about not only the nature of sound, but also about the ear itself. Helmholtz in particular was concerned with finding a means for approaching the physiological sensation of the ear when detecting musical sound in that he wanted the theory of the sensations of sound "to play a much more important part in musical aesthetics".[236]

The Aesthetic Ear

The consideration of the sine tone within a musical appliance, which Helmholtz introduces, invites an investigation of the scientific claims made in relation to the sine tone within the contemporary audiological field. The determination of the sine tone as not

230 The siren consisted of a thin disc of cardboard which was set in rapid rotation around its axle by means of a string which passed over a larger wheel. A punched set of holes were placed at the margin of the disc. Setting the disc in rotation and blowing through a pipe which was directed over one of the holes, caused a musical tone to rise. Helmholtz (1954), p. 11

231 Blamey (2016), p. 264

232 In a presentation of sound's historical development into a measurement unit, Ampel & Uzzle note that until the Seventeenth Century natural philosophers thought it absolutely illogical to make any attempt to quantify sound or even theorize about its measurement. An attempt of capturing sound was considered a "fruitless exercise". Ampel & Uzzle (1993), p. 1

233 Ampel & Uzzle (1993)

234 Pierce (2001), p. 39

235 The figuration of the sine tone as "a pure sound" was already proven to be practically unattainable by Helmholtz, who noted that the tuning fork contained "very high inharmonic secondary tones". Helmholtz (1954), p. 54

236 Helmholtz used the observation of regular oscillations of the sine wave to constitute a theory of timbre and harmonic interaction. Helmholtz (1954), p. 3

only a scientific sound used within audiometry, but as an almost "ur-musical sound"[237] invites exploration of the experimental and aesthetic conditions it can invoke. Such an exploration may provide the basis for a further characterisation of *the otologically normal ear* as not only evolving around an idealisation of *hearing* as a specific objective conception of sound sensation, but also as a specific auditory attention.

Residues of the sine wave are by no means limited to the domain of science. Concepts from acoustics have been implemented in the arts caused, amongst other factors, by the popularisation of acoustics presented in the writings of Helmholtz. During the first half of the 20th Century, composers such as John Cage, Karlheinz Stockhausen, Alvin Lucier, LaMonte Young and others formulated new definitions of musical sound based upon a reappraisal of the sine tone. The sine tone announced a restricted approach to sound which accommodated artists looking toward a new discourse of sound that exceeded the traditional concerns of music.[238] Through experimentation with technology that produced electrically generated sine tones, a new sonic aesthetics was cultivated which left ideals pertaining to melody, harmonics and fixed tuning systems behind. The sine wave was regarded as the exemplary form of "sonic purity"[239] – both physically and aesthetically – and it became a prime example of reduction as a radical form of aesthetic practice.

The work of Alvin Lucier in particular outlines how the sine tone has displayed a new approach to sonic aesthetics which in turn has allowed for an activation of a specific auditory attention. Lucier has described his own practice as intending to "explore the natural properties of sound".[240] From the mid 1970s onwards, he cultivated this approach through explorations of the sine tone generated by a sine wave oscillator which he used in sound works such as *Still and Moving Lines of Silence in Families of Hyperbolas* (1973-74),[241] *Music on a Long Thin Wire (1970)*[242] and *Music for Pure Waves, Bass Drums and Acoustic Pendulums* (1980).[243] These pieces clearly draw upon an acoustic approach to sound, as they stage the sine wave as the basic phenomenon of sound propagation. Lucier himself has explained that the sine tone for him has expressed "the exemplar form of neutral sound".[244] He has valued the "purity" of this sound phenomenon in that it has depicted the propagation of sound without disturbing factors such as "personality". Lucier designates the sine wave as "neutral" and as "found material" which can be used to constitute a kind of "depersonalized' material".[245]

237 A notion derived from Blamey (2016), p. 5
238 Blamey (2016), p. 265
239 Blamey (2016), p. 262
240 Blamey (2016), p. 174
241 In this piece, sine tones were distributed to four loudspeakers dispersed in a space. As the sine waves propagated into the space they became subject to different forms of interference, such as beatings and standing waves.
242 This piece displayed a length of a piano wire stretched from one side of a space to the other. A large horseshoe magnet was placed over one end. Both ends of the wire were connected to an amplified signal from a sine wave oscillator, causing the wire to vibrate in ways clearly observable to the eye. Microphones placed at each end of the wire routed the audio signal to loudspeakers, providing the sonic analogue of the visible oscillations.
243 In this piece, four bass drums are placed side by side. In front of each bass drum, a ping pong ball is suspended from the ceiling, touching the center of the drumhead. A loudspeaker is positioned behind each bass drum and a sine wave is played back by all loudspeakers at the same volume. The sine wave slowly sweeps upwards through the low frequency resonance region of the bass drums. Once the frequency of the sine wave reaches the resonance region of a drum, the drumhead starts to vibrate sympathetically and pushes the ping pong ball away from the drumhead.
244 Blamey (2016), p. 228
245 Blamey (2016), p. 263

I will argue that in Lucier's work the sine tone is used to carry out a clear programme of impersonalising, neutralising or objectifying the musical content. The association of sine tones with scientific appliances supports a specific staging of his musical intentions as "differentiated from those of more traditional composers".[246] Lucier's terminology in large part echoes the discourse of the sine tone as it has been cultivated within acoustics and, as such, I will claim that he exploits the aural signifier of scientific experimentation which is attached to the sine tone. He does not reproduce the conditions of the physics laboratory but rather transplants the acoustic comprehension of the sine tone as an idealised concept of sound's inception to the concert stage in order to stage a specific kind of auditory attention. Lucier himself has described this auditory attention as activated by the use of sine tones as a means to "uncover sounds or aspects of sounds which we seldom hear because of our concern with musical language".

Even though I will argue that Lucier uncritically transfers an idealised concept of the sine tone from the realm of acoustics to the aesthetic domain, I have found that his conception of the sine tone invites further examination of the auditory attention produced by *the otologically normal ear* as a phenomenological or even pre-phenomenological mode of sound perception. When used within a hearing test situation as a physical sound event the sine tone evokes an auditory attention that searches for the origin of the sound's propagation and stimulation. In this respect, the sine tone encourages an exploration of the origin of *hearing* itself as attention is focused on the very moment in which the ear detects vibrations as a sonic occurrence. The sine tone may still lead to a non-discursive notion of *hearing* – not because it presents a standardised or even objective definition of *hearing*, but because it exposes *hearing* as the essence of a bodily experience of sound where all former acquaintance with sound is turned into a single *astonishment* at the sound's appearance.

The Auraltypical Ear

The phenomenological approach of Husserl has led me to present the sine tone as a possible entry point for becoming conscious of *how* we hear, as opposed to *what* we hear. However, this conception of the sine tone uncritically adopts the audiological idealisation of this specific sound object. In a contemporary setting, the sine tone might well evoke other auditory attentions, as this specific sound might also be associated with the tradition of electronic music. I will argue that the sine tone no longer represents, either physically or aesthetically, a "pure" sound and, as such, it does not form a pure basis for reaching an understanding of *hearing*. Making a further inquiry into the hearing test situation as a composite mode of perceiving sound, and thereby beyond the limited focus on the sound object, will allow me to approach *hearing* from another perspective. I will therefore set out to explore the hearing test situation between the scientific and aesthetic realms which will enable me to critically disturb the ideal of *the otologically normal ear* as covering a steady and detectable auditory attention and instead evolve a notion of *hearing* which includes the generally fallible, fluctuating and indeed performative aspects of perceiving sound. I wish to advance this conception by turning to John Drever who has

246 Blamey (2016), p. 229

recently called for a new agenda in hearing research.

According to Drever, the normal equal-loudness-level contour as it is expressed in ISO:226 is an exemplar of a normative, even idealised, hearing subject. Drever remarks that the definition of otologically normal persons, as stated by ISO, does not take account of people with sensitive hearing, such as people suffering from hyperacusis, tinnitus or misophonia,[247] or people with Asperger's syndrome, autism, dementia or other conditions which often lead to hyperacute hearing.[248] He proposes a new conception of a standardised representation of auditory sensation which will include vulnerable groups. Drever suggests the application of the terms *auraltypical* and *auraldiversity*.[249] He coins the term auraltypical from autism, where neurotypical refers to non-autistic people. The term implies the neurotypical people's tendency to impose their understanding of normality on everyone else as correct and natural. Auraldiversity refers to the shifting auditory attitudes that the ear posits, like temporary threshold shift, transient ear noise or intolerable pain from hyperacusis.[250]

The auraltypical circumstances surrounding *the otologically normal ear* can be further comprehended by critically appointing these demands to the hearing test situation, that the equal-loudness-level contours of the ISO:226 are based upon:

a) the sound field in the absence of the listener consists of a free progressive plane wave;
b) the source of sound is directly in front of the listener;
c) the sound signals are pure tones;
d) the sound pressure level is measured at the position where the centre of the listener's head would be, but in the absence of the listener;
e) listening is binaural;
f) the listeners are otologically normal persons from 18 years to 25 years old.[251]

The application of these preconditions to the hearing test situation set by ISO clearly reflects the ambition of achieving a notion of an auraltypical listener. These conditions display a sort of formulae or recipe which reflect a desire for "scientific exactitude".[252] However, a critical inspection of the list quickly reveals these conditions as fundamentally unattainable. By no means do they reflect a common or natural listening setting, where many uncertain factors affect the general performativity of the physiological ear. These circumstances include the listening surroundings (open free field, headphones, reverberate room etc.), the actual structure of the sound (frequency, intensity, timbre etc.), the listener's ability to focus on the very act of *hearing* in a specific listening mode in order to analyse the sounds heard and, not least, the technology used for testing the ear. As such, the conditions of the hearing test situation proposed by ISO:226 supports Drever's characterisation of the normal equal-loudness-level contour as representing "an exemplar of the normative even idealized hearing subject". Consequently, ISO:226

247 Drever describes misophonia as related to people who evolve strong negative emotions when hearing eating sounds of others. See Drever (2017), p. 3
248 Drever (2017), p. 2
249 Drever (2017), p. 2
250 Drever (2017), p. 6
251 See ISO:226
252 Drever has attached this characterization to the discourse of acoustical engineering. See Drever (2017), p. 1

poses the question of whether it is actually a standardised conception of *hearing* which is conceived through these test conditions or rather that they present *hearing* as an extraordinary, even exceptional, state of auditory perception?

Drever's notion of auraldiversty and auraltypicality points towards a new characterisation of auditory attention as practiced by *the otologically normal ear.* With Drever's remarks on the auraltypical and the auraldiverse, *the otologically normal ear* becomes an ear which is shifting, unsteady, individual and consequently always more or less pathologically disturbed. This characterisation of *the otologically normal ear* introduces a new comprehension of *hearing* which now must take account many deviational states as these states constitute a new norm.

Drever's critical approach to the equal-loudness contours provides a basis for new reflections on the nature of hearing tests: Who and what is actually tested when conducting a hearing test? A new International Standard definition from 2014 seems to take these questions into consideration.[253] In this standard, which determines a conceptual framework for soundscape,[254] it is stated that "hearing impairments and hearing aids" are included as factors that may "influence auditory sensation". This criterion has led Drever to conclude that "a sea change in how standards in acoustics relate to hearing" is under development.[255]

Traditionally, audiometer tests have been conducted in highly artificial sonic atmospheres, using soundproof rooms or creating an isolated listening environment through the use of headphones. A description of the circumstances of a hearing test conducted by a Dr. Kerridge during the 1930s in London indicates how accuracy in hearing tests has a long history of depending upon the construction of a specific space. Dr. Kerridge tested children in a hospital's "silence room", which was a 3500-cubic room in a basement:

> "walls impenetrable to extraneous noises and which will never reflect, deflect nor refract sounds—a chamber of the stillness of death, where absolute accuracy and complete consistency in results will be obtained."[256]

Besides it's gloomy characterisation, the room's specifications as described in this quote indicate that the aim of reaching an accurate result regarding hearing acuity has been contingent upon the ideal of total silence – even though silence must itself be regarded as relative.[257]

In an article published by The Public Health Reports in 1969, a research team from the University of North Carolina defines the space of a hearing test as follows:

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253 BS ISO 12913-1:2014. This standard explains factors relevant for measurement and reporting in soundscape studies, as well as for planning, design and management of soundscape. It aims to enable a broad international consensus on the definition of 'soundscape', to provide a foundation for communication across disciplines and professions with an interest in soundscape.

254 There is a diversity of opinions about the definition and aim of soundscape. Consequently, the use of the term 'soundscape' has become idiosyncratic and ambiguous. ISO conceives soundscape as a perceptual construct, related to a physical phenomenon. The standard distinguishes the perceptual construct (soundscape) from the physical phenomenon (acoustic environment), and clarifies that soundscape exists through human perception of the acoustic environment. See ISO 12913-1:2014

255 Drever (2017), p. 1

256 *Nature 146* (1940)

257 Many theorists have conjectured about the term silence, e.g. John Cage (in the piece 4'33) and Don Ihde. I will return with a further elucidation on Ihde's conception of silence in the chapter *The Mediated Ear*.

> "The accuracy of hearing tests is directly related to a number of factors, such as the training and experience of the operator, environmental noise, and the cooperation and attention of the subject. Of equal importance is the state of calibration of the audiometer."[258]

This remark reveals how the outcome of hearing tests have been confined to a specific space constructed according to a number of factors, including the technology, the operator of the technology and the listener. The restricted notion of the hearing test subject has been described further in a recent document from the British Society of Audiology, where a recommended procedure for pure tone audiometry is outlined:

> "The subject's face shall be clearly visible to the tester. The subject shall not be able to see or hear the tester adjust the audiometer controls. When the test is controlled from outside the audiometric test room, the subject shall be monitored through a window or by a closed-circuit TV system. Audible communication with the subject should also be possible."[259]

The confined space of the hearing test serves to suppress what Drever refers to as aural-diversity. Nevertheless, I will argue that the space of the hearing test reveals a notion of *hearing* as a highly individual mode of sound perception. In the space of a hearing test, judgments and actions are carried out which directly affect the results of the hearing test. Besides being determined by the technology and by the operator of the technology (a circumstance I will return to later in this and subsequent chapters), *hearing* is indeed defined by the hearing test subject's body and its placement and actions in the room.

The confined space of the hearing test exposes a notion of *hearing* which conforms to Husserl's analysis of perception which draws on the subject and its experiences. In Husserl's phenomenology, the subject's body is conceived as the absolute zero point. According to Husserl, it is from the body's placement in the room, and furthermore from its movements, that any object can be experienced.[260] With Husserl's emphasis of bodily perception it becomes evident that *hearing* as performed by *the otologically normal ear* can no longer be conceived as a passive or static condition, but rather a multitude of conditions comprising both external circumstances and internal, subjective parameters which constitute the conditions of *hearing*.

The audiological hearing test situation indeed emphasises that *hearing* differs according to the hearing test subject's intentional approach to the sound object. Thus, the hearing test subject has to activate a specific auditory attention, a specific intention, in order to become conscious of *hearing*. The hearing test subject must activate what I will term a *listening-to-hearing*. This peculiar auditory attention revolves around more than just a focusing on the quality of the sound phenomena. The hearing test situation encourages a focus on the quality of the sensation of sound, or we might say – with an analogy to Husserl's phenomenological concept of polar sensation – that *hearing*, as practiced by *the*

258 Thomas et al. (1969), p. 311
259 British Society of Audiology (2011)
260 Husserl (2010), p. 73.

otologically normal ear, encourages an awareness of the "touch" of sound.

The Performative Ear

I wish to investigate further into the perceptual circumstances which governs *the otologically normal* ear. In order to do so, I will approach the hearing test situation as a specific performative moment.

Pinch describes the act of testing as an attempt to "specify and identify how the technology in question will perform, is performing or has performed."[261] He emphasises, that the test is a performance in that it can be witnessed by others. The audience analyses the results and may very well have different interests in the outcome of test.[262] Furthermore, the performativity of the test is given by its user or operator, as Pinch underlines, in that the outcome of the test relies on a specific operation of the technology. These considerations can be transferred into a phenomenological notion of the auditory attention practiced by *the otologically normal ear. The otologically normal ear* has a specific directedness, it operates with an intention in mind. It sets out to detect or identify the appearance of sound as such. Accordingly, *the otologically normal ear* is a focused ear, an intentional ear, which sets out to perceive the sound with one goal in mind, namely to define or locate *hearing.*

Obviously, the focused act of *the otologically normal ear* challenges any ideal of relating *hearing* to an objective or unconscious act. The *hearing* of *the otologically normal ear* is constrained by intention, as it operates according to specific set of rules and conditions. The enervating focus on the sound's mere appearance becomes almost "unnatural" – it is performative in so far as it unfolds around the deliberate aim of ignoring the act of *listening.* These conditions can be evolved further by turning to art historian Camilla Jalving's notion of *performance.* Jalving's conception of *performance*[263] derives from the specific artistic genre within the field of theatre and visual arts which has its roots in the American art scene of the 1960s and 70s. Jalving points towards specific notions and expectations which belong to the genre of performance art:[264] *Presence, subversion, relationality and presentation. Presence* links to the performance's placement in time, which is "live, present" and further entails "a specific expectation of authenticity".[265] *Subversion* represents the formal mode of performance for recognising its forms in society. Here performance becomes a way of conceptualising the ways in which social meanings and values are embodied in behaviours and events. *Relationality* is characterised as the incorporation of the observer as part of the work. The audience simply becomes active players.[266] It is

261 Pinch (1990), p. 3

262 Pinch (1990), p. 4

263 The term performance has, as Jalving also points out, many applications. It is applied to cover a concert or a play yet performance is also a cultural concept which has been developed within anthropology and sociology. These fields explore how culture consists of performances and not only artefacts.

264 Jalving also accounts for the historical outset of performance art. She links it to the DADA and Futurist cabaret, where the traditional art object was replaced with theatre-like acts. She also relates it to John Cage's "untitled" (1952) which marked a break with the object and the relation between object and observer. In the 1960s and 1970s, performance art was established as an independent genre especially linked to the (artist's) body. See Jalving (2005)

265 Jalving (2005), p. 27

266 As examples of relationality, Jalving uses Marina Abramovic and Yoko Ono, whose work challenges the observer's judgement and actions through a deliberate staging and radicalisation of the theatrical element. See Jalving (2005), p. 33

the performance's relational setting which enables the establishment of a certain kind of theatrical relationship with the observer. Performance art thus covers art works that establish a consciousness about the relation one enters into with the art work. Finally, performance operates through *presentation* rather than representation. Performance creates significance through the way it works, rather than through what it refers to. The art work is no longer a picture of something else. Its significance is to be found within the frame of what happens between the performers and the audience. The presence of a bodily experience has the effect that it cannot be reduced to signs.[267]

In the account of performance art presented by Jalving, the auditory attention practiced by *the otologically normal ear* unfolds as a dialogue between actor and an audience. The space of the hearing test accentuates that the circumstances surrounding *the otologically normal ear* are highly artificial. The hearing test situation echoes many of the parameters associated with the genre of performance art: It is an act which requires *presence*. The hearing test emerges in a specific moment, that demands the presence of both an operator and a hearing test subject in order to proceed. The test situation also demands *subversion*, in that the hearing test subject enters into an expected behavioural mode, a specific social context which can be described as a contract between the operator and the hearing test subject. This contract requires requisite modes of auditory attention and modes of responding from the hearing test subject. The *relationality* of the hearing test can be ascribed to the role of the hearing test subject: The hearing test subject is not just a passive observer but part of the process of acquiring knowledge of hearing acuity, as the definition of *hearing* depends on the test subject's ability to account for his meeting with a specific sound. The relation between the operator and the hearing test subject establishes a theatrical moment, where each participant agrees to enter into a specific role with the attitudes connected to their respective spheres. There is an agreed logic in this moment where silence from both the surroundings and the participants is cultivated. Only necessary verbal utterances are carried out between the operator and the hearing test subject. In this theatrical moment the sound of the machine, of the audiometer, is offered as the focus of attention. It is in this theatrical moment, in this *presentation*, that the significance of the hearing test can be found as it establishes consciousness of *hearing* itself. As such, the hearing test situation may outline a general comprehension of *hearing*, however the confined space of the test situation results in a particular tuning of the ear.

The Self-Objective Ear

What does the performative take on the hearing test situation add to my general comprehension of *the otologically normal ear* as a specific auditory attention and furthermore to my notion of both *hearing* and *listening* as epistemological practices? It definitely challenges any ideal notions of understanding *hearing* as a particular objective sensation of sound, as *hearing* is now contingent upon on a series of cultivated practices, amongst them the act of *listening*. However, I will argue that the performative comprehension of *the otologically normal ear* creates an approach for understanding *hearing*, which proceeds

267 Jalving (2005), p. 33

through the act of *listening-to-hearing.*

In the previous chapter entitled "The Ear", I outlined *listening-to-hearing* as a particular auditory attention that advances a phenomenological self-objectification which can be aligned to Husserl's concept of polar bodily consciousness. *Listening-to-hearing* allows for a kind of double perspective, where we are both *hearing* and conscious of our own way of *hearing*. In the case of *the otologically normal ear,* attention is cultivated which is directed toward *how* we hear the sound, instead of toward *what* we hear. In this act of sound perception, our attention is not on sound as an aesthetic or discursive expression but rather on the tactile and bodily encounter with sound as sensation. As such, *the otologically normal ear* provides a basis for a conception of *hearing* as a feeling of a touch which can be aligned to Husserl's example of a hand that is both touched, but is also feeling this touch. In the case of *hearing,* the ear is being touched by the vibrations of sound waves (it *hears*), but it also feels these vibrations: it *listens* to *hearing*.

The concept of *listening-to-hearing* provides a basis for an approach focusing on the sensation of sound. However, it also resonates with the difficulties of achieving the phenomenological conception of *reduction.* Merleau-Ponty has aligned the complexity of reduction to the fact that it will always demand a thematisation of the ego:[268]

> "The most important lesson which the reduction teaches us is the impossibility of a complete reduction."[269]

According to Merleau-Ponty, reduction will remain a layer of reflection, a kind of verbalisation, which stands in the way of obtaining a direct experience of the world.

> "The task of a radical reflection, the kind that aims at self-comprehension, consists, paradoxically enough, in recovering the unreflective experience of the world, and subsequently reassigning to it the verificatory attitude and reflective operations, and displaying reflection as one possibility of my being."[270]

Merleau-Ponty's critical perspective on the phenomenological notion of reduction emphasises that *hearing* can only be understood through the act of *listening,* that is through a subjective act of interpretation. Even though a sound may hit the listener as a genuine *astonishment*, it will always undergo an interpretative process of comparing patterns of reaction derived from both human responses and other datafication of hearing stimuli.

In conclusion, *listening-to-hearing* does not lead to a direct or objective experience of the world as it remains a layer of reflection, a verbalisation. Rather it lets us tune between the perceived body and the perceiving body, between *listening* and *hearing.* However, by inviting us to explore the tuning between different bodily consciousnesses, I will claim that *the otologically normal ear* generates new approaches for reaching alternative notions of *hearing. The otologically normal ear* causes a specific attention towards *hearing.* This attention indeed proceeds through the intentional and subjective act of *listening,* however it creates a new focus on the very moment where the ear is physically touched by sound

268 Merleau-Ponty (1999), p. 25.
269 Merleau-Ponty (2005), p. XV
270 Merleau-Ponty (2005), p. 280.

and, as such, cements the bodily act of *hearing* as pivotal to the perception of sound.

The Intentional Ear

Within this chapter, presentations of the boundaries of *hearing* have in many respects acted as my point of departure for making a recursive cut into a conceptualisation of the ear which I have chosen to term *the otologically normal ear.* These charts have reflected diverse attempts to grasp a standardised conception of *hearing* through technology, sound, numbers, graphs, discourses and behavioural codes. I have proposed the term *the otologically normal ear* as an adequate characterisation covering both idealised notions of *hearing*, which the use of audiometers and hearing tests have cultivated, but also as covering the phenomenological dynamics at stake when trying to grasp a notion of *hearing* beyond idealisations.

I have deliberately chosen to expose how technology and tests have not only been employed to reflect hearing acuity, but also to present an objective assessment of *hearing*. As such, I have critically explored the perspective on *hearing* that the industry of hearing technologies has cultivated where economic profit must be seen as an essential motivation for presenting normative descriptions of *hearing*. With this focus, I am aware that I may undermine the beneficial effects that hearing tests necessarily have had for the diagnostic treatment of patients who suffer from hearing impairments. However, my intention has at no point been to make a qualitative analysis of this technology. Rather it has been to explore the perceptual ideals implicit in this technology.

Presenting *the otologically normal ear* through media archaeological discursive excavations of audiometers, hearing tests and the boundaries of hearing has introduced a new norm of *hearing*. This norm takes all the ideals, deviations and performative traits that the ear constantly depends upon into account. By appealing to fields beyond audiology and the history of audiology, such as the music theory of Helmholtz, Alvin Lucier's practice of sound art and Jalving's performance theories, I have explored *the otologically normal ear* as a specific tuning of the ear, where specific sonic content, specific spatial demands and specific performative traits residing between the audiometer, the hearing test subject and the operator cultivate auditory attention to listening to the efficiency of one's own hearing acuity. However, these parameters have also emphasised that *the otologically normal ear* suggests a new normative description of *hearing* which exposes it as being general fallible, fluctuating and indeed performative.

I have explored the tuning of the ear that *the otologically normal ear* cultivates further through phenomenological analyses which has provided me with a methodology and a language for describing the auditory attention of *the otologically normal ear* beyond idealisations. I have used Husserl's emphasis on bodily perception to remark that *hearing,* as it is performed by *the otologically normal ear,* cannot be conceived as a passive or static condition. Rather, *hearing* is formed by many conditions which include external and internal matters surrounding the hearing test subject.

My conception of *the otologically normal ear* has introduced a specific methodology for understanding *hearing* which recalls the concept of phenomenological reduction. However, *the otologically normal ear* cultivates an attention which is directed toward *how* we hear the sound, instead of *what* we hear. This act of sound perception activates a

specific *intention*, which I have termed *listening-to-hearing*. *Listening-to-hearing* evolves as a double-perspective on the quality of the sensation of sound, where the ear is both an object touched by sound, it *hears*, but also a perceiving subject that feels this touch and becomes aware of this touch, it *listens* to how it *hears*.

My introduction of the term *listening-to-hearing* has accentuated that *the otologically normal ear* is governed by an intentional act. However, I have also argued that this intentional act does not lead to a pure or objective conception of *hearing*. Rather, it challenges the phenomenological concept of reduction, as we are constantly confronted with the subjective thematising of perception.

In conclusion, phenomenology has failed to deliver a theory of *hearing* which appears any more truthful than the graphs charting the boundaries of hearing that technology has delivered. However, I will claim that it has proposed a methodology for exploring *hearing*. The phenomenological approach has allowed for a new focus on the conditions that forms the conceptions of *hearing* and indeed also on the impossibility of capturing the essence of *hearing*. Furthermore, the phenomenological approach has contributed new perspectives on the many perceptual dynamics that surround *the otologically normal ear* which emphasises that *hearing* can by no means be conceived of as a static perceptual mode.

Open box #2
Push power button
on the deivce.
Detect light in the earphones

Place earphones in ears
Read the following chapter
with earphones in ears

THE IMAGINARY EAR

The human brain is sensitive to light. This sensitivity is due to the photoreceptor-proteins in the brain. For mammals, including humans, light passes naturally through the skull. Recently, researchers have found that light can also pass through the ears. Between 2008 and 2010, researchers at the University of Oulu, Finland, discovered that brain areas specifically pertaining to emotion-attention interaction, can be reached through the ear canals. The researchers found that penetration of light through ear canals had a beneficial effect on human mental and physical health. Tests were conducted on a Finnish National Ice Hockey League team that were exposed to a 12-minute dose of bright light or placebo daily over a period of 24 days. The tests showed a statistically significant difference in cognitive performance between the two groups. Further tests revealed effects on energy levels, mood sensations and physical wellness.[271] Based upon the experiments conducted at The University of Oulu, a small device called the HumanCharger was launched by the Finish company Valkee in 2007. The device consists of an iPod-like object that distributes light through earphones. According to Valkee, using the device regularly for 12 minutes a day can reduce symptoms of winter blues or jet lag.

Besides its curative properties, I will argue that the HumanCharger offers other perspectives. The HumanCharger is possessed of a rich poetic aura as new areas and functions of the ear are literally illuminated. For me, this device stands as an example of a technology made to manipulate the physiological mechanisms of the ear in order to reach new sensitivities as well as to correct both physical and psychological impairments. With the Human Charger, the ears are attributed an imaginary property in that they are no longer just distributers of sound but a direct channel to our brain and thereby our mental wellbeing. Penetrating the ears with light offers the promise of reaching and controlling the most powerful and fascinating area of the human body, namely the brain.

My conception of the HumanCharger places it within the narrative of *imaginary media.* The term imaginary media has been put forward by the media archaeologists Erkki Huhtamo and Eric Kluitenberg who emphasise that media are not only means by which new modes of communication might be imagined. Media constitutes a technique for manipulating humans and their culture.[272] According to Kluitenberg, conducting an archaeology of imaginary media is an attempt to shift attention somewhat away from a history of the apparatus in order to focus on the imaginaries and "histories" surrounding technological media.[273] In their pure form imaginary media are "strictly discursive objects", which can be just as revealing as realised artefacts.[274]

In the following section, I will use the concept of imaginary media to unfold a

271 All information on the research is derived from HumanCharger's website, www.humancharger.com/research/ (visited march 2017)
272 Huhtamo & Parikka (eds.) (2011), p. 25
273 Kluitenberg (2006), p. 48
274 Kluitenberg (2006), p. 53

notion of what I have chosen to term *the imaginary ear.* I will construct my notion of *the imaginary ear* through discursive investigations into media, methods and specific sounds that have been used to penetrate the ear in order to combat impairments or disturbances, not only of the ear, but of human perception as a whole. I will trace these imaginaries across historical epochs and within different fields of knowledge such as medical sciences, acoustic therapy, sound healing and sound art. I will use the notion of *the imaginary ear* not only to reveal imaginaries of optimising or normalising the ear through physical stimulation, but also to present *the imaginary ear* as a distinct auditory attention which tunes between the act of *hearing* and the act of *listening.* Finally, I will introduce a multisensorial notion of the auditory attention practiced by *the imaginary ear,* which can add a multifaceted perspective to the notion of *hearing.*

Penetrating the Ear

My media archaeological exposition of *the imaginary ear* will depart from a historical survey into remedies used to cure the ear. Within hearing research, penetrating the ear with external stimulants has been a frequently used method for overcoming hearing impairments. Diverse objects, fluids, electric currents and sounds have been conducted into the ear in order to regain lost hearing abilities or restore damaged hearing. Obtaining knowledge of the ear and its impairments has often been accompanied by a search for patterns of physical reaction, as the actual impairments of the ear have been invisible. A method that has been frequently used to produce physical reactions from the ear has been to conduct sound through the ears in order to activate them. Sound stimulation as treatment for hearing impairment was already cultivated by the Romans. Archigenes, a Roman physician, is said to have used loud sounds presented into the ear via a "tuba" to stimulate the auditory system (98-117 AD).[275] Alexander of Tralles (525-605 AD), another physician, reported on both treatment and acoustic stimulation procedures by blowing a trumpet directly into the auditory canal or penetrating the ear with sounds made by large bells and other musical instruments.[276] These examples demonstrate an understanding of sound as a physical force that can eradicate a possible barrier that prevents sounds from entering the ear.

The idea of treating the ear using not only sound, but even very loud or high-pitched sounds that cause an instant, and most likely painful, reaction from the ear has been developed further in modern times. In the collection of devices used to test and treat the faculty of hearing belonging to The Central Institute for the Deaf in Saint Louis, Missouri, various apparatuses, dating primarily from the 19th and 20th Century, intended to activate the ear through sound stimulation can be found. In the collection, an instrument called the Massacon (dating from app. 1902) appears which produces "sharp impinging sounds" in order to "exercise the enervated and disused middle ear and adjacent parts."[277] The rapidly recurring sharp sounds are said to promote circulation and improve the general physical condition of the ears of a deaf person.[278] Nevertheless, a

275 Staab (2012)
276 Staab (2012)
277 Koelkebeck et al., (1984), p. 97
278 Ibid.

Fig. 16: The aerotherapeutist Dr. Julian J. Hovent cured deafness in the 1890s by raising the atmospheric pressure within a sealed chamber. The cure was to be conducted during the course of two weeks in 3-hour sessions. Picture derived from The Lancet (1893)

Fig. 17: Dr. P. Hall claimed that deafness was caused by blockage and inflammation in the Eustachian tube. Applying the "Catarrh Remedy for Deafness" in the ears could counteract the blockage. Production year unknown. Picture derived from The Brainy Deaf (2018).

Fig.18: The Oticon (1) was a patented device designed to massage the ear drum and stimulate the circulation of the middle ear. The tip of the device was to be inserted into the ear and the "trigger" drawn back with one finger while counting to 50. What exactly happened when drawing back the trigger is not revealed by the manufacturer. Despite the name of the device, the manufacturer is not the Danish hearing aid company Oticon but Hearing Devices Co. Inc. of New York. The Massacon (2) was an instrument produced in about 1902 by the Hitchinson Acoustic Company. It was developed as an "ear massaging" device which produced sharp "impigning" sounds in order to exercise the enervated and disused middle ear. The Phono-Faradic Apparatus (3) was manufactured by Waite and Bartlett, New York. The device was to massage the ear with electric current. All pictures derived from Koelkebeck et al. (1984)

publication celebrating the Danish brand Oticon emphasizes that the Massacon "had no effect whatsoever".[279]

Treating the ear with high intensity sounds has also been examined by the Danish acoustician Christian Volf. During the 1950s, he conducted several listening tests intended to reactivate frequency areas of the ear that appeared dampened or damaged.[280] Here patients were to listen to records with sounds generated from a home-built tone generator. Each record contained tones that equaled an octave on a piano. When a client was tested, he had to listen to the record containing tones in the frequency spectrum where he had *perfect* hearing ability. Playing tones in this specific area at a very loud amplitude, Volf could provoke hearing loss that levelled out the total hearing range of the patient.[281] The client would subsequently be equipped with hearing aids that could amplify the whole hearing spectrum. The procedure of damaging the nerve cells inside the ear in order to reach uniform hearing ability was never scientifically approved and Volf's methods were generally dismissed as "unscientific" in Denmark.[282] Nevertheless, his methods were applied in Denmark during the 1950s where they were used to conduct national tests on school children suffering dyslexia.[283]

Another frequently used treatment method for curing the impaired ear is based upon experiments with electric impulses. In the CID-Goldstein Collection[284] several examples of devices incorporating electricity are included. A device called the Oticon (not to be confused with the Danish hearing aid brand), manufactured in New York, was "to be used in all cases of deafness, head noises etc."[285] The device was formed like a small hand gun and, according to the instructions, should be used by inserting the tip in the ear while holding a finger on the "movable trigger".[286] Drawing the trigger back while counting to 50, a stimulation of the middle ear was activated. Unfortunately, no further explanation of how the stimulation functioned is offered. Another instrument from the CID-Goldstein Collection, The Phono-faradic Apparatus, manufactured by Waite and Bartlett in New York and patented in 1897, conducted a series of impulses or pulsations of air. The ear was to be subjected to these pulses which would take place while the patient held an electrode in his hand and applied it to their body thus completing the circuit.[287] A similar procedure could be performed with the Electro-Vibratory Cure for Deafness invented by Dr. Guy Clifford Powell in 1905 in the US. This device pumped air through the ears via cotton-covered electrodes soaked in salt water**.** After pumping in the air, a jolt of electricity generated by the solenoid coils was sent to the

279 Oticon (2004)
280 Johannesen (1975)
281 Volf's sounds are still used today at sound clinics in Denmark, e.g. as part of sound therapy for curing reading difficulties. See Wolf (2004)
282 Volf emigrated from Denmark to Santa Barbara, USA as his theories did not gain attention in Denmark. In the USA, he patented several sound inventions such as sirens for American police cars, hearing aids and more curious inventions such as an acoustic filter consisting of 50 organ pipes. In his private sound clinic, his clientele included prominent cultural personalities such as Igor Stravinsky and Aldous Huxley. . See Johannesen (1975)
283 During the 1950s, Volf had discovered that his sound records had a beneficial effect in retraining therapy for children with dyslexia. However, he was never able account for why this was the case. Johannesen (1975)
284 The CID Collection was originated by Max Aaron Goldstein (1870-1941) who had a private collection of "curious hearing devices". Today it is part of Central Institute for the Deaf in Saint Louis, USA.
285 Koelkebeck et al. (1984), p. 96
286 Ibid.
287 Ibid., p. 98

patient's head.[288]

The past decade has brought great advances in our understanding of the mechanisms underlying auditory pathologies. Molecular biology and genetics have contributed to this enhanced understanding which have been designated "novel rational therapeutic interventions".[289] Where hearing loss today is defined as "disorders of cellular homeostasis",[290] meaning damage to the hair cells of the inner ear, researchers in the late 1800s were convinced that hearing loss was caused by a thickening of the eardrum which prevented sound from penetrating the real hearing organ – the inner ear.[291] This conception of deafness creates an imaginary barrier that needs to be penetrated with a physical force. Sound and electricity are here regarded as appropriate means for delivering these impulses.

Another cause of hearing impairment was noted in the beginning of the 1900s by Doctor H.E. Cook from the Ear Department at Cornell University, USA. He described hearing loss as related to inactivity: "The ears thrive on sound, just as the muscles thrive on movement and the body on food. Deprive the muscles of movement, and they will perish. The same goes for the ears."[292] Here another imaginary of the ear is constructed, where deviations from "normal" hearing become self-inflicted, or at least a circumstance that can be prevented with personal engagement and activity. Training the ear several minutes a day becomes an activity aligned to sports or musical training where practice is necessary in order to ensure the best result. The individual holds responsibility for the end result.

Approaching the ear not just as an analyser taking all sounds in somewhat passively, but rather as a muscle that must be trained, encourages me to make an initial characterisation of *the imaginary ear. The imaginary ear* describes the ideal of enhancing the physiological ear exclusively through physical stimulation. Therefore, *the imaginary ear* operates on an idealisation of *hearing* as it approaches the ear beyond any intervention in the individual act of *listening.*

Imaginary Media

The preceding examples of media that have been used to cure the ear operate on the boundary between the imaginary and the realised. The devices are real in the sense that they have actually been manufactured and even applied to humans on numerous occasions. However, their imaginary properties also constitute a significant part of their design. Their design incorporates the promise of the recovery of a dysfunctional sense even though the effects of the devices are highly debatable. It is exactly this interplay between the imaginary and the actual, the realised and the desired which has been emphasised as a characteristic of "imaginary media".[293]

The concept of imaginary media has been defined by Eric Kluitenberg as "me-

288 Virdi (2014)
289 Fay et al. (2008), p. xv
290 Ibid.
291 Oticon (2004), p. 12
292 Oticon (2004), p. 12
293 Huhtamo & Parikka (eds.) (2011), Kluitenberg (2006)

dia that mediate impossible desires."[294] According to Kluitenberg imaginary media "can never attain what they are proclaimed to achieve."[295] The historical hearing treatments I have discussed appear to belong to this category. Penetrating the ear with either sound or electricity in order to cure hearing impairments reflects an impossible desire to normalise the ear. These novel treatments promised methods to defeat deafness and subsequently normalise not only the ear but humans themselves. However, this desire must be read in conjunction with the more general development of the conception of the Deaf, as outlined by Mara Mills. Before the 1500s, deaf individuals were highly isolated in society.[296] The common conception was that being deaf was directly linked to low intelligence which Mills has described as an effect of the belief that rational thought was dependent on speech and on hearing speech.[297] Thus, searching for ways to cure deafness reflects an attempt to combat social stigmatisation. Finally, these hearing treatments reflect a general desire to achieve new knowledge of the ear and its impairments.

According to Kluitenberg, imaginary media may prefigure realised media machines and they play an important role in shaping the significations of these machines.[298] They are not entirely fictional creations or narrative devices, but rather products of a subject's projections.[299] Following this line of thought, the media and methods for curing the ear that I have previously discussed can be read as preliminary intentions for attaining knowledge of the ear and its impairments as we know it today. Sound and electricity were used as a physical source to reach a part of the ear that remained concealed from visual exploration and as such these approaches align to of modern technological methods such as x-rays and scans.[300]

Kluitenberg notes that actual media machines can give rise to "intense speculation of what such machines might be able to achieve or what they signify." The apparatuses and methods designed to cure the ear not only suggest the improvement of *hearing* but aspire to the total eradication of deafness. However, it is not only the apparatus itself which promises the possibility of eradicating impairments. It is the physical stimulus that the apparatus produces that constitutes its imaginary properties. The machines are first and foremostly containers of a more indeterminable force represented by sound or electricity.

During the 19th Century, the physical implications of auditory pathologies were still unknown and the reliability of cures were therefore highly dependent upon creating a convincing imaginary. The curative and scientific potential of sound and electricity was cultivated through a specific discourse which appears in commercial promotion from this period. Here electricity is presented as radiating a scientific authenticity. In various advertisements, hearing cures using electricity are promoted as remedies in which "medical science" at last "has conquered deafness"[301] and as methods that can

294 Kluitenberg (2006), p. 48
295 ibid., p. 66
296 Mills (2015) p. 45
297 ibid., p. 46
298 Kluitenberg (2006), p. 67
299 ibid., p. 66
300 These technologies became available in the 20th Century.
301 Advertisement: "Electricity cures Deafness", (app. 1900), see figure 23

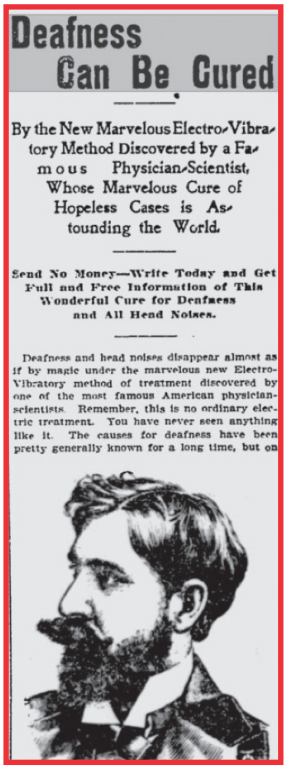

Fig. 19: Advertisement for The Electro-Vibratory Method in which electric current was to cure deafness (app. 1900). Picture derived from *The Hands of Quacks* (visited November 2017).

Fig. 20: Advertisement for the Massacon & Acousticon electrical apparatus for curing deafness (app. 1900), courtesy WNYC Archive Collection.

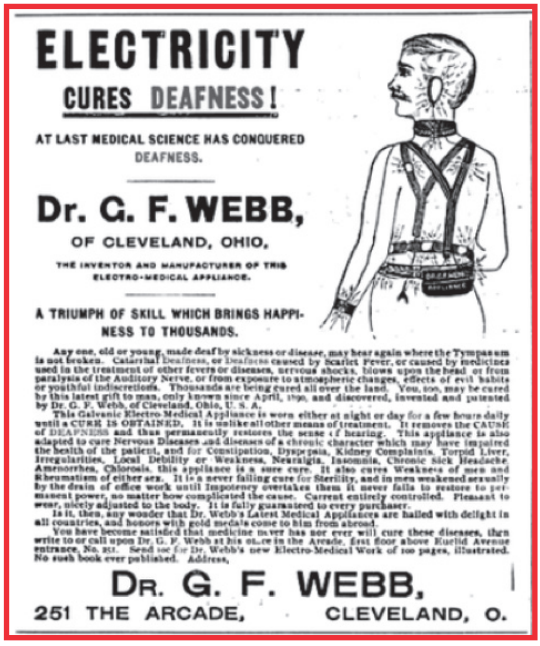

Fig. 21: Advertisement for Dr. G. F. Webb's electricity cures to combat deafness (app. 1900). Picture derived from The Brainy Deaf (2018).

make deafness and head noises "disappear almost as if by magic".[302] This discourse is of course part of a promotional language where exaggeration or the garnishing of facts are part of a profit strategy. The historian of medicine Stephen Jackson emphasises that companies could say and claim anything they wanted "since nobody tested them to see if they lived up to their wild claims (…) They invested a tremendous amount of money in advertising and the public was pretty gullible."[303] However, the discourse found within the commercial promotion of hearing cures also stresses the importance of connecting the actual media machine to physical phenomena, such as sound or electricity. Where Kluitenberg attaches imaginary media to a sense of superstition, magic or transcendental power, exemplified in media which might facilitate communication with the Divine or the spirit world,[304] I will argue that treatments of the ear using sound or electricity incorporate further imaginaries. The discourse of hearing cures emphasises a magical aura connected to the apparatus, however, the magical aura appears through promoting the electrical element of the apparatus as a scientific means whose powers exceed expectation. As such, these hearing cures exploit electricity and sound to portray what Kluitenberg has referred to as "the domain of pataphysics" which belongs to the realm of imaginary solutions.[305] The imaginary solutions of curing the ear by breaking a barrier with either sound or electricity are supported by the fact that these two phenomena are immaterial and invisible. They have a physical yet elusive character that not only promise to break down the barrier that prevents sounds from entering the ear, but furthermore to reach and reveal more knowledge of the ear itself.

The concept of imaginary media, as presented by Kluitenberg, allows me to present further perspectives relating to my conceptualisation of *the imaginary ear. The imaginary ear* incorporates an impossible desire to normalise the ear through purely physical remedies. It stages the ear as a physiological entity that can be trained. Accordingly, *the imaginary ear* entails a strategic attempt to present apparatuses, methods and not least discourses which can secure the ideal of reaching the act of *hearing* beyond any intervention in the act of *listening*. I will argue that this attempt entangles the act of *hearing* in a magical and speculative aura.

The Hyperacute Ear

My conceptualisation of *the imaginary ear* not only covers an ear which entails the promises of the past, it also points toward the promises of contemporary media. Penetrating the ear with sound is part of many contemporary research practices in audiology and neuroscience. Sound is widely used to customise and train the ear into tolerating specific sounds and sound environments, especially within retraining therapy for auditory pathologies such as tinnitus and hyperacusis.

Tinnitus is an aberrant auditory phenomenon occurring in a significant number of people. Tinnitus appears as a ringing tone inside the ear which is not connected to any external sound source. In Denmark, 10-15 % of the population is estimated to suffer

302 Advertisement: "Deafness can be cured", (app. 1900), see figure 21
303 Jackson (2012)
304 Kluitenberg (2006), p. 57-58
305 Kluitenberg (2006), p. 48

from tinnitus to varying degrees.[306] Because tinnitus is said to be caused by neurological disorders treatment is often concerned with examining how the brain reacts to sound stimulation. In treatments for tinnitus, many different sounds have been incorporated as part of a therapeutic practice: Broadband noise, nature sounds, synthesized sounds and music.[307] Today a wide swathe of commercial products offer treatment for tinnitus, such as Beltone's Calmer, Resound's Relief, Oticon's Tinnitus Sounds, Phonak's Tinnitus Balance, which all consist of specially designed relaxing music. Hearing aids are also used in treatments for tinnitus as they can amplify background environmental sounds to levels that provide adequate distraction for the patient. Common to all these treatments is that they use sound to shadow or mask the consistent tones heard by tinnitus patients. Masking is made to provide immediate relief by presenting competing sound to either reduce or eliminate the perception of tinnitus.[308]

Hyperacusis is another auditory pathology which has experienced growing attention in recent years. Hyperacusis is characterised by an increased sensitivity to certain frequencies and volumes. People suffering from hyperacusis are said to experience pain or discomfort when exposed to specific sounds which do not evoke the same response in "an average listener".[309] The characteristics of these intolerable sounds vary depending on the patient.[310] Nevertheless, it is common for patients with hyperacusis to have a lower loudness tolerance than the standard which is set at 85-90 decibels. Some treatments for hyperacusis use pure tone stimuli,[311] however the most common treatment is retraining therapy which uses broadband noise. Pink noise is often preferred in this kind of therapy as it mimics the frequency bands of day to day living. The broadband noise is delivered through noise (sound) generators customised to fit the patient's ears or through headphones using a CD player or digital sound files. Patients are to listen to the noise in a gradually rising volume in order to retrain their ears to cope with higher amplitude. The aim of this training is to keep the patients' hearing sense active.[312]

Even though earmuffs and ear plugs dampen incoming sounds and thereby protect the ear against loud sounds, they are often not recommended by hearing therapists as they are said to reinforce hypersensitivity to sound.[313] However, many patients have lately turned to other remedies in order to seek relief from the general noises of everyday sounds. The technology of noise cancellation offers a way of dampening incoming sounds. Noise-cancelling headphones consist of a microphone which measures ambient sound in order to generate a waveform that is in exact counterphase of this sound. Playing the phase-inverted sound back cancels out the unwanted noise. Noise cancellation does not eliminate all noise. It does not block out high frequencies and sudden sounds but is most effective in eliminating long wavelengths such as lower-frequency sounds. Many audiologists as well as hyperacusis patients consider noise cancellation as a good alternative to protect the ear. In chat forums concerned with discussing the beneficial

306 Arnoldus (2016), p. 17
307 Arnoldus (2016), p. 17
308 Arnoldus (2016), p. 36
309 Jastreboff (2013), p. 88
310 Baguley (2013)
311 Baguely (2013), p. 21
312 Malcore (2013), p. 73
313 Mraz & Folmer (2003)

effects of various retraining therapies the technology is described as "a technological marvel"[314] and as "incredibly helpful for individuals with tinnitus and hyperacusis".[315] Others dismiss it as a placebo effect which simply makes the patient "feel more in control".[316]

Some methods of retraining therapy for hyperacusis demand up to 8 hours a day of listening to either pure tones or noise which necessarily requires a specific kind of patience from the listening subject. A former patient of hyperacusis accordingly reports, "the patient must be convinced to stay the course or they will not improve". I will not go further into the actual benefits of each retraining therapy. It will suffice to conclude that in cases of hyperacusis and tinnitus sound is often used to retrain the ear and that consequently these auditory pathologies are aligned with my initial positioning of *the imaginary ear* as pertaining to a specific idealisation of the act of *hearing.* These contemporary auditory pathologies reproduce an imaginary of the ear as a muscle that needs training. However, in contemporary acoustic therapy conducted in relation to hyperacusis and tinnitus, training is not only used in order to stimulate *hearing* but also to manipulate the brain into *listening* in specific ways. In a publication containing clinical guidelines for conducting tinnitus retraining therapy (TRT), the goal is described as for patients to "habituate to tinnitus".[317] In order to achieve habituation, the tinnitus neural signal must be "reclassified" to the status of a meaningless auditory signal such as the continuous sound from an air conditioning vent, computer/electric fan, or refrigerator.[318] Sound is thus used to train the brain to *listen* in specific ways, however it is a mode of *listening* which seeks to surpass any habitual ways of deducing meaning from what is heard. This kind of *listening* forms a mode of sound perception which does not focus particular attention to what is being heard and, as such, it is a listening mode that reflects an ideal of *hearing*.

Tracing the topos of *the imaginary ear* in a contemporary context through the retraining therapy of hyperacusis and tinnitus has introduced new perspectives on the relationship between the act of *hearing* and the act of *listening*. Retraining therapy is used to reach *hearing* in order to manipulate the neural processes of the brain. However, I will claim that the therapeutic practices do not enable a pure conception of *hearing.* Rather, *the imaginary ear* activates an impossible desire not only to cure the act of *hearing,* but also to cultivate a specific auditory attention that idealises the act of *hearing. The imaginary ear* encourages a *listening* which imitates the act of *hearing,* that is, an auditory attention which surpasses habitual ways of deducing meaning from sound, and, as such, the idealisation of *hearing* reaches its climax.

The Neurotic Ear

The imaginary ear's attempt of curing and achieving *hearing* emphasises that *the imaginary ear* is an ear that constantly struggles with its own imaginary state. This presumption can be illustrated further in the constant struggle for scientific recognition which character-

314 The Hyperacusis Network (webpage visited August 2018).
315 Chat forum, Action on Hearing Loss (webpage visited August 2018)
316 Ibid.
317 Jastreboff et al. (2007), p. xii
318 Jastreboff et al. (2007), p. xii

ises responses to incidences of hyperacusis and tinnitus. The causes and effects of these auditory pathologies are not unambiguous. Incidences of hyperacusis and tinnitus are said to be increasing which may be due to the fact that the noise pollution is a general problem in contemporary society.[319] However, another reason for their increase may be that these auditory pathologies have only recently gained recognition. Historically, hyperacusis and tinnitus have been considered ephemeral auditory states connected to individual experiences.

By turning to religious scripts, literature, art and film, the audiologist David Baguley has found that hyperacusis and tinnitus have a long history which goes way beyond the first medical record which appeared in 1938.[320] This trajectory emphasises the imaginary state which these auditory pathologies has been assigned to. In Ancient Oriental mysticism, hyperacusis and tinnitus were regarded as a sensitivity to the divine. Roman medicine associated it with depressive and disorders and seizures on the basis of presumed common pathophysiology.[321] In the Babylonian Talmud, tinnitus appears as the Roman Emperor Titus' (ad 39–81) curse after ordering the destruction of the Second Temple in Jerusalem (ad 70):

> "A gnat entered his nostril and pecked at his brain for seven years. One day Titus was passing by a blacksmith. He heard the sound of the sledgehammer and the gnat became silent. Titus thus said: "here is the remedy." Every day, he brought a blacksmith to bang in his presence."[322]

This description depicts an early attempt to conduct sound therapy in order to cure tinnitus.

Another example of tinnitus can be found in *Sylva Sylvarum or a Natural History in Ten Centuries* (1670), in which Sir Francis Bacon mentions a personal experience of tinnitus in the context of exposure to intense sound and temporary threshold shifts:

> "A very great Sound, neare hand, hath stricken many Deafe; And at the Instant they have found, as it were, the breaking of a Skin or Parchment in theire Eare: and myself standing neare one that Lured loud, and shrill, had suddenly an Offence, as if somewhat had broken, or been dislocated in my Eare; And immediately after, a loud Ringing; (Not an ordinary Singing, or Hissing, but far louder, and differing;) so as I feared some Deafnesse. But after some half Quarter of an Houre it vanished."[323]

Likewise, Jean-Jacques Rousseau (1712–1778) in "Confessions" (1782) describes personal symptoms of tinnitus. Here the chronic and life changing character of the disease is emphasized:

319 See *Noise in Europe* (2014)
320 Baguely (2011), p. 14
321 Dan (2015)
322 The audiologist David Baguely has gathered historical examples of tinnitus and hyperacusis as they have appeared in literature, religious texts, film and art. The following examples are derived from Baguely & Fagelson (2015).
323 Baguely & Fagelson (2015), p. 4

> "A great noise started up in my ears, a noise that was triple or rather quadruple, compounded of a low and muffled humming, a softer murmuring as though of running water, a piercing whistle. This internal noise was so loud that it robbed me of the keen ear I had previously enjoyed and made me, not completely deaf, but hard of hearing in spite of the throbbing in my arteries and the humming in my ears, which since that time, some thirty years ago now, have never left me for a moment…"[324]

In the novel *A Pair of Blue Eyes* (1873) by Thomas Hardy (1840–1928), further symptoms of tinnitus can be traced as one of the characters suffers from a specific disorder of the ear. Here, a melodramatic character is delineated through the description of a high frequency pitch which may be aligned to the perceived high-pitched tone of tinnitus. Associating sonic disturbances with neurotic or melodramatic characters is also found in the novel "The Woman in White" (1860) by Wilkie Collins, in which he uses hyperacusis as a trait of one of the main characters who cannot tolerate loud sounds.[325]

These literary examples denote a long history of cultural reference to hyperacusis and tinnitus. However, they also emphasise the imaginary and ephemeral state that these auditory pathologies have been aligned with, as tinnitus and hyperacusis are time and again linked to the personal experiences of highly sensitive individuals, neurotic artists or persons unique status. Accordingly, literary accounts of tinnitus and hyperacusis outline how *the imaginary ear* is bound to struggle with its own imaginary states.

In the last decade, protocols for the diagnosis and treatment of both hyperacusis and tinnitus have been formulated and an evidence base for treatment efficiency has begun to be built.[326] Recently research has concluded that hyperacusis and tinnitus is caused by significant noise exposure, either over a long period of time or from a short blast.[327] This includes noise from the extensive use of Mp3 players or noise emitted by road traffic, rail traffic, air traffic and from sites of industrial activity or household machinery. Hyperacusis is also said to appear with patients suffering from mental disorders such as ADHD, stress or anxiety or as a consequence of a sudden shock or accident such as concussion.[328] Looking at the causes and effects of hyperacusis and tinnitus and the increased noise pollution of our time [329] emphasises the arbitrary character of these auditory pathologies. Although these disorders are clinically recognised today, the nature of the diagnoses are still puzzling researchers. Research into the neurological processes that sound activates still does not explain the discrepancies in sensitivity that patients experience, but rather emphasises that the specifics of how sound is encoded and perceived in the human auditory brain are highly individualised and yet to be fully

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324 Rousseau (1782), p. 222

325 In his presentation, "Hyperacusis and Wilkie Collins", at the conference *Ear Pieces,* Cambridge University, December 2016, David Baguely accounted for how hyperacusis has been described in literary works of the past by authors such as Wilkie Collins. In the novel, "The Woman in White", Collins used hyperacusis to distinguish one of the main characters who cannot tolerate loud sounds.

326 Baguley (2013)

327 Shi et al. (2005) p. 15

328 Shi et al. (2005), p. 16

329 According to the report "Noise in Europe", noise pollution is a growing environmental concern and it has increased the risk of many diseases and conditions such as high blood pressure, diabetes, overweight, sleeping problems and some specific kinds of cancer. *Noise in Europe*, EEA Report, 2014

established.[330] As a patient of hyperacusis notes: "The patient must make a leap of faith and understand that even though sound may have caused their hyperacusis, sound, if administered correctly, will help them recover."[331]

The Dosed Ear

In contemporary retraining therapy connected to the hearing disorders of tinnitus and hyperacusis, sound penetration of the ear is used to stimulate the brain to enter into new mental states. Using the ear as an entry point to manipulate neural processes has also been explored in a number of contemporary products including, amongst others, so-called digital drugs. Digital drugs are produced by the company I-Doser who have created specific sounds that are marketed as an alternative to real drugs. These sounds or 'doses' can be used to "achieve a simulated mood or experience", as stated on the company's website.[332] A variety of doses are available including sexual doses, designer doses, sport doses and game enhancers. A package called "recreational doses" promises effects similar to "MARIJUANA / COCAINE / OPIUM / PEYOTE".[333] Common to all packages is that they offer tracks constructed of frequencies which create the acoustic phenomenon of *beating*.[334] The company claims that listening to tracks constructed upon this acoustic phenomenon can "help you control all aspects of human emotion and mood".[335]

I-Doser's product offers a further perspective on *the imaginary ear*. It stages the ear as a portal through which an inner state of human existence can be reached. These digital drugs are not concerned with examining the exact neural processes that sounds activate and are not even concerned with activating specific *listening* modes. Rather, the aim is to penetrate the ear with sound in order to physically trigger the brain to enter new mental states. The example of I-Doser stages *the imaginary ear* as a central organ for reaching higher sensations of not only the human ear, but of the whole body and mind.

Imagining the ear as a portal to the inner human or the unconscious has a long lineage in the history of ideas. Tim Ingold has described it by noting that ears are time and again "imagined topologically as openings in the head that actually allow the sound to seep in and touch the innermost surfaces of being."[336] Ingold finds that sound has been attached a specific quality which enables it to "get inside you and shake you up, in a way that light cannot", and to reach "directly into the soul".[337] He proposes, that this conception of the ear is part of a larger imaginary of the human subject as "a seat of awareness, bounded by the skin, and set over against the world".[338] Ingold notes a new problem, however, in the process of translation. The ear is imagined as an "interface" or translator between the exterior and the interior. When sounds penetrate from the

330 Baguley (2013), p. 71
331 Malcore (2013), p. 73
332 I-Doser Audio (webpage visited 2018)
333 I-Doser Audio (webpage visited 2018)
334 Beatings appear when any partial of a lower tone has a frequency close to some partial of a higher tone.
335 I-Doser Audio (webpage visited 2018)
336 Ingold, 2000, p. 244
337 Ibid.
338 Ibid.

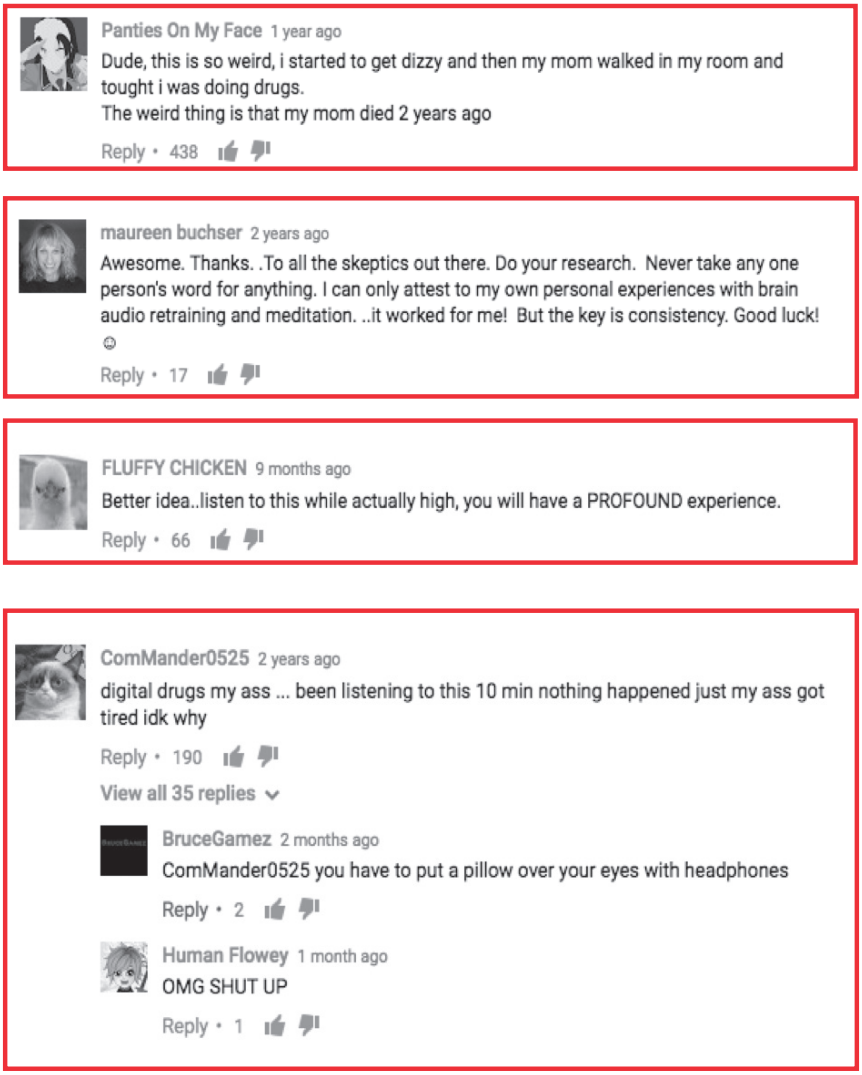

Fig. 22: Testimonies derived from Digital-drugs video at YouTube, published by Binaural Beats PRO (2013)

outside to the inside, "a possibility of genuine intersubjectivity, of a participatory communion of self and other" is constructed.[339]

Following the thoughts of Ingold, *the imaginary ear* indeed reproduces a persistent cultural idea of regarding the ear as a space for exploring and extending human perceptive potential. Sound is imagined as a physical entity that can be used to reach the core of human existence and even extend the human sensory apparatus. However, in the process of translation this ideal is disturbed. The challenges of translation are discussed in the testimonies of users of digital drugs (see fig. 22).Where some of the users of these digital drugs report achieving mental expansion or recreational states, others dismiss the product as a total fraud. The effects do not just appear with a click on YouTube. One user of the digital drugs encourages sceptics to listen to the digital drugs with "a pillow over your eyes" and with headphones, while another suggests combining real drugs with the consumption of these digital drugs.

The reactions reported by users of digital drugs point towards a more general consideration of the frame in which *the imaginary ear* operates. The testimonies of digital drug users emphasise how the penetration of sound through the ears is no longer only a question of the sound's curative properties, but also of the many circumstances surrounding the process of translation. The auditory attention practiced by *the imaginary ear* does not live up to the ideal of performing a pure mode of *hearing*, as *hearing* is constantly disturbed. However, by constructing a specific frame for *hearing*, concentration and dedication to the heard is momentarily secured through the act of *listening*.

The Multisensorial Ear

Until now, I have designated the auditory attention of *the imaginary ear* to be centred around an idealisation of *hearing*. However, this idealisation has been punctuated several times as I have pointed out instances in which the act of *listening* disturbs the idealised practice of *the imaginary ear*. In the following section, I will set out to challenge the idealised conception of *hearing* even further by characterising the auditory attention of *the imaginary ear* through a multisensorial perspective.

In western culture, there's a strong tradition for conceiving the ear as an isolated sense. Tim Ingold notes that this tradition takes its point of departure in a divide between the ear and the eye where vision "objectifies" and, contrarily, sound "personifies".[340] The separation of the senses has been modified by theorists such as Juhani Pallasmaa who considers it as a reduction of "the innate complexity, comprehensiveness and plasticity of the perceptual system."[341] According to Pallasmaa, the cohesion of all the human senses defines the interface between the skin and the environment – between the opaque interiority of the body and exteriority of the world.[342] This line of thought has also been explored in depth by the phenomenologist Merleau-Ponty who argues that we cannot conceive our body from its separate parts, such as arms, legs and face. Rather,

339 Ingold, p. 246-47

340 Ingold links the tradition of the division of the senses to the thoughts of the media theorists Walter Ong and Marshall McLuhan. See Ingold (2000), p. 246

341 Pallasmaa (2005), p. 39

342 Pallasmaa (2005), p. 42

the unified body exists prior to these separate parts and consists of more than these discrete elements.[343] Likewise, Don Ihde has emphasised that the act of *listening* cannot be isolated "from its situation, its embedment, its "background" of global experience."[344]

A concrete attempt to conceive of sound perception as a multisensorial activity is practiced in the therapeutic branch of *sound healing*. Sound healing is primarily cultivated within so-called alternative practices. Many practitioners of sound healing have clinical case studies that demonstrate its positive effect yet sound healing is still widely criticised for being unscientific and fraudulent.[345] Sound healing lacks a uniform definition and scientific recognition specifically because of its many individual practitioners and diverse methods.[346] Nevertheless, looking at some of the practitioners of sound healing some common features emerge: Sound healing is often aligned with spiritual aspirations and personal development[347] and occasionally its methods build upon revitalising sonic rituals found in diverse cultures and religions.[348] The French otolaryngologist Alfred Tomatis, who is said to be the father of *sound healing*, determined the ear's prime function to be the activation of the nervous system through sound. He emphasises that the brain is primarily energised by high frequencies and overtones.[349] Unlike music therapy,[350] which often uses well-known music (music that the patient knows and relates to),[351] many sound healing practices, such as those practiced by The British Academy of Sound Therapy and Soundworks (BAST), are concerned with the deconstruction of music "into pure sound, harnessing the knowledge that sound can have a powerful effect on our emotions."[352] BAST also conducts sound healing from a belief that our bodies "contain 'energy frequencies' and that sonic frequencies can be used to reattune these energies when they go off key."[353]

Where remedies for curing the ear in the past relied on penetrating the ear with sound of great force in order to break down the barrier that prevented sound from penetrating the ear, contemporary sound healing practices favour sounds of a more mild or pleasant character such as singing bowls, tuning forks, marimbas, bells, percussion instruments (e.g. rain sticks, shakers, chimes and gongs) or the human voice.[354] Most commonly

343 Merleau-Ponty (2000), p. 41
344 Ihde (1976), p. 44
345 Keneally (2008)
346 In studies conducted at The British Academy of Sound Therapy (BAST), sound therapy has been proved to have a beneficial effect on stress-related disorders. BAST (2014). The conclusion may not be controversial, as one can argue that this study only suggests that sound therapy has a deeply calming effect on stressed-out clients.
347 Grönwall (2010), p. 54
348 Many sound therapists are inspired by chakra systems found in traditions of Hinduism, Buddhism and Jainism. A chakra is an energy point related to a specific part of the body. Chakras are used to explain unbalances of the body and soul. See Grönwall (2010), p. 65
349 Grönwall (2010)
350 Unlike sound healing, music therapy has gained recognition as a scientific research field during the last decade. In Denmark music therapy is a field of research at Aalborg University and a practice that is used in hospitals. Music therapy is often defined as a social engagement with music, which can include the patients playing or listening to music. According to the Danish music therapist Lars Ole Bonde penetrating the ear with sound as part of a music therapeutic session is primarily used in order to evoke feelings or memories in the patient. Bonde (2011)
351 See Bonde (2011)
352 Keneally (2008)
353 Keneally (2008)
354 Sound therapy using voice techniques can be performed by the singing of one tone – usually using a vowel sound, overtoning - a technique where more than one tone is sung simultaneously, or mantra - the chanting of Sanskrit words. Githa Ben-David (2017)

patients are to experience the sounds individually lying down on a clinic couch or as part of a group session, maybe sitting in a circle on the ground, producing the sounds themselves.

Sound healing aims at producing sound that has a physical effect, not only on the ear, but on the whole body. In sound healing sound is conceived as "vibrating energy".[355] It is a recurrent principle in sound therapy that sound has a resonating power which has a healing effect on the human body. The notion of resonance is derived from acoustics,[356] however in the context of sound healing it is understood as the effect that appears when a sound wave hits a subject and sets this subject's "energy into motion".[357] The English osteopath Peter Manners claims to have identified specific resonance frequencies of the human body. He notes that every organ of the human body vibrates at a certain frequency. If a sick organ is exposed with its associated frequency, the organ can be affected in a positive manner and the healing of the organ can begin.[358] The sound therapist Jonathan Goldman has also argued that the goal of sound therapy is to re-establish the correct resonance in that part of the body or psyche that is vibrating disharmonically.[359]

In order to obtain the physical effect of resonance on the human body many sound therapists have worked with very deep frequencies which emit detectable physical vibrations. The Danish acoustician Christian Volf, whose methods have been incorporated in contemporary sound healing practices, encouraged his patients to sit on subsonic speakers.[360] Other practices indulge the patients in water beds where deep frequencies make the water vibrate.[361] In BAST the instruments are combined in a specific way "to influence brainwave frequencies, enabling a person to enter an altered state of consciousness (ASC) similar to very deep relaxation or meditation."[362]

My exploration into contemporary sound healing practices opens a new perspective on the auditory attention practiced by *the imaginary ear.* The auditory attention of *the imaginary ear* operates in the larger system of the human body, where the sensation of sound takes place in circuits that cross the boundaries between brain, body and world. With sound healing the goal is no longer to *tune* the ear to "normal" hearing, as was the case with the hearing cures of the past and even with acoustic therapy of modern hearing disorders such as tinnitus and hyperacusis. Rather, the aim becomes to *massage* the body in order to enter a recreational state of mind. In this process, the ear is just one parameter in a series of parameters in the multisensorial human body.

355 Grönwall (2010), p. 17.
356 Resonance is an acoustic phenomenon that covers an acoustic system's ability to amplify sound waves whose frequency matches one of its own natural frequencies of vibration. Helmholtz worked intensively on exploring resonance phenomena through the use of his specially constructed resonators which he used to pick out specific frequencies from a complex sound. See Helmholtz (1954), pp. 43-44
357 Grönwall (2010), p. 33
358 Grönwall (2010), p. 26
359 Grönwall (2010), p. 34
360 This method is described in Johannesen (2008-2011) and in Denmark it is practiced by sound healing practitioners such as Kaare Johannesen, Ruth Klinge Thomsen and Lea Gitz Hansen.
361 Grönwall (2010)
362 BAST (2014)

The Deaf Ear

Despite its tarnished reputation as a scientific practice sound healing adds a new perspective on *hearing* as the ear no longer appears as the only entry point for *hearing*. Instead, *hearing* as practiced by *the imaginary ear*, engages the whole body. The conception of *hearing* as a multisensorial practice can be further developed by turning to Deaf Studies where a strong tradition of confronting the very notion of what it actually means to *hear* has been established.

Deaf Studies has confronted static and stereotypical conceptions of *hearing* through various approaches. One of these approaches has a terminological basis in which more specialised diagnoses of hearing loss have been suggested in order to reflect a diversification of identities rather than a homogenization.[363] Differentiating the identities of deaf individuals as, for example, deaf, Deaf[364], late-deafened, deaf-blind, hearing, or hard of hearing has also opened up a variety of *hearing differences* that account for bodily and communicative differences.[365]

A further challenge to the rendering of "hearing, deafness, and seeing as ideal types",[366] has been instigated by Friedner & Helmreich. By merging Deaf studies with Sound studies they have opened a possible path for reaching new epistemological grounds on which to explore auditory attentions. Even though Sound Studies and Deaf Studies may seem to operate in worlds apart, as sound studies privileges sound perception and Deaf studies has urged the promotion of a new consideration of visual space as a communicative practice, Friedner & Helmreich argue that these fields share several approaches to sound, Both fields assume a clean division between *hearing* and deafness and, furthermore, they both depend on a divide between *hearing* and seeing.[367] However, Friedner & Helmreich call for further dialogue between these two fields which might open new perspectives on "different degrees, kinds, genres, and articulations of perceiving sound."[368] They argue that Deaf Studies can adopt a new experience of sound from Sound Studies which can lead to experiences that go beyond purely visual translations of sound (such as sign language). Likewise, scholars of Sound Studies may find in deaf and Deaf experiences of sound further hearing modalities.

Friedner & Helmreich point out specific moments where the hearing-deaf binary can be distorted. They specifically call attention to auditory domains that operate on the borders of sonic articulation, as these domains propose new articulations of "common and uncommon senses of the world."[369] Examples of such domains would be infra

363 Examples of specialised diagnoses are *conductive hearing loss* and *sensorineural hearing loss*. Conductive hearing loss occurs when there is a problem, usually in the middle ear, that reduces the transmission of sound to the cochlea. For example, viscous fluid may build up in the middle ear as a result of infection (otitis media), or the stapes may be immobilised as a result of the growth of bone over the oval window (otoscelrosis). Sometimes a conductive loss is produced by wax (cerumen) in the ear canal. Sensorineural hearing loss covers noise induced, aged-related and genetic impairments or hearing loss caused by acoustic trauma or ototoxic drugs. Moore, p. 62

364 Contemporary Deaf communities capitalise 'Deaf ' in order to refer to people who share significant hearing loss and who feel that they belong to a community of people with cultural similarities. See Cockayne (2003)

365 Some members of Deaf culture reject the term deafness as pathologising and claim that it can no longer be used colloquially to designate the large cultural group of individuals that experience what they describe as "deaf gain". "Deaf gain" provides an account of new representations of communicative difference. See Mills (2015), p. 45

366 Friedner & Helmreich (2012), p. 72

367 Ibid., p. 73

368 Ibid., p. 81

369 Ibid., p. 73

sound or low-frequency vibration which are explored both by scholars of Deaf Studies and scholars of Sound Studies.

As an example of a practice which seeks to challenge the hearing-deaf binary through a presentation of a multisensorial conception of *hearing* I wish to draw attention to the work of Christine Sun-Kim.[370] In the performance/installation *Unlearning Sound Etiquette* (2013), Sun-Kim places transducers on piano wires in order to let the audience feel the sound vibrating through the wires. In Sun-Kim's work, sound sensation is primarily considered as a physical vibration. The audience is encouraged to move away from purely audiological conceptions of sound sensation and instead approach it as a tactile domain. Focus is no longer on what sounds are produced, but rather on how sound perception takes on many forms. In *Unlearning Sound Etiquette* we do not *hear* the sound of a piano wire as a timbre in the room with our ears – rather we feel the sound as vibrations through our body. Accordingly, Sun-Kim's work presents *hearing* as incorporating both audile, tactile and visual approaches to sound.

In Christine Sun Kim's approach to sound, I find a latent political statement, in that the ownership of sound is clearly challenged. It is no longer only non-deaf subjects that can define what it means to *hear*. The hearing perspective of the Deaf can open up new hearing modalities and thereby introduce the complexity which governs *hearing*. I will argue that Sun-Kim's work provides a basis for a phenomenological exploration of *hearing* as it constructs a situation that challenges what Husserl described as *the natural attitude*. The parameters that normally make up our notion of what it means to *hear* are set aside for a moment as our habitual meeting with sound is challenged. Sun-Kim's work evokes a notion of *hearing* as touch, however it is a touch which should not be compared to Husserl's conception of the double-sensing hand. Sun-Kim's vibrating piano string leaves a clear objectification of sound. It is not the sound of the string that first catches our attention, rather it is the way we feel this sound as a tactile experience. Our attention is no longer aimed at the sound, but at our own corporal and tactile encounter with sound. Accordingly, a displacement takes place: For a moment, the act of *listening* evaporates which intensifies the concrete sensation of *hearing* as a tactile event. Our *intentionality* is no longer directed to *what* is actually heard but rather to *how* we hear it.

The multisensorial notion of *hearing* that I have found in Christine Sun-Kim's sound work can be extended further through Merleau-Ponty's description of the phantom pain. Merleau-Ponty defined phantom pains as excitations of the intersection between the lost limb and the extant body.[371] As we approach a sound work that operates on the auditory horizon,[372] that is, on the borders of what we are able to perceive, the operation of our body is challenged and a dialogue between the body to which we are accustomed and our body as it currently exists is initiated. In the pathologically disturbed frame of Sun-Kim's sound work, in which we are no longer able to hear the

370 Many sound artists operate in this domain, amongst others Toshiya Tsunoda and Kaffe Mathhews. Tsunoda has conducted a series of field recordings with high-sensitivity microphones picking up low frequencies. In the work, *Sonic Bed* (2005), Kaffe Matthews constructed an oversized bed that has a 12-channel speaker system built into it. This allows audiences lie in the bed in order, as the artist states, "to feel rather than just listen" to the music played. Matthews (2018)

371 Merleau-Ponty (2000), p. 25

372 The term auditory horizon is taken from Don Ihde who uses it to explore the outer limits of a sound. See Ihde (2007), p. 50. I will return to this concept in the chapter *The Mediated Ear*.

Fig. 23: “Resonator treatment” conducted by Ruth Klinge Thomsen, inspired by the methods of Christian Volf.. Courtesy: Klinge Thomsen (2017)

Fig. 24: AquaSound, waterbed with inbuilt speakers Courtesy: Grönwall (2017)

Fig. 25: Sound therapy session with singing bowls. Courtesy: BAST.

Fig. 26: The artist Christine Sun-Kim touches a vibrating speaker as part of a sound art installation. Photo still from Selby (2011)

Fig 27: Sonic Bed by Kaffe Matthews. Courtesy: Matthews (2005)

Fig. 28: *Unlearning Sound Etiquette*, sound art work by Christine Sun Kim where the audience is asked to touch vibrating strings. Photo by Catherine McElhone.

sound with our ears, we are constantly reminded of our habitual *hearing*, however at the same time the contemporary numbness that the situation stages forces the body to gather into a unit or, as Merleau-Ponty would formulate it, to form a uniform attitude.[373] Merleau-Ponty accentuates that the pathologically disturbed body illuminates how the body cannot be conceived as separate parts, such as eyes, ears, arms and legs. When our habitual bodily practices are set aside our body is forced to gather into a unit.

Likewise, Sun-Kim's sound work forces the listener to explore new hearing modalities which include a perception of sound that incorporates visual as well as tactile domains. It is through the physical and visual staging of sound that Sun-Kim offers a multisensorial perspective on *hearing*. In this staging the mediation of sound (which the vibrating piano wire introduces) not only serves to translate sound and facilitate communication between deaf and non-deaf subjects. On the contrary, the muted presence of the sound work forces us to initiate a specific focus or amplification of the physical properties of sound which make us aware of the multisensorial perspectives of *hearing* that are typically overlooked.

The Aesthetic Ear (II)

The work of Christine Sun-Kim has allowed me to relate the field of hearing cures to the field of sound art. I will unfold this relation further by tracing the discourse pertaining to *the imaginary ear* within the field of sound art.

Sound art is not a uniform field referring to a specific sound material or a specific listening setting. Even the term sound art is subject to many different interpretations.[374] Nevertheless, a common feature of sound art has been formulated by Christopher Cox, who notes the specific perceptive potential that this art genre possesses:

> "At its best, 'sound art' opens up or calls attention to an auditory unconscious, a transcendental or virtual domain of sound that has steadily come to prominence over the course of the twentieth century."[375]

According to Cox, the aesthetic forms of sound art can "suspend our ordinary sensory-motor habits and the aim of practical communication in favour of an exploration of the very stuff of perception and sensation".[376] Brandon LaBelle also suggests a similar conception of sound art. He considers sound art as a practice that expands our perspective onto the world through "a deepening of the listening sense". The propagating, vibrating and resonating movements of sound create a dialogue which is "embodied" and "sensed", LaBelle notes.[377] Through the term "dirty listening", Labelle incorporates sound's potential to integrate and connect, not only to things such as buildings or water but also to bodies in order to get "under the skin."[378] This conception of sound art, in which sound is marked as a materially anchored me-

373 Merleau-Ponty (2005), p. 94
374 See introductory chapter for a definition of sound art, p.
375 Cox (2009), p. 19
376 Cox (2009), 22
377 LaBelle (2015), p. 296
378 LaBelle (2015), p. 298

chanical vibration phenomenon that affects its surroundings, is also shared by Aden Evans: "Every vibration, every sound, hangs in the air, in the room, in bodies".[379]

In Voegelin's theory of *listening* I have found a similar presentation of sound art. Here she argues that sound in an aesthetic context can activate a perception which exceeds the human being's normal ways of perceiving its surroundings. Sound art stages sound as an engaging force:

> "Sound involves me closely in what I see; it pulls the seen towards me as it grasps me by my ears. Sound renders the object dynamic."[380]

I wish to call attention to the fact that the definitions of sound art presented by Cox, Labelle, Evans and Voegelin echo a discourse which I have already traced as belonging to *the imaginary ear.* It is a discourse that promotes an idealised conception of sound as a force that can penetrate the human ear in order to reach fundamental perceptual experiences of the human being. They present sound as a vibrational force and the ear as a portal through which to reach the unconscious layer of human perception.

Concrete examples of sound art practices can illuminate how the ideals of *the imaginary ear,* which I originally observed within the scientific and pseudoscientific practices of sound therapy and sound healing, have been transferred into other domains. In the piece *Labyrinthitis* by Jacob Kirkegaard specific frequencies are played into the ears of the audience in order to create otoacoustic emissions, sonic responses produced within the inner ear.[381] By using this specific practice of medical diagnosis Kirkegaard stages an imaginary of penetrating the ear with sound – not in order to detect any malfunctions it might have but rather to reveal the ear as an aesthetic locus of rich sonic activity. The sound heard represents how mechanical motion is transformed into electrical and chemical impulses sensible to the brain.

In the piece *Crossings* (1982) by Alvin Lucier, I have also found an example of how the auditory attention of *the imaginary ear* is reproduced. Here instrumental sounds are combined with electronically generated sine tones. The instrumental sounds are played across a steadily rising sine tone in order to produce sounds which the listener perceives as interference beats. Earlier in this chapter, I noted the use of beatings in so-called digital drugs where this particular acoustic phenomenon is used to provoke a recreational bodily attention. In Lucier's work something similar is at stake. Sound is here promoted as a means of activating specific patterns of physical reactions from the ear which stimulate not only the ear but the whole body.

Other sound art works also stage the imaginary of the multisensorial ear. The work *Sonic Bed London (2005)* by Kaffe Matthews stands as a clear example of how hearing is constituted as not only as an activation of the ear but of the whole body. The work encourages its audience to lie in a bed, where speakers are placed underneath a mattress. The speakers play deep frequencies in order to create a physical vibration in the audiences' bodies. This piece resembles the practice of sound healing, where resonator treatments and sonic beds are a common part of the therapeutic practice.

379 Evans (2005), p. 14
380 Voegelin (2010), p. 11
381 Otoacoustic emissions are primarily used within programs for hearing screening of newborn babies.

But what then differentiates sound art from the practice of sound therapy and sound healing? I will argue *that* sound art and sound therapy share a specific imaginary of the ear, where the ear is designated as a possible entry point for not only new auditory attentions but new perceptual practices. Even though the sound art pieces I have referred to do not incorporate a promise of recovery of a dysfunctional sense or even a healing effect on the human body or mind, the interplay between the imaginary and the actual, the realised and the desired, is emphasised. I argue that these sound art pieces stage a specific idealised conception of sound as a force that can infiltrate the ear in order to activate a specific physical reaction – either within the ear or within the human body and mind. These sound art works are not only based upon physiological or physical explorations of the ear, but also unfold an imaginary property where sound is conceived as a force that can activate subconscious human perceptions and even allow for a new awareness of auditory perception itself. In addition, sound art stages sound as an aesthetic phenomenon which activates all the imaginaries connected to the act of perceiving sound. I find support for this conclusion in a description of sound art set forth by Holger Schulze who argues that sound art is a technical physical emanation, an "artistic-aesthetical imagination" and "a tangible and rich subject of our experience, feelings and thoughts".[366]

However, comparing sound art practices and sound healing practices also disturbs my general conception of *the imaginary ear*. The similarities between these two endeavours provide the basis for a discussion of the general distrust which governs the auditory attention of *the imaginary ear*. While the practices of sound therapy have been widely criticised for being pseudo-scientific or overtly fraudulent similar practices have been conceived of as an aesthetic means for exploring human consciousness and perception within the field of sound art. Accordingly, the scientific claims regarding sound made by sound therapy, sound healing and sound art are ambiguous which supports the conception of these branches as operating on the boundaries between the imaginary and real.

The Tactile Ear

My media archaeological excavation of *the imaginary ear* has been led by the promise of tuning the physiological ear through physical stimulus to regain lost powers or to reach higher perceptual states. I have found this promise demonstrated in the many different hearing practices related to sound therapy, sound healing and sound art. These practices have presented the ear as a vessel appropriate for projecting wishes, demands and potentials not only of the ear but of the whole human sensory apparatus. Certainly, the effects of the stimulation of the ear at times appear doubtful and many of the therapeutic practices that I have accounted for lack a verifiable evidence base. However, my investigation into *the imaginary ear* was not aimed at denigrating the intentions of the different hearing cures. Rather, my exposition of *the imaginary ear* has served to reveal how the beneficial effects of the hearing cures are highly dependent upon each individual hearing subject's approach to the incoming sounds which often require patience, concentration, attention and even the daily training of the listener.

I have traced the topos of *the imaginary ear* from early attempts at curing the ear with sound and electricity to contemporary practices acoustic therapy, digital

drugs and sound healing. In the magical-scientific aura which were attached to these remedies I have found an entry point for revealing a discourse which has presented *the imaginary ear* as a portal to unknown tunings of the ear. In contemporary hearing cures related combatting hearing impairments such as tinnitus and hyperacusis I have found a conception of *the imaginary ear* as an ear which not only seeks to overcome impairments of *hearing* but also an ear which struggles with its own imaginary state. The personal testimonies I have presented from both religious text and literature have revealed how impairments of hearing have lacked a scientific evidence base. Turning to contemporary hearing cures, such as Idoser and sound healing, I have staged *the imaginary ear's* attempts to create a reliable evidence base for its curative properties. Here I have exposed how *the imaginary ear* is highly dependent upon the listener's willingness to activate their own imagination, to actually *listen.* This imagination often requires a planned staging of the act of *hearing*, whether being an isolated act in the form of ear buds or a multisensorial hearing séance such as resonating chambers.

My comparison of the practices of sound healing with the practices of sound art has emphasised that the ideals of *the imaginary ear* have been reproduced within parallel activities. I have argued that the field of sound art uses the potential of *the imaginary ear* to operate in an extended field between the imaginary and the realised.

My conceptualisation of *the imaginary ear* contributes to my general aim of revealing the ideals of *hearing*. I have used *the imaginary ear* to expose the many different attempts to combat hearing impairments and thereby normalise *hearing.* Furthermore, I have used *the imaginary ear* to expose how the ideals of *hearing* are produced by offering specific listening practices that imitate the act of *hearing.*

My phenomenological exploration of *the imaginary ear* has not reached a pure conception of *hearing.* However, it has presented a methodology for reaching a multifaceted conception of *hearing*. Through my phenomenological exploration of *the imaginary ear* I have found a basis for exposing *hearing* as a multisensorial attention towards sound. I have proposed a conception of *hearing* which appoints it as a concrete tactile encounter with sound as vibration. I have used Merleau-Ponty's phenomenological explorations of the pathologically disturbed body as a basis for introducing a multisensorial concept of *hearing.* In my elaboration of *hearing* as a multisensorial sensation the work of artist Christine Sun-Kim stands as pivotal. In her work, the act of *listening* is evaporated which intensifies a sensation of *hearing* as a tactile phenomenon

In my exposition of *the imaginary ear,* I have repeatedly pointed out how critics have considered the auditory attention produced by *the imaginary ear* as an inaccurate means for producing epistemic claims. Nevertheless, I will claim that the multisensorial perspective of *the imaginary ear* has underlined the complexity of *hearing* which provides a new basis for making epistemological claims.

Remove device from ears

Find box #3
Turn hearing aids on
Place hearing aids in ears

Read while wearing
the hearing aids

THE MEDIATED EAR

Since the first ears appeared more than four million years ago in amphibians their pur pose has been to detect sound. However, the form of the ear has changed dramatically throughout evolution. At its evolutionary starting point, the ear primarily consisted of an inner ear which took form as a breathing tube in fish. As species left the water in favour of ground and the body was later elevated from it, the acoustic sensitivity of certain reptiles was reduced which provided an evolutionary imperative for a system capable of perceiving sound through air. The pinna, along with its curved structures, evolved in order to detect vibrations in air and amplify incoming sounds. The cochlear substantially enlarged its length by coiling together leading to an increase of the frequency range of hearing. Changes in receptor cells and neural innervation patterns developed the ability to localise sound and morphological changes in the central nervous system resulted in greatly improved differential acuity.[382]

I am drawing attention to the evolution of the ear's physiological form and performance abilities as they reveal the ear as a transformable organ that has evolved in order to refine the sensitivity of the auditory system. The transformation of the physiology of the ear historically occurred in order to adopt to new tasks and demands, such as finding food or detecting danger. However, the recent evolution of the ear has taken on new characteristics. Today, the ear is frequently augmented by technologies such as hearing aids or even cochlear implants. These devices are prominent physiological mediating technologies that not only compensate for lost frequencies or intensity levels but also add new auditory sensations to the human vocabulary of perceiving sound. Several authors have drawn attention to how these new technologies introduce new perceptual dilemmas. Don Ihde has noted that "We invent our technologies, but, in use, they "re-invent " us as well".[383] In 1985, Roland Barthes declared that "phylogenetic development and technological development have modified (and will modify further) the hierarchy of the five senses".[384] As early as 1964, Marshall McLuhan similarly took notice of the new sensibility that media imposed not only the faculty of hearing, but on all of the human senses when he remarked that "media are extensions of man"[385] that "evoke in us unique rations of sense perceptions. The extension of any one sense alters the way we think and act – the way we perceive the world."[386]

In this chapter, I will present what I have chosen to term *the mediated ear,* which will serve to continue my general investigation into how technology lets us *hear* and how technology has been used to make epistemological claims concerning the ear. *The mediated ear* describes the notion of an ear whose sound perception is mediated through

382 All facts on the evolution of the physiological ear are derived from Stebbins (1980), p. 422-423
383 Ihde (2007), p. 243
384 Barthes (1985)
385 McLuhan (2001)
386 McLuhan (1967), p. 41

some kind of technology. The media theorist Peter-Paul Verbeek has emphasised that in a mediated relationship technology is not part of the world but part of our relation to the world: it is the mediator that allows us to experience the world. This mediation affects not only the functionality of the technology in use, it also creates specific relations between its users and the world as they perceive it resulting in specific experiences and practices.[387] Following Verbeek's approach to technological mediation, *the mediated ear* must necessarily imply an exploration of how mediating hearing technologies contribute to the formation of different auditory attentions and thereby how these technologies form the conditions of *hearing*, which in turn affect the act of *listening*.

My conception of *the mediated ear* will appear through a media archaeological excavation of audiological technologies used to improve *hearing* – from hearing trumpets to cochlear implants. Again, *hearing* will here be used as a term to emphasise the idealised conception of reaching the physiological ear beyond intervention of human intellect. I will present the mediating role of these technologies as both physical manipulations of the ear and as compensatory machines which have been developed in order to overcome a disability as well as extensions of the human ear that have facilitated new auditory attentions. I will register the ideals of *hearing* which can be attached to *the mediated ear* by investigating the presentations of hearing technologies that have been made by media historians, media theorists and manufacturers as well as users and promoters of hearing technologies. But I will also set out to challenge the ideals of *hearing* that *the mediated ear* proposes by turning to a post-phenomenological analyses of mediating hearing technologies. This approach will expose how mediating hearing technologies are incorporated in human bodily practices, and it will lead to a conception of the mediating hearing technologies as possible facilitators for performing a *listening-to-hearing*.

The Transformed Ear

The most perpetual mediation of the ear must be that of the cupped hand. Placing a cupped hand behind the ear, thereby expanding the reflecting surface of the pinna, was observed by Early man to have an amplifying effect on incoming sounds.[388] Likewise, rolling a dry newspaper into a cylinder and placing one end over the ear, as suggested by the acoustic instrument builder Hawksley in 1883, may also be conceived of as an early attempt to mediate the ear.[389] Another early attempt to mediate the ear is proposed by the Danish acoustician Christian Volf, who believed that feathered headdresses helped the American Indians to hear better by acting as a collector of sound.[390] Even though the actual benefits of these primitive mediating technologies may be minimal, I find it reasonable to consider that the evolution of *the mediated ear* departs from such basic experiments conducted with the materials at hand. These simple devices bear witness to how the ear has a long history of being considered physically malleable. By extending the reflective area of the pinna or prolonging the ear canal an enhancement of sound

387 Verbeek (2015), p. 30
388 A cupped hand behind the ear amplify sound 5-10 decibels.
389 A "Catalogue of Acoustical Instruments to Aid the Deaf" made by T. Hawksley is reprinted in Koelkebeck et al. (1984), p. 103
390 Koelkebeck et al. (1984), p. 5

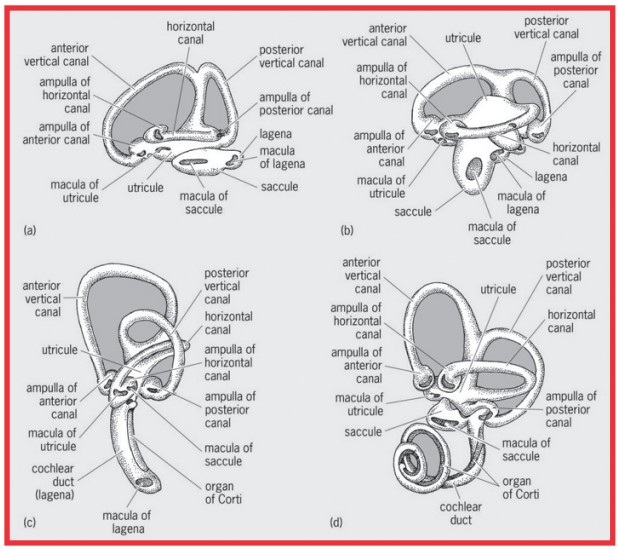

Fig. 29: View of the evolution of the ear. Membranous labyrinths of (*a*) teleost, (*b*) frog, (*c*) bird, and (*d*) mammal. Picture derived from Romer (1962).

Fig. 30: Comparison between the pinna of apes and humans. The form of the pinna has evolved in order to catch incoming sound waves conducted through air. The pinna acts as a collector of sound from the outside world and also as a directional filter. Picture derived from Biokemia (2017)

is obtained. In the following section, I will trace this trajectory of changing the physical form of the ear by taking account of the first strata of the evolution of *the mediated ear* which will serve as a framework for the subsequent media archaeological investigation.

Shells and animal horns have been used for the amplification of sound since ancient times. These artefacts were to be placed behind the pinna in order to extend the reflecting surface or inside the opening of the ear canal in order to direct and compress incoming sounds. The preparation of sea shells and animal horns preceded the fabrication of similarly shaped devices in wood, hard rubber or metal. The use of horns to amplify the voice was also an influence of this stage of the evolution of *the mediated ear*. The use of conical shaped megaphones was the prototype for ear trumpets which were developed during the 17th and 18th centuries.[391] Ear tubes consisted of a long tube that was placed at the opening of the auditory canal. Sound waves were amplified as they travelled through the conduit of the ear tube and bounced off its walls re-enforcing some sounds and damping others. When the sound energy was confined in the narrow diameter of a tube it could not be diffused in ever-expanding waves, but instead travelled in the direction of the tube with much less energy loss. In general, the larger the diameter of the tube the lower the frequency region reinforced. The ear trumpet consisted of a cone which enabled the collection of sound over a relatively large area. Amplification of the sound energy was produced as the movement of air passed down the cone in smaller and smaller spheres. The release of sound was concentrated in a very small area at the end of the cone which was attached to the ear.

Whereas shells, animal horns, tubes and trumpets were mainly used to extend the outer ear, other artefacts have been used to mould the ear canal and the tragus. Examples of these artefacts, such as miniature tubes, hollow pipes, solid rods, plugs and electrophones, can be found in the CID-Goldstein collection of historic devices for hearing[392]. These devices were applied to physically expand the opening area of the ear canal, straighten the ear canal or enlarge the tragus backwards, thereby increasing the size and capacity of the parts of the sound-conducting mechanism.

During the 20th Century, despite the advent of electric sound amplification, further development of acoustical extensions of the ear occurred. A shell-like device called "the artificial hand"[393] was mounted on a metal head band to fit under the external ear. This aid was intended to surround the auricle and thereby fortify and enlarge the pinna. A further development of "the artificial hand" came with "the audi-ear" (around 1925). It consisted of a transparent shell held over the external ear by wires designed to fit over and under the ear. Also, the "Super-Ear" (1925-26) was a device made to enlarge the pinna. It consisted of a celluloid cup-like piece which fitted into the ear.

Common to all these devices, which I align with the first strata of the evolution of *the mediated ear,* is that they set out to enhance *hearing* through concrete physical manipulations of the ear. By extending the physical shape of the ear an acoustic amplification is obtained which is considered an optimisation of the act of *hearing*.

391 Koelkebeck et al. (1984), p. 6

392 No further description of the electrophone appears in the CID collection, however the picture shows that the metal device does not seem to have any electrical parts, as it consists of a metal plug.

393 Production year unknown. Appears in Koelkebeck et al. (1984), p. 52.

Fig. 31: The Simplex hearing tubes in use. Picture derived from Koelkebeck et al. (1984)

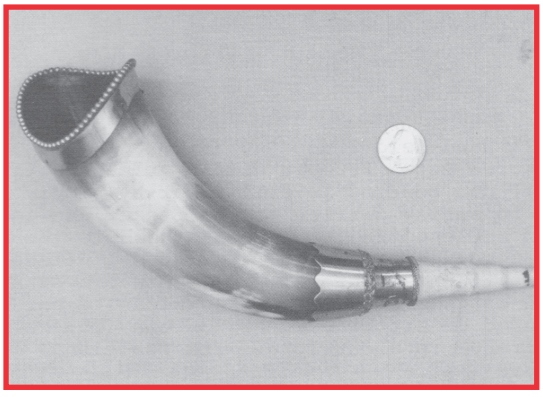

Fig. 32: A hearing horn made of the natural ram's horn and with an ivory ear piece and silver trimming, dates about 1800. Photo derived from Koelkebeck et al. (1984)

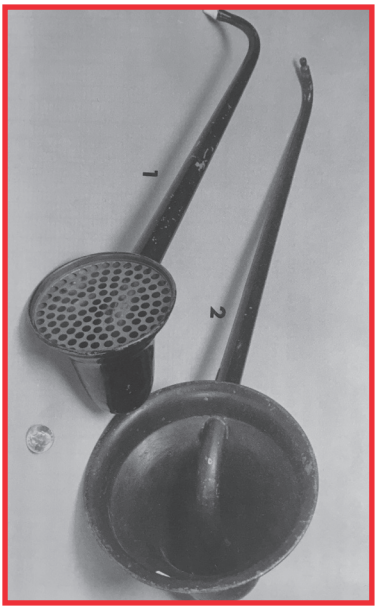

Fig. 33: Hearing trumpets. A popular style of hearing aid in the18th and early 19th Centuries. Photo derived from Koelkebeck et al. (1984)

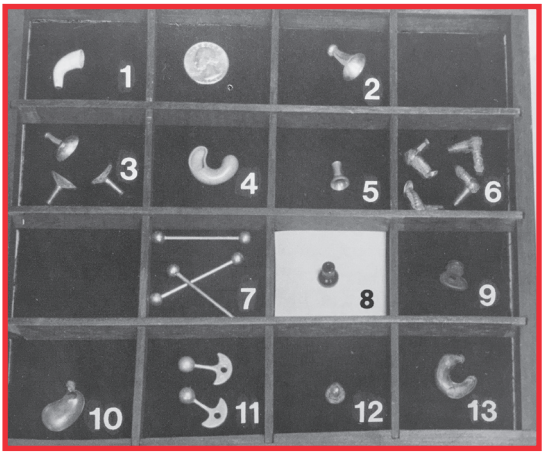

Fig. 34: Tubes to alter the auditory canal. These devices are made for the purpose of opening or changing the shape of the external auditory canal. Amongst others, there is a metal trumpet to open the canal and assist in collecting sounds (2), a politzer device to enlarge the tragus backwards (4) and a hollow round sphere to assist bone conduction (5). Picture is derived from Koelkebeck et al. (1984).

The Normalised Ear

The second strata of the evolution of *the mediated ear* stages mediating hearing technology as a compensatory tool for optimising *hearing*. Here technology appears primarily as an instrument[394] which enables human beings to do specific things and maybe even things they would not otherwise be able to do without these technologies – from this perspective namely to *hear* what would otherwise be left unheard. The mediating hearing technologies thus hold a compensatory and even prosthetic function.

Numerous media theorists have conjectured about the "prosthetic function"[395] of technology, inferring that media technologies have been invented in order to compensate for physiological impairments.[396] Within sound studies a general assumption exists that modern sound reproduction technology emerged in part from with the aim of developing technology to assist and ameliorate deafness. The German literary scholar Friedrich Kittler has emphasised sound media's strong kinship with "disabilities or deformations". In *Gramophone, Film, Typewriter* he has described the telephone as an "artificial ear" and thereby stressed that deafness lies at the centre of the development of sound reproduction technologies.[397] According to Kittler, technologies such as the phonautograph, the telegraph and the telephone all emanated from attempts to overcome physical impairments of the ear.[398] Mills has employed this historic pretext for sound reproduction technology to propose the phrase "assistive pretext" to examine how the deaf have been at once the target of "improving" technologies as well as guinea pigs for technological investigations made primarily for the benefit of hearing persons.[399]

The prosthetic origins of sound reproduction technology allow me to critically approach the second strata of the evolution of *the mediated ear,* which I will claim has evolved around an ideal of normalising the ear.[400]

During the 19th Century, hearing research suddenly gained serious interest. This interest can be ascribed to the new means of electrical amplification and transformation of sound which were invented at this time. Electric sound amplification exploited the change in electrical resistance that naturally occurs between two pieces of carbon when the mechanical pressure between them varies. In Denmark experiments with the electrical amplification of sound were conducted by hearing aid manufacturers such as Oticon, Danavox and Widex who used them to produce hearing aids. The production of hearing aids was stimulated by social conditions as a state grant was provided for the acquisition of a hearing aid. At one point, hearing aids were even distributed free of charge in Denmark.[401]

Using electricity to amplify sound led to the multiplication of the components in hearing aid circuitry which increased the precision with which an acoustic signal could be manipulated and allowed for control over loudness, frequency or distortion.

394 See introductory clarification of my conception of *instrument*, p. 22
395 Mills (2011c), p. 124
396 Kluitenberg (2011), Mills (2010, 2011), Sterne (2003), Winthrop-Young & Wutz (2009), Kittler (1999), Friedner & Helmreich (2012)
397 Kittler (1999), p. 28
398 Kittler (1999), p. 22
399 Mills (2010)
400 Many authors have accounted for how sound reproduction technology has been evolved through a normalised conception of the ear. See for example Sterne (2012), Mills (2011a). My conception of the normalisation of the ear will focus on attempts to eradicate deviances in *hearing* through the means of mediating hearing technologies.
401 Dalsgaard (1982), p. 23

Electrical sound amplification was not only integrated into hearing aids, but also into phonographs and telephones which suddenly not only enabled the ear to hear more, but also to hear across large geographical distances and even to hear the past.

The predecessor of this new sound reproduction technology was an instrument invented in 1874 by Alexander Graham Bell and Clarence John Blake called the phonautograph. This instrument turned audible vibrations into visible phenomena by using an excised human ear as a mechanism to transduce sound. The ear was attached to a wooden chassis and when sound entered a mouthpiece it would travel through the ear and the ear would vibrate a small stylus which left traces on a smoked glass platen.[402] For Bell this machine presented a possible solution to a pedagogical problem[403] in that it could be used to "make speech truly visible" and subsequently help deaf children to speak "in normal fashion."[404] The machine was used for so-called speech training of the deaf. Here the deaf person was to see the sound they were making with their voices and afterwards copy it until they matched the tracings of vowels or consonants spoken.

In Bell's own words he had discovered, "a machine to hear for them".[405] Nevertheless, what Bell did not consider was that ear phonautograph did not hear. Rather, as Kittler later stated about the phonograph, it registered acoustic events.[406] The ear phonautograph demanded highly sophisticated interpretation efforts from the Deaf. Furthermore, this machine and Bell's methods in general, were criticised for being driven by eugenics.[407] Speech training presented oralism as the only true portal to knowledge.[408] It was promoted as the best way for educating and integrating the deaf into society (as opposed to sign language and lip reading). Together with pedagogical bans on sign language, speech training became part of a larger attempt of eradicating deafness altogether.[409]

Whilst Bell's ear phonautograph did not achieve a significant impact on deaf education it did however gain popularity in another domain. Realising the difficulties of perfecting "visible speech" Bell was led to the study of new electrical devices that yielded the telephone.[410] It became part of a larger cultural impulse to streamline communication in industrialising nations.[411] Bell's acoustic research eventually led to many important inventions – the telephone being the most iconic.[412]

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402 See Sterne (2003)

403 Furthermore, it presented a solution to a personal problem, because Alexander Graham Bell's mother and wife both were deaf.

404 Snyder (1974), p. 11

405 Bell quoted in Snyder (1974), p. 30

406 Kittler (1986), p. 23

407 As Sterne notes, Bell considered himself a "friend of the deaf", but deaf communities later criticised Bell for seeking to eradicate deaf culture altogether. As an example, Bell was against deaf marriages which Sterne characterises as "deaf marrying deaf", because he advocated for a full integration of deaf people into mainstream culture. Sterne (2003), p. 40

408 Mills (2011c)

409 Another method of speech training was conducted by asking the deaf person to feel the movements of the speaking organs with the hands in order to be able to reproduce the exact same movements when speaking. Widell (1988), p. 57.

410 McLuhan (2001), p. 293

411 Mills (2010), p. 42. I discussed the attempt to streamline audition within the communication industry in the chapter *The Otologically Normal Ear.*

412 The research conducted with the ear phonautograph also led to the spread of spectography, which became profitable in many other fields such as linguistics, ecology and communication engineering and later became the basis for

Sterne has described the early development of sound reproduction technology as driven by "an attempt amongst hearing people to "solve" or at least contain the cultural problem of deafness".[413] Likewise, McLuhan formulates the intentions of Bell's work as driven by a promise of releasing "the deaf from their prison".[414] This critical approach to the invention of so-called compensatory tools is recalled in the contemporary debate evolving around modern mediating hearing technologies such as digital hearing aids and cochlear implants. Even though digital hearing aids have introduced more individualised designs to accommodate diverse impairments of hearing based on signal processing for speech enhancement, noise reduction, self-adapting directional inputs, feedback cancellation, data monitoring and the storing of appropriate parameter settings for different acoustic environments,[415] the technology has been criticised for attempting to eradicate deaf culture altogether. When digital hearing aids first entered the market[416] they were presented as a marvellous technology that could greatly diminish, if not eliminate, hearing problems, as described by the audiologist Mark Ross.[417] Ross also emphasises that the term *digital* was employed in "a magical, almost reverential manner".[418] The accusations of eugenics only increased as the mediating hearing technology of the cochlear implant was developed.[419]

The cochlear implant is a surgically implanted electronic device that provides "a form of hearing"[420] to a person who is profoundly deaf or severely hard of hearing. A cochlear implant consists of a tiny receiver placed under the skin behind the ear. The receiver has a probe with electrodes which are implanted into the cochlear. The user wears a device similar to a hearing aid that is attached to the outer ear and features a microphone, a processor and a transducer. The microphone captures incoming sounds which are manipulated by the processor and sent to the transducer. The transducer changes the signal from electrical to magnetic and the receiver then stimulates the probe in the cochlear, "causing hearing".[421]

In recent years, the cochlear implant has fostered a significant debate.[422] Where some envision cochlear implants as "bringing deaf people into the hearing world" by providing sound through an electromagnetic interface operating in the skin behind the ear, critical voices have argued that the technology valorises speech and thereby undermines a distinct, vibrant cultural identity.[423] In an article in The Atlantic in 2013, cover-

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contemporary techniques such as speech recognition, machine speech and spectral audio editing.

413 Sterne (2003), p. 40

414 McLuhan (2001), p. 293

415 Levitt (2007), p. 16

416 The first digital hearing aid was developed in the 1970s, however it was not until the 1980s that they were developed as wearable technologies and entered the market. See Levitt (2007)

417 Ross (2007, p. 26

418 Ross (2007), p. 26

419 Experimentation with the technique of the cochlear implant dates back to the 1950s. The modern cochlear implant was developed and commercialized in the late 1970s, but only in the last decade has the technology been significantly implemented, primarily in newborns.

420 Blume (1999)

421 Helmreich & Fried (2012), p. 78

422 A study carried out by Guillem et al. notes how the cochlear implant has resulted in stronger opposition than genetic testing. They conclude that this reflects a strong bond to a minority culture. See Guillemin et al. (2005)

423 Blume (1999) accounts for the different voices in the debate on cochlear implants as they have evolved since the first experiments with this technology in the 1950s.

ing a protest against an annual event put on by the Alexander Graham Bell Association for the Deaf and Hard of Hearing (AGB), a participant expresses criticism of the symposium's sponsors and exhibitors who were affiliated with companies that sell cochlear implants:

> "My whole life I've lived as a Deaf person. I married a Deaf person, I've worked and associated with Deaf people, and I've had no problem in this world. So why are organizations like this trying to take away my right to live the way I want to live, my right to raise my children the way I feel they should be raised?"[424]

Reactions towards the cochlear implant revolve around a discourse of bodily empowerment. The contemporary technological approaches to deafness are described as "technology of oppression",[425] and as "an artificial invader of the body" that causes "a disruption of the subculture of the Deaf community, forced upon people who do not want it by advocates who continue to represent deafness as problematic and abnormal".[426]

A whole new field of research, namely the field of Deaf studies, has urged a response to this "sonocentrism", where "phonocentric tendencies" has "tuned to hearing and voicing as key modes of discriminating human sociality."[427] Contemporary Deaf studies are highly concerned with illuminating the normalisation of the ear as it occurs in current technologies associated with deafness - from the ubiquitous visual utilities offered by smart phones (used extensively by deaf people), to the more controversial approaches of the cochlear implant and genetic testing for deafness.[428] Voices from Deaf communities reject these technological approaches and locate them within "a history of their own oppression".[429]

Tracing a conception of *the mediated ear* as a compensatory tool indeed reveals an ear which has evolved around an ideal of using technology to normalise *hearing*. The technology has acted as a prosthetic device to secure or enhance the physical act of *hearing*. However, it also provides a basis for a critical approach to mediating hearing technologies that goes beyond the scope of alleviating an impaired sense. Since the late nineteenth century, the evolution of *the mediated ear* has primarily been governed by an eagerness to develop new electronic and acoustic innovations for sound amplification in order to present new technology such as telephones, carbon microphones, subminiature vacuum tubes and sound spectrography. As such, *the mediated ear* has not only ensured *hearing*, but also presented new ways of *hearing*.

The Transparent Ear

The evolutionary aspects of *hearing* that I have detected within the second strata of the evolution of *the mediated ear* can be traced further by exploring the discourse surrounding

424 Ringo (2013)
425 Guillemin et al. (2005)
426 Lupton & Seymour (2000), p. 1853
427 Friedner & Helmreich (2012), p. 73
428 The increasingly routine use of prenatal genetic testing for deafness is being used both to select for and against a fetus carrying a genetic disposition towards deafness. See Guillemin et al. (2005)
429 Blume (1999)

the act of mediating *hearing*. This discourse has evolved around the ability of *the mediated ear* to make a transparent representation of sound and thereby an authentic reproduction of *hearing*.

The ideal of representing sound as transparent, authentic and as natural as possible has governed the discourse of sound reproduction technology ever since Edison launched his phonograph in 1877. We might say that the ideal of any sound reproduction medium has essentially been to eradicate its own presence. This ideal is reflected in an Edison pamphlet from 1917 in which the New Edison is described:

> "There are no acoustic properties in any of these materials. . . The New Edison has no tone of its own."[430]

The aim of creating a more *authentic* reproduction by making the medium inaudible, by diminishing the noise of the machine's mechanical sounds or the acoustic distortion of the reproduction process for example, has influenced the technological development of sound reproduction media as well as the cultural discourse surrounding these media. The term authenticity is indelibly associated with Walter Benjamin who relates it to the artwork's aura, cult value and originality. For Benjamin, authenticity is challenged as the artwork enters into the age of reproducibility.[431] In the discourse surrounding *the mediated ear's* representation of sound the concern for the preservation of authenticity is also apparent. Debates on hearing aid devices have traditionally been framed around a number of key points concerning the technology's fidelity and thereby its potential to reflect the world unfiltered, directly and authentically. A critique is often staged by aligning the listening experience of *the mediated ear* with the listening experience of an unassisted "natural" ear. As expressed by Hawksley:

> "A hearing instrument is at best but a sorry substitute for natural or unaided hearing and only when the Ausist fails should its use be undertaken."

The discourse concerning the authenticity of the mediating technology is repeated in contemporary discussion of hearing aids where, for example, prolific presentations of digital hearing aids as "top of the line" are contradicted by the fact that, as noted by Ross, the digital format "doesn't help people hear better" [432] and where cochlear implants are described as only offering "modest hearing gains".[433]

These critical statements concerning the technology's ability to reproduce sound authentically recall Adorno's perspective on sound reproduction technology. In the essay "The Curves of the Needle" (1927), he argues that the new means of reproducing and mass-producing music, including the gramophone, have created problems of authenticity:

> "The moment one attempts to improve these early technologies through an em-

430 Text from Edison pamphlet reprinted in Thompson (1995), p. 146
431 Benjamin (1969), p. 3
432 Ross (2007), p. 30
433 Guillem et al. (2005)

> phasis on concrete fidelity, the exactness one has ascribed to them is exposed as an illusion by the very technology itself. (...)"[434]

For Adorno, sound reproduction media indisputably transformed music when heard through the filter of a medium. The medium pretends to offer a transparent representation of reality that it cannot fulfil.

Even though the reproduction technology of hearing aids cannot be directly compared to the reproduction technology discussed by Adorno and Benjamin[435] - mostly because the reproduced sensibility in hearing aids occurs in real-time rather than in relation to an original time and place of recording[436] – their perspectives concur that the transparency of reproduction is a mere illusion and this can be used to challenge the discourse surrounding hearing aids. The eagerness to promote hearing aid devices as a transparent reproduction technology constitutes a large part of the discourse surrounding hearing aids as it has been expressed by manufacturers, audiologists and teachers. Such a promotion appears in a report evaluating *The Simplex Tubes,* which were hearing tubes used with children at the Central institute for the Deaf from 1920 to 1940. It was claimed that "the voice or sound source reached the ear in its most natural quality".[437] A similar description can be found in a presentation of Oticon's hearing aids dating from 1950. At that time, Oticon's audiologists toured Denmark offering consultations at hotels and inns where they presented hearing aids that offered "a natural lively and subtle reproduction".[438] The discourse on authenticity of reproduction appears perpetual as it can even be traced in contemporary advertisements. The newest hearing aids are described as delivering a "natural, open sound experience" (Oticon 2018), "a natural listening experience" (Starkey 2018) or even "The most natural sound experience ever" (AGXiq, 2018).

Other manufactures have been more modest in comparing their apparatuses' reproduction technology to unaided hearing. In an advertisement from 1957 an Otarion aid's efficiency is described as follows: "Next to nature's – it's the finest hearing you can get!". This statement marks an awareness of the status of reproduction as a mere copy – though a very good one of its kind. Similarly, in a more recent ad for Phonak, the whole brand is conceived through a recognition of the impossible aim of reproducing the natural ear's auditory experience: "We admit we make the second-best hearing instrument in the world".[439] These recognitions situate the reproduced listening experience as something distinct from the unaided listening experience.

A recognition of the reproduction's presence and character is further elucidated by looking at the debate relating to the electrification of hearing aids. Manufacturers of mechanical aids saw an opportunity to promote their devices as more *authentic* compared to electrical aids by highlighting the material presence of the reproduction technology in electrical aids. In an ad for the AUDI-EAR from 1925, the argument is articulated as

434 Adorno (2002), p. 271
435 Adorno is foremost concerned with the phonograph and Benjamin with typography, photography and film.
436 When discussing reproduction technology, Benjamin emphasizes that "even the most perfect reproduction of a work of art is lacking in one element: its presence in time and space." Benjamin (1969), p.3
437 Koelkebeck et al. (1984), p. 17
438 Oticon hearing aid advertisement (1950), quote derived from Oticon (2003)
439 Date unknown but probably 1990s.

Fig. 35: Oticon's description of the Dynamo hearing aids. Screenshot from Oticon's webpage: https://www.oticon.com/solutions/dynamo (visited May 2018)

Fig. 36: The hearing aid Oticon Opn is presented as delivering a "natural" sound experience. Screenshot derived from Oticon's webpage: https://www.oticon.com/solutions/opn (visited may 2018)

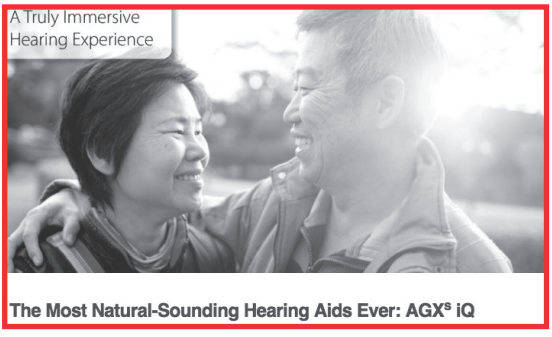

Fig. 37: AGX's describes their hearing aids as "natural" and "immersive". Picture derived from AGX's homepage: https://www.agxhearing.com/agx-hearing-technology/agxr-series/ (visited May 2017)

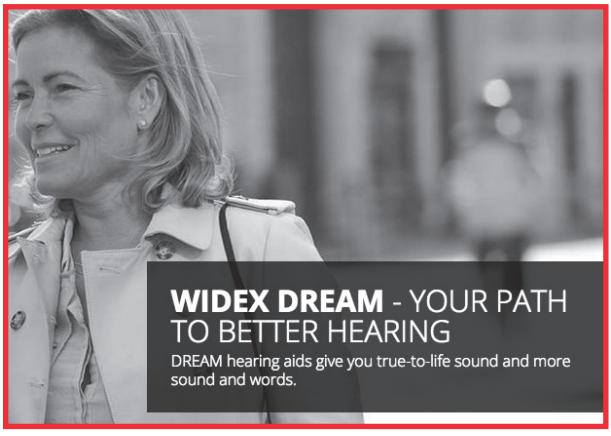

Fig. 38: Widex' description of their DREAM hearing aids. Screenshot derived from Widex homepage: https://global.widex.com/en/hearing-aids/other-hearing-aids/dream-hearing-aids (visited May 2018)

Fig. 39: Phonak hearing aid advertisement by Gendel Advertising, 1998. Copyright Paul Arnot.

follows:

> "AUDI-EAR does not buzz or roar of its own accord as do the electrical earphones. AUDI-EAR reproduces only the natural voice, music etc., without distortion."[440]

This comment stands as an example of how the manufacturers of mechanical aids did not recognise, or chose to ignore, that the filtering mechanism was not something unique to electrical representations of sound. Even though mechanical devices did not contain noisy circuits the form and material of the aids affected the character of the amplification. Early hearing tubes and trumpets were shaped from different materials "wood, rubber, metal etc.), which "coloured" the timbre of incoming sounds. Furthermore, many ear trumpets as well as tubes consisted of an integrated resonating dome or chamber which served to amplify certain frequencies over others. The use of these resonating domes permitted early selective amplification where important sounds, such as speech, could become more audible to the hearing-impaired listener, however, as a result of this process, the entire spectrum of sound was necessarily seriously limited.

The transparency of *the mediated ear,* and thereby its ability to "normalise" *hearing*, thus cannot be said to be merely preserved by the implementation of technology. Sound reproduction will always, as Sterne also emphasised, "turn sound into something else and that something else back into sound".[441]

The Embodied Ear

The ideal of *the mediated ear* as a means of securing a transparent perception of sound and thereby optimising *hearing* through objective means has not only been sought through attempts to technologically perfect of the reproduction of sound. It has evolved through bodily demands that have required the technology to be incorporated into the praxis of the natural body. In the following section, I will trace these bodily demands by approaching the evolution of *the mediated ear* through Don Ihde's mediation theory, specifically his notion of *embodiment.*

The most obvious bodily demand that *the mediated ear* proposes is that it should be wearable. In the history of hearing aids, this demand has affected their general design which has evolved through an ongoing process of compromise between amplification and portability. This development has been outlined by Mara Mills who accentuates the fact that the quest for portability made hearing aids the preeminent site for component miniaturisation and compact assembly prior to World War II.[442] This miniaturisation also served other purposes as it enabled the concealment of a disability which for a

440 An advertisement for The Audi-ear, 1925, presented in Koelkebeck et al. (1984), p. 53

441 Sterne (2003), p. 22

442 The first electric hearing aids introduced new means of amplification, however they were often large, heavy and immobile. Gradually vacuum-tube hearing aids became more popular during the 1930s both because of their amplification technology and because they introduced new possibilities of mobility. They often came in so-called multipacks where each part was to be distributed on the user's body: Batteries were carried in a pocket or strapped to the leg, microphones and amplifiers were worn underneath the clothes and thin wires were connected from these to the ears. See Mills (2011)

long period of time was a social stigma.[443] The history of hearing aids consists of many attempts at concealment in which trumpets, tubes and other mechanical hearing aid devices have been integrated into clothes, accessories (such as glasses or hair clips) or furniture.[444] The total concealment of technological mediation has reached new heights in contemporary digital hearing aids where they have become so small as to be unnoticeable.

The full integration of *the mediated ear* as part of the human body does not , however, only take place through portability and miniaturisation. Looking at the mediation theory of Ihde will allow me to approach *the mediated ear* as an embodied technique that becomes a mediator of human-world relations.

In Ihde's mediation theory, bodily perception is essential. He presents the term *embodiment* as entailing a notion of how humans are bodily engaged with technology.[445] In embodiment relations, technologies form a unity with the human being and this unity is directed at the world: We speak with other people through the phone, rather than speaking to the phone itself, and we look through a microscope rather than at it. [446] Embodying technologies cover the act of relating to the world by means of technologies and the ability to incorporate this technology into the very essence of bodily experience. Embodied technologies thus rely on the hope that technologies will become so transparent that they "become our very selves".[447] I have found this desire reflected in a comment by a first-time user of hearing aids:

> "It took me a few months to adjust to my hearing aids – having something in my ears and hearing every little noise. But once I got used to this, my hearing aids became 'part of me'."[448]

As this testimony reveals, conceiving *the mediated ear* as a natural part of the body's practice is a challenge. Ihde (himself a wearer of hearing aids, or as he more poetically terms it "acoustic technologies"), explains the process of accommodating to the mediated listening experience: "One has to "learn" and bodily accommodate"[449] to mediating technologies. Once learned the technology withdraws (it is transparent) but this will only happen, as Ihde emphasises, if the technology is good.[450] For example, glass must be sufficiently transparent to see through. If you cannot see through the class, embodiment is not possible. The closer to invisibility, transparency and the extension of one's own bodily sense the technology allows, the better, in Ihde's estimation, it is. Ihde emphasises that a hearing aid should ideally function in a manner analogous to eyeglasses but argues

443 Mills (2011a), p. 24
444 An example of a hearing aid integrated into furniture is King Goa's "acoustic throne" from 1819. See figure 42.
445 Ihde is inspired by Merleau-Ponty's examination of perception as it was carried out in *Phénoménologie de la perception* (1945). Merleau-Ponty links perception to a positioning of transcendental subjectivity in the body and it is this notion that Ihde develops in his conceptualisation of *embodiment.* Ihde (1990) p. 72
446 Ihde (2007), p. 244
447 Ihde (2012), p. 132
448 Testimony of Jenny Macintosh, East Sussex https://www.actiononhearingloss.org.uk/~/media/Files/Factsheets/Hearing%20aids/pdf/Life%20with%20hearing%20aids%202016.ashx (Accessed: May 2016)
449 Ihde (2007), p. 244
450 Ihde (1990), p. 74

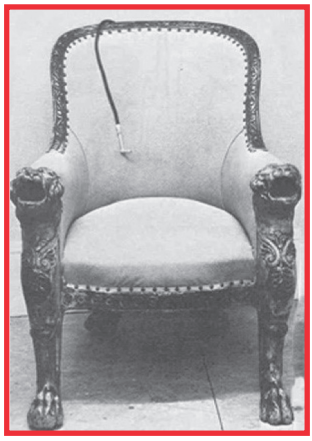

Fig. 40 : King Goa's "acoustic throne", 1819. The chair was made for King Goa as he realised he had trouble hearing. Courtiers were intended to kneel and speak into the mouthpieces located in the arms of the chair and the king would listen to an earpiece which connected to the tube. The acoustic throne is an example of *how technology was used to invent a special device that semi-disguised hearing loss, which at this point in time was looked down upon.* The ear tube was concealed in the design of the throne and sound was conducted through holes in the armrest through a tube that the king was to place inside his ear.

Fig. 41: The first digital hearing aid (1982) was a large instrument mounted on a rack of equipment with FM radio links between the processor and an ear worn unit containing a microphone and output transducer. At the time, the idea of a computer being small enough to fit on or in the ear was viewed as science fiction, Levitt (2007), p. 11-12. Picture derived from Levitt (2007).

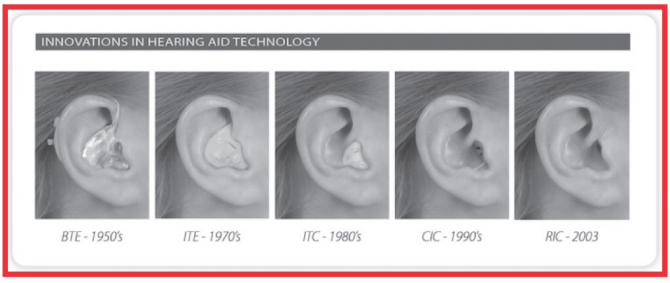

Fig.42: The miniaturisation of hearing aids from 1950 to 2003. Picture courtesy: SeboTek.

Fig. 43: Example of a contemporary approach to the issue of the embodiment of *the mediated ear.* "Ear accessory" designed by Antoine Bertin, Hélène Combal-Weiss and Simon Cacheux.

that "auditory transparency is much more difficult to attain."[451] Ihde adds that natural hearing is difficult to match because it is highly multidimensional and implicates balance and motility in ways that affect whole body experience.[452] Even though the hearing aid allows for auditory sensation it will remain a "prosthetic technology" the development of which continues to strive for a fully transparent bionic recovery of "normal" human hearing but will never attain it.[453]

Thus, the embodiment of *the mediated ear* is characterised by a desire for total transparency and the total embodiment of *hearing* through technological means, but the desire for transparency carries a contradiction within it. If it were possible to obtain total transparency through *the mediated ear*, "it would be equivalent to there being no technology, for total transparency would be my body and senses",[454] as Ihde notes.

Following the testimony of hearing aid users, such as Ihde and others, the future of *the mediated ear* is dystopic as it can never attain the bodily demands of transparency and thereby a total normalisation of *hearing*. Nevertheless, Ihde's notion of embodiment opens up an alternative reading of *the mediated ear* as the incomplete transparency of the technology necessarily "reinvents" the human being,[455] and thereby reinvents *hearing*. The mediating process allows for a conception of *the mediated ear* as not just a material object that stands in opposition to an unmediated act of *hearing*, but as a relationship that is developed between humans and technology. The ear and the technology mutually shape each other in the relationship that emerges between them. In this respect, *the mediated ear* will never allow for an authentic reproduction of *hearing* but rather a *hearing* that is transformative which eventually will lead to new auditory experiences and, if we are to follow Ihde's claim, to new experiences of perception as such.

The Extended Ear

I will turn to the mediation theory of Marshall McLuhan in order to approach a further conceptualisation of how *the mediated ear* "re-invents" *hearing* and consequentially the general human perceptual means.

McLuhan's approach to mediation is founded on a strong notion of physicality in which basic human corporal operations are extended or even upgraded through technology. In McLuhan's mediation theory, "media are extensions of man".[456] As examples, McLuhan describes the car as an extension of the foot, the television as an extension of touch and clothes as an extension of the skin.[457] *The mediated ear* can indeed be regarded as an extension of the body. At its evolutionary outset it functioned as a concrete physical extension of the ear and throughout its evolution it has developed as an extension of human auditory ability. However, McLuhan not only focuses on how perception can

451 Ihde (2007), p. 245
452 Ihde's description of using hearing aids dates from 2007 and his remarks should be considered in this light.
453 Ihde (2007), p. 250
454 Ihde (1990), p. 75
455 Ihde (2007), p. 243
456 McLuhan (2001)
457 McLuhan emphasises that TV not only introduces the extension of touch but also a sense interplay that involves "the entire sensorium". McLuhan considers touch the primary sense, "because it consists of a meeting of the senses." McLuhan (2001), p. 290

be augmented through technology. He is also concerned with the mediating role of technology and therefore points to the fact that the medium is in itself the message, not only the content it carries. The medium changes our relation to the world, it actually has an effect on the character of human perception – as he puts it, it *massages* the human sensorium.[458]

In McLuhan's mediation theory, the major shift in society's predominant technology of communication is the crucially determining force behind not only social changes but also transformations of human sensibilities. This perspective introduces a further layer to *the mediated ear* in that the technology that is used to physically extend the ear creates a whole new relation to the heard. The transformations of the sensibilities that *the mediated ear* has produced can be studied further by aligning the evolution of *the mediated ear* to McLuhan's designation of different technological sense regimes.

McLuhan outlines the first technological regime as *the mechanical age* which is linked to industrialisation. In *the mechanical age*, mechanics (such as the printing press and the factory assembly line) were used to assist human operators with physical requirements. By the process of segmenting and fragmenting an integral action a handicraft could suddenly be mechanised.[459] McLuhan concludes that *the mechanical age* did not introduce severe perceptual changes because it was characterised by "slow movements" which "insured that the reactions were delayed for considerable periods of time."[460] Locating *the mediated ear* within *the mechanical age* leads to an acknowledgement of acoustic hearing technologies such as ear tubes and ear trumpets whose design basically departs from a further development of the amplification effect found in the perpetual aid of the cupped hand.

If we are to follow McLuhan's notion, the first strata of the evolution of *the mediated ear* did not introduce drastic changes in auditory sensation because the amplification effect was still relatively limited and the sound reproduction fairly poor. The significant changes in auditory sensation can be found when *the mediated ear* is aligned to the sensory paradigms that McLuhan attaches to *the electrical age. According to McLuhan, electrical* modes of communication initiated widespread changes in the distribution of sensory awareness because they enabled messages to "travel faster than a messenger".[461] Electricity became, in the words of McLuhan, "an irresistible intruder in time or place".[462] McLuhan describes electricity as "an extension of the central nervous system."[463] This characteristic reveals that McLuhan conceived pre-electric extensions as outward explosions of physical scale, while electronic technology was an inward implosion toward shared consciousness in that electricity connected individuals across distances.[464]

With McLuhan's conception of *the electrical age*, the evolution of *the mediated ear* acquires a new perspective. It is no longer only *hearing* that is optimised. The ear is no longer only extended physically. It is also extended in time and across space in that new

458 In the collage-book *The Medium is the Massage* (1967), McLuhan substitutes the word *message* with *massage* in order to denote the effect each medium has on the human perceptive body.
459 McLuhan (2001), p. 173
460 McLuhan (2001), p. 4
461 McLuhan (2001), p. 97
462 McLuhan (2001), p. 296
463 McLuhan (2001), p. 3
464 McLuhan is especially concerned with the technology of the telephone.

auditory technologies, such as the telephone and the phonograph, have opened up new ways of distributing sound.

Tracing the evolution of *the mediated ear* to its contemporary state reveals even more advanced modalities of *hearing* which even exceed the scope of *hearing.* This state may aspire to McLuhan's anticipation of a final phase of technological change that he argues will lead to "a technological simulation of consciousness".[465] In this technological simulation of consciousness McLuhan claims the human family will be transformed into "a single consciousness".[466]

The technological simulation of consciousness that *the mediated ear* introduces can be explored further within the digital development of hearing aids which has introduced new extensions of the ear. Digital technology has introduced an ever finer granularity of sound amplification and programmability which can be attributed to individual customisation.[467] Moreover, many digital aids have introduced actions that exceed the scope of hearing.[468] The incorporation of a wireless link with other communication systems, such as internet connectivity, has extended the functions of *the mediated ear* as the technology now can be used to control different external parameters such as alarm systems, light sources or telephone calls. Manufacturers claim that this digital technology provides "the first technology to support the brain", however the digital advancement of hearing aids primarily seems to demonstrate a quest for multi-functionality which is a predominant tendency within the contemporary design of so-called smart technologies.[469]

I will claim that an even more serious manipulation of the human mental sphere is introduced with the contemporary hearing technology of the cochlear implant. A minority of deaf implant users gathered under the term *Deaf futurists* have offered alternative readings of this implant technology which stands in contrast to the critical discourse I referred to earlier in this chapter. The Deaf futurists compare the implants to "cyborgian elements"[470] that introduce a new human-machine interface. Here cochlear implants are believed to introduce new sensory perspectives as they function as a genuine neuro-enhancement which become ports into virtual worlds or realisations of a "fully web-worked cybernetic sensory future in which virtual and actual sensory worlds intertwine".[471] Whilst this prospect remains speculative it is nonetheless a fact that the cochlear implant works by directly manipulating the brain through by stimulating nerve cells within the ear. This technology demonstrates how *the mediated ear* has indeed entered a new stage in which the distance between technology and human is highly diminished.

However, McLuhan delivers a nuanced perspective on mediation as he not only describes the general extension of the human body but also believes that every extension

465 McLuhan (2001), p. 3-4
466 McLuhan (2001), p. 61
467 The fundamental difference between analogue and digital hearing aids is that, in the digital hearing aid, the audio signal is converted to a sequence of discrete samples which are processed digitally and then converted back into an analogue signal.
468 Many digital aids allow for internet connectivity which, for example, enables the listener to receive notifications of email through the ears. Oticon promotes their hearing aids by emphasising this extended use. See https://www.oticon.com/solutions/accessories/connectclip (visited May 2018).
469 This tendency can also be observed in the design of smart phones, smart watches and google glasses – all technologies that have been developed as multifaceted tools.
470 Helmreich & Fried (2012), p. 78
471 Helmreich & Fried (2012), p. 78

Fig. 44: Oticon's description of their "connect clip" technology which enables hearing aids to connect to the Internet. Screenshot derived from Oticon's webpage: https://www.oticon.com/solutions/accessories/connectclipvisited (visited March, 2018)

introduced by media leads to a "numbness" in the individual and in the society.[472] This numbness appears both as a stimulating shock delivered by the new technology and as a defensive reaction of the body to block out new sensations caused by new technology. McLuhan regards every extension of the body as a self-amputation. Technological innovation may make human lives easier but it also creates new forms of stress as "The stimulus to new invention is the stress of acceleration of pace and increase of load" (42).

By drawing attention to the numbness that mediation creates, McLuhan presents the argument that humans do not shape technology, but rather that technology shapes humans. His somewhat dystopic perspective on mediation provides a basis for a further tracing of the recent evolution of *the mediated ear.* The extension of auditory perception has changed the physiology of the human ear. The numbness that *the mediated ear* has introduced appears as a detectable increase in hearing loss. This increase is especially apparent in young adults where 1 in 5 have some form of hearing loss - a rate about 30% higher than it was in the 1980s and 1990s.[473] A report released in 2015 by the World Health Organization (WHO) designates the reason for this increase in hearing loss amongst young people to be "due to the unsafe use of personal audio devices"[474], such as cellular phones or iPods with earbuds or headphones. The primary reason for damage to the ear is caused by the compression technology of the MP3 file which is the most popular music format today. [475] This format specifically allows for a very high listening volume which, along with an increase in listening time, has led to severe hearing damage.[476]

Tracing the evolution of *the mediated ear* through McLuhan's conception of technological sense regimes has allowed me to find a possible entry point for illustrating how *the mediated ear* has approached *hearing* through both material, spatial and neurological extensions. Approaching mediation in terms of extensions has demonstrated how *the mediated ear* becomes a means for altering sense ratios or patterns. McLuhan's key concerns make us aware of the implications of the evolution of *the mediated ear* that introduce not only an optimisation of *hearing*, but also change the very act of *hearing* by introducing a new relationship between humans and technology.

The Amplified Ear

A recurring imaginary which I have found in the history of *the mediated ear* is that it allows for an extension of the ear in order to hear *more* than the unaided ear. In the 16th Century, the mediated ear was augmented in order to hear things that would otherwise escape the ear. When amplifying trumpets and tubes entered the market they were not only offered to the hard of hearing, but also for overhearing.[477] The concept of using *the mediated ear* to eavesdrop was implemented in the court of Henry VIII (1491-1547) where

472 McLuhan (2001), p. 6
473 American Osteopathic Association (2018)
474 WHO (2015)
475 Sterne has described the perceptual techniques incorporated in the design of the MP3 format in *MP3 – The Meaning of a Format* (2012).
476 New portable music devices hold much more music than older music players. As a Walkman or a portable CD-player could only hold one CD or cassette at a time, people used to listen for shorter periods.
477Mills (2015), p. 47

carved wooden figures were built into the ceiling in order to overhear everything said and thereby discourage unwanted gossip.[478] The Jesuit scholar Athanasius Kircher also integrated hearing instruments into the designs of buildings in order to transmit sound across large distances and act as acoustic spies. Kircher assumed that sound was reflected like light in mirrors and consequently favoured spiral-shaped channels (imitating the form of the cochlear) with polished interior surfaces for effective transmission and amplification.[479] In Kircher's illustration of *The Dome of Dionysius*, an ancient prison, an ear trumpet technology was integrated into the architecture of the prison allowing the prison guards to eavesdrop on the conversations of prisoners and thereby reveal escape plans or other information.[480]

The imaginary of extending the auditory field beyond the natural limits of human perception has been partly redeemed with the advent of modern measuring technologies. Technologies such as accelerometers,[481] hydrophones,[482] electro-magnetic coils,[483] contact microphones,[484] stethoscopes[485] and hypersensitive acoustic microphones are contemporary tools that are used to detect sounds that would otherwise remain inaudible to the naked ear.[486] They allow for listening to underwater sounds, physical surface vibrations, electromagnetic fields, bodily sounds and very subtle sounds such as those produced by, for example, insects.

According to Don Ihde, the technological amplification of sound is a clear example of how "amplified listening" can give voice to "the previously silent".[487] Ihde describes silence using Husserl's concept of the *empty intention.*[488] The empty intention describes a quality that objects can have which humans are unaware of in their daily relation with the object. This hidden quality can be regarded as an absent profile that is waiting to be revealed. A persistent relationship between the present and the hidden – or

478 Etymologically the word eavesdropping has its origins in these devices which were tucked into the "eaves", the overhanging edges of the beams in the ceiling.

479 Examples which fulfill Kircher's ideals of creating an architecture with integrated amplification systems to transmit sound over great distances can be found in Danish history. King Christian the Fourth implemented sonic tunnels in the construction of castles. By touching a small mechanism beneath a table, the king was able to open tunnels to other floors in the building where musicians were playing. This concept led visitors to report on "invisible music". Jørgen Petersen (1982), p. 97.

480 Bennion (1994), p. 3

481 An accelerometer is a measuring device that detects changes in physical vibration. The accelerometer transforms vibrations into signals which can be amplified and thereby make physical vibrations that would otherwise be inaudible audible. In this way the accelerometer becomes a hyper-sensitive microphone.

482 A *hydrophone* is a microphone designed to be used underwater for recording or listening to underwater sound. Most *hydrophones* are based on a piezoelectric transducer that generates electricity when subjected to a pressure change. Hydrophones are commonly used by oceanic researchers.

483 An electromagnetic coil is an electrical conductor that picks up the vibrations of electromagnetic fields. These fields occur as electromagnetic forces cause vibrations in materials resulting in an audible sound. Electromagnetic coils are used in electrical engineering.

484 Also known as a piezo or pickup microphone, a contact microphone senses audio vibration through contact with solid objects. They only transduce vibrations in the structure not, as with a conventional microphone, through the air.

485 Stethoscopes are used for auscultation (which I have touched upon in the chapter *The Ear)*. The stethoscope consists of a small disc-shaped resonator and two tubes connected to earpieces. Bodily sounds vibrate the diaphragm, creating acoustic pressure waves which travel up the tubing to the listener's ears.

486 I deliberately do not mention ultra sound detectors or hypersonic explorations, as these methods depend on translation of the sound into the audible range of human hearing and thereby do not qualify, in my opinion, as a sensation of the actual sound.

487 Ihde (2007), p. 55

488 Ibid., p. 110

if we transfer it to the auditory field, the audible and the inaudible - is thus a constant condition. Silence can be conceived of as "the other side of sound".[489] However, Ihde emphasises that we will never hear the silence in itself, but rather the movement away from or towards sound, in that it is in this movement that we can become aware of sound's "coming-into-presence"[490] – the exact point where sound originates.

For Ihde, the technology for amplifying sounds that would otherwise be unattainable for the human ear demonstrates how the notion of silence is relative. The technology transfers "mute objects"[491] into the audible domain. Ihde's conceptualisation of "mute objects" includes artefacts that are physically and visually present but do not emit sound (for example a cup or a table). These objects are present, but we cannot hear them, only see them. For Ihde, mute objects are visual and static artefacts in contrast to artefacts that move which he couples with the sonic dimension. Ihde uses these mute objects to designate the boundaries of hearing or, as he puts it, "the auditory horizon".[492] Ihde argues that the borders of visuality can be determined through the auditory field. The boarders of visuality are made up of the invisible, but the invisible can be audible. As an example, Ihde takes the wind: We cannot see the wind but we can hear it. Accordingly, listening can make the invisible present.

The auditory phenomenology of Ihde proposes that *the mediated ear* changes the character of the invisible. *The mediated ear* establishes a new departure point for sound, it pushes at the borders between the audible and the inaudible. However, I will argue that *the mediated ear* does not reveal the boundaries of *hearing*. Rather the constant extension of the human audible range, which the technology introduces, emphasises that *hearing* can by no means be considered a static entity.

The Aesthetic Ear (III)

Within the field of sound art, *the mediated ear* has frequently been employed to reveal the unheard in order to extend the human auditory field. The Danish artist Jacob Kirkegaard has worked with accelerometers in the piece *Eldfjall* (2005), amongst others, in which he has recorded seismic activity. By placing accelerometers below the surface of the earth at various places around geysers, the sonic characteristics of volcanic activity are picked up from below the surface of the earth, exposing rich sonic activity below the threshold of human auditory perception.[493] The artist Christina Kubisch is well-known for her artistic use of electromagnetic coils, which she used to produce her *Electrical Walks (2004-2013)* in which the electro-magnetic fields of urban environments are traced. The sounds of electromagnetic fields appear as rhythmical structures and colourful drones. Other mediating hearing technologies, such as hydrophones have been used by sound artists such as Jana Winderen, Kim Cascone and Edwin van der Heide.

A common feature of these sound works is that they introduce a shift from a

489 Ihde (2007), p. 110
490 Ibid., p. 111
491 Ibid., p. 109
492 Ibid., p. 103. Ihde notes that the concept of *horizon* is derived from Heidegger's notion of reaching the limits of phenomenology. The horizon is what situates the very field of experience itself.
493 *Eldfjall* released on label Touch in 2015.

phenomenological and epistemological register to a poetic and aesthetic register. They use *the mediated ear* to reveal an aesthetic quality rather than an epistemological potential. *The mediated ear* is no longer a means for staging an optimisation of *hearing*, but rather a means for reaching a sensation of *hearing*. Brandon LaBelle describes this artistic approach as a way of displaying "vibration as material" and thereby heightening an awareness of "sound's looming presence within the environment, its impact on health and interaction, and its potential to create relationships."[494] This claim sets a new departure point for *the mediated ear* as it argues that operating on the auditory horizon of sound within an aesthetic context focuses the ear's attention on the very moment where sound comes into being. *The mediated ear* is used to stage a new awareness of the origin of *hearing*. Furthermore, within these aesthetic contexts, *the mediated ear* not only expands the auditory dimension but also challenges the very notion of silence. *The mediated ear* makes the hearing subject aware of their own deafness, as the new sonic world can only be revealed through the mediating act. Through the *hearing* of *the mediated ear* we become aware of the fact that we are all, more or less, partially deaf, in so far as we constantly fail to register sounds.

I will argue however, that at no point does the aesthetic staging of *the mediated ear* allow us to achieve silence. Rather, it contributes a poetic staging of what silence may be. I will claim that the aesthetic staging of *the mediated ear* makes us aware that what is unheard is limitless. It poses new questions that challenge "the mute object's" presence. Is the mute object really always mute, or does every object have a sound within it that we have yet to hear? Where does the range of *hearing* actually stop?

Placing *the mediated ear* within an aesthetic framework provides a new point of departure, not only for sound and sound aesthetics, but for *hearing* itself, as the technologies form the conditions of *hearing*. However, I will argue that it does not allow us to attain either silence or the horizon of *hearing*. These sound art pieces can open our ears anew and make us initiate a specific *intentionality* towards the heard, but the incorporation of mediating hearing technologies in an aesthetic setting first and foremostly reproduces the ideals of optimising *hearing* which I originally posited as a departure from the industry's standard presentation of this technology. These sound works create an artificial frame that asserts access to reality and, as such, I infer that these aesthetic projects adopt an epistemological project connected to the audiological field. However, these sound works only present a fantasy of what *hearing* might be. *Hearing* is romanticised as a scientific exploration which now appears filtered, painted and accustomed to an audience who already have many aesthetic expectations and preferences.

The Sounding Ear

I have already provided an account for the history of *the mediated ear* and I have explored the different hearing modalities that *the mediated ear* contains through the mediation theories of both Ihde and McLuhan amongst others. However, I wish to reach a more profound characterisation of the particular auditory attention evoked by *the mediated ear*. What does *the mediated ear* actually *hear*? In order to pursue a characterisation of how

494 LaBelle (2006), p. 239

the *hearing* of *the mediated ear* functions, I will return to an exploration of the incomplete transparency of *the mediated ear.* The specific materiality of the mediation may hold a key for characterising *hearing* beyond the ideal of normalisation.

Even though the discourse of *the mediated ear* has been primarily characterised by the endorsement of a totally transparent reproduction of sound, I have also found a specific kind of materiality attached to the act of mediation. This materiality has been described as the *tone* of the medium. In an advertisement for the Globe Silvertone Earphone (1921), the apparatus is described as "so clear in tone", while promotional material for Oticon (1950) states that their apparatuses can be "adjusted in tone" and advertising copy for the Mears Ear Phone (1914) promotes the apparatus as a "new 8-tone earphone" which offers "different adjustment to suit every condition of the user". The tone of the apparatus obviously refers to a specific equalising or filtering of the incoming sounds, and thereby not to a concrete tone or sound. The tone of the apparatus refer to particular settings that amplify certain frequencies in order to adjust to various acoustic circumstances (examples include a "cocktail party" setting, and settings for the theatre or for private conversation),

In the examples above, the *tone* of the apparatus comes to signify individuality, as it can be adjusted to fulfil individual sound preferences. However, the *tone* of the apparatus also refers to the specific materiality of the reproduction, the filtering, which is now transformed into something positive that can be used to promote each apparatus as a distinct auditory experience. This approach to addressing the sound of the medium itself, or the materiality of the reproduction process as a quality, is also used by the contemporary hearing aid manufacturer Widex. In a recent description of newly launched hearing aids, the company presents the distinct sound character of their apparatuses as advantageous or even proprietary, as it is stated that the apparatuses produce a so-called "Widex-sound", which is "richer", "detailed" and "well-rounded".[495] Widex even presents their apparatuses as no longer only enhancing sound perception but even producing "more sounds". This presentation of *the mediated ear* as containing a specific sound which not only aids the impaired listener to *hear* better, but even enriches the general auditory experience is an echo of a discourse which also can be traced in a Globe advertisement from 1920. Here the Vactuphone hearing aid is presented as a gateway to an unprecedented world of sound that allows the user to "(…) hear sounds that even normal and healthy ears have not heard since the world began."[496]

Promoting the sound of the medium provides a new conception of *the mediated ear.* As total transparency of reproduction remains an impossible ideal, the materiality of *the mediated* ear is embraced in order to present a *hearing* experience which differs from the *hearing* experience of an unaided ear. If we are to follow the argument presented by the manufacturers and promoters, *the mediated ear* introduces a *hearing* that makes the user aware of auditory events that would otherwise escape the ear. This approach to reproduction as a quality in and of itself recalls Walter Benjamin's presentation of the sensibility of photographic reproduction:

495 From Widex' webpage describing the DREAM hearing aid, Widex (2017)
496 Globe advertisement quoted in Mills (2011a)

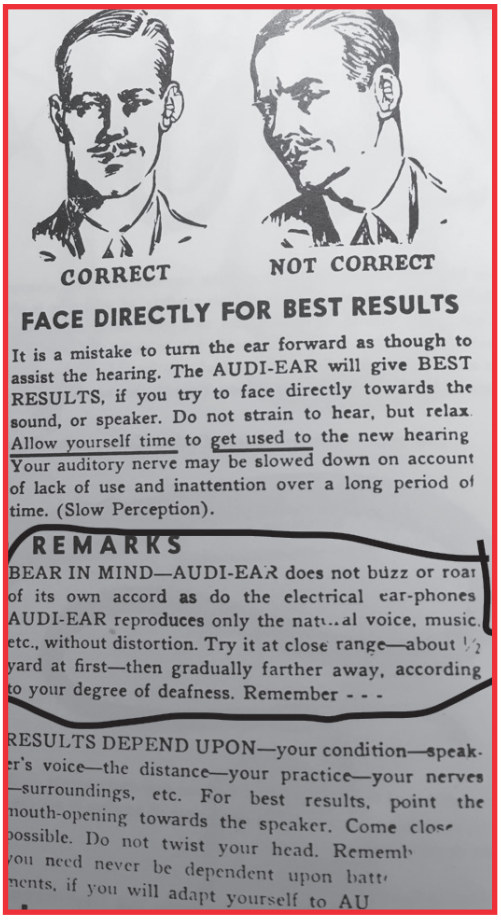

Fig. 45: Descriptions of the sound of the Audi-Ear. Derived from the instruction manual for the Audi-Ear. Reprinted in Koelkebeck et al. (1984).

Fig. 46: Descriptions of the reproduction quality of the Mears Ear Phone. Mears advertisement from 1914. Picture derived from Your Hearing Now, Inc.

Fig 47: The picture illustrates Oticon's description of "traditional hearing aid technology" that "focuses on one sound source at a time. By reducing all other sound signals – speech and noise alike – it leaves the wearer with a narrowed and artificial listening experience." Citations and screenshot derived from Oticon webpage: https://www.oticon.com/solutions/opn (visited May 2018)

> "(…) reproduction can bring out those aspects of the original that are unattainable to the naked eye yet accessible to the lens, which is adjustable and chooses its angle at will. And photographic reproduction, with the aid of certain processes, such as enlargement or slow motion, can capture images which escape natural vision. Secondly, technical reproduction can put the copy of the original into situations which would be out of reach for the original itself."[497]

Benjamin's approach to technological reproduction provides a basis for a further conceptualisation of the specific auditory experience of *the mediated ear*, as it becomes an act of focusing the ear, just like the lens of a camera focuses the eye. *The mediated ear* may allow for new auditory experiences, not only because it acts as a compensatory tool, but because it presents sounds that would otherwise escape the naked ear.

This is, of course, a rather positive take on the reproduced auditory experience offered by *the mediated ear*. Many testimonies by hearing aid users have provided a different perspective on the materiality of their reproduction of sound which has often been described as contributing distortion effects or unpleasant resonance. In reviews of a Starkey hearing aid, the materiality of the apparatus is described as creating a "buzzing sound that bounces from one hearing aid to the other" and the mediated hearing experience is compared to "listening to a radio that's on the fritz".[498] Such testimonies challenge the ideal of *the mediated ear* as facilitating the transparent reproduction of *hearing*.

However, the sound of *the mediated ear* provides yet another perspective. I will argue that *the mediated ear* still holds the potential to support the sensation of *hearing.* By virtue of its simple strategy of offering a device that mediates the act of *hearing,* I will claim that *the mediated ear* is aligned with Helmholtz's conception of the instrumental ear.[499] Helmholtz's experimental research into the physiological sensations of sound suggested a method for enhancing the sensation of *hearing* through the use of musical instruments. Musical instruments were to create a new awareness of our encounter with sound by challenging basic listening habits.

Conceiving these mediating hearing technologies as Helmholtzian instruments can illustrate how these technologies can be approaches in order to activate a sensation of *hearing*. The mediating hearing technologies invites for a *listening-to-hearing* in that they function as concrete sonic microscopes that amplify and intensify the physical sensation of sound. By *listening* critically to how the mediating hearing technologies form the conditions of *hearing* - for example by *listening* to the sound of the medium itself - the ear can be trained to take on a new approach to accepted norms concerning sound. As such, *the mediated ear* not only extends the auditory range of the ear, but furthermore facilitates a *listening-to-hearing* that enhances the sensation of *hearing.*

The Modified Ear

In my introduction to this chapter, I emphasised that the ear in its evolutionary aspect was a flexible organ which has undergone a series of physical manipulations and vari-

497 Benjamin (1969), pp. 3-4
498 Testimonies of Starkey Halo 2 RIC 13 i2400 derived from Hearing Tracker (2018).
499 See p. 61

ations in order to optimise *hearing*. By conducting a media archaeological investigation of the diverse audiological technologies which have been used to improve *hearing*, I have traced a conception of the ear as a malleable entity which continues to introduce new perceptual modes. My media archaeological discursive excavation of *the mediated ear* has exposed the many ideals of using mediation technology to tune the ear in order to optimise *hearing*. But it has also presented alternative conceptions of how this mediation has sought to "re-invent us",[500] and how this re-invention must necessarily challenge normalised conceptions of *hearing*.

My exposition of *the mediated ear* has followed the development of attempts to optimise *hearing*. I have identified technologies which have been used since ancient times to optimise *hearing* through simple physical extensions of the surface of the pinna or the tragus. My initial conception of *the mediated ear* has taken its point of departure from compensatory means, where mediating hearing technologies have been used to enable human beings to *hear* more and *hear* what would otherwise be left unheard. Through the work of Bell, as well as through the critical approaches to mediation technologies presented by contemporary Deaf Studies, I have demonstrated how the process of mediation has been driven by an attempt to overcome the cultural problem of deafness. I have managed to trace the ideal of normalising the ear even further by exploring the discourse on transparency evolving around *the mediated ear*. Here I have pointed out how, across historical epochs, *the mediated ear* has been presented as facilitating the transparent reproduction of *hearing*.

With my exposition of *the mediated ear*, I have presented an ear which is dependent upon technology in order to *hear*, however it is also an ear that, due to its technological augmentation, creates new ways of *hearing* that have changed the relationship between humans and technology. My exposition of *the mediated ear* presents an ear which entails the promise of erasing, or at least diminishing, the distinction between humans and technology, however in the process of pursuing this goal it produces a number of alternative *hearing* modalities. Following Ihde's notion of embodiment, I have taken the first steps toward an alternative reading of *hearing*, which has presented *the mediated ear* beyond its function as a compensatory tool. I have evolved a new conception of *the mediated ear* as not just a material object that stands in opposition to an unmediated act of *hearing*, but as a specific modality of *hearing* that is evoked in the relationship between humans and technology. I have approached a further characterisation of this *hearing* modality pertaining to *the mediated ear* through the mediation theory of McLuhan, which has emphasised the perceptual changes that hearing technologies can activate. I have explored the hearing modalities of *the mediated ear* further by looking into technologies used to extend the horizons of *hearing*. I have emphasised that these technologies indeed support the imaginary of extending the auditory field beyond the natural limits of human perception. I have argued that this ideal notion of *the imaginary ear* has been uncritically adopted by some practitioners within the field of sound art. Within aesthetic explorations of *the mediated ear* I have found a perspective which supports a notion of *the mediated ear* as being an entry point for not only amplifying and fortifying incoming sounds in order to *hear* better, but also to *hear* more. However, I have argued that not even an aesthetic framing can extend

500 Ihde (2007), p. 243

or reveal the boundaries of *hearing* itself.

With this exposition of *the mediated ear*, I have staged a discussion of how technology affects the conditions of *hearing* and in so doing I have echoed McLuhan's iconic statement that "the medium is the message". I have also shown how technology can be approached in order to reveal the complexities of *hearing*. I have argued that *the mediated ear* invites for a *listening-to-hearing* which offers an entry point for exploring physical and physiological aspects surrounding *hearing*. I have emphasised that *the mediated ear* cannot only be seen as a compensatory tool as the physical conditions that technology sets for *hearing* present new hearing modalities which affect our perception of the world.

Remove hearing aids from ears

Listen with your own ears

REFLECTIONS ON TECHNOLOGY AND THE EAR

I have now explored articulations of *hearing* as they appear in the tuned relationship residing between the ear and technology. By initiating an investigation into the wider contextual and perceptual framework surrounding audiometers and hearing tests, hearing cure artefacts and mediating hearing technologies, I have introduced three technology-dependent ears*: The otologically normal ear, the imaginary ear* and *the mediated ear.*

These three modalities have functioned as a way of attending to the construction of *hearing* as both an idealised auditory state and as a potential epistemological starting point. Through a discursive investigation of the media archaeology of the audiometer, artefacts pertaining to hearing cures and hearing technologies, I have exposed the implicit constructions that reside in definitions of *hearing*. I have established that *the otologically normal ear, the imaginary ear* and *the mediated ear* all operate on physical understandings of *hearing* in which technology is staged as a means for either standardising, normalising or optimising the sensation of sound. However, in investigating the technological circumstances surrounding the development of these audiological instruments and their scientific results, I have suggested that the design and operation of these instruments has not taken the complexity of *hearing* into account. These complexities include the many external circumstances that affect conceptions of *hearing*, amongst other the spatial frames, the materiality of the audiological instruments, the sounds of the instruments, the general performative frames which the audiological instruments are operated within, and not least, the thematization that the act of *listening* imposes on *hearing.*

I have observed that the construction of *hearing*, as I have found it articulated in the wider discursive context surrounding audiological instruments, has been adopted by the arts. Sound artists such as Alvin Lucier, Kaffe Matthews and Jacob Kirkegaard have been concerned with exploring the conditions of *hearing* by staging the instrumentation used within audiology and sound therapy within an aesthetic setting. This artistic strategy has led to a series of interesting sound works, which have depicted conceptions of *hearing* which must be considered valid within their own aesthetic frames, however none of these works have presented an objective approach to sound sensation just because they have adopted the instrumentation used to reach scientifically respectable conceptualisations of *hearing*. I have therefore presented these works as reproducing standardised and idealised conceptions of *hearing* that ignore the uncertainty and complexity that I argue governs *hearing.*

My investigation of audiological instruments has revealed the historical construction of the epistemology of *hearing.* Ideas of standardising, normalising, and optimising the ear have led to the development of technology, which, in turn, have produced epistemologies of *hearing* which have been adopted into artistic theories and aesthetic practices. In order to avoid blindly following this historical construction of *hearing* I have turned to the field of phenomenology and post-phenomenology.

Using a phenomenological approach to study the human sensation of sound is not new. In the first part of this thesis I argued that this approach has ,to a large extent, been used to form sound and sound perception as epistemic resources, not least through the terminological designation of *listening*. However, as I have already argued, auditory phenomenologists such as Schaeffer and Voegelin have left the act of *hearing* at a very basic and indeed static level. I have used a phenomenological approach to explore the possibility of retrieving new conceptions of *hearing*, which can take *hearing* beyond the limitations imposed by both the industry surrounding it and the scientific branches of audiology as well as sound studies that have traditionally formed conceptions of *hearing*. My phenomenological analyses have not proposed a more truthful or objective conception of *hearing*. But, they have proposed a methodology for addressing conceptions and conditions of *hearing*.

My phenomenological analyses of *the otologically normal ear* have introduced the methodology of *listening-to-hearing*. I have presented *listening-to-hearing* as an example of Husserl's phenomenological concept of double-sensing, which proposes an attention towards *hearing* as a physiological sensation of sound. This attention creates a focus on the very moment where the ear is physically touched by sound. However, as *listening-to-hearing* will always be contingent upon the thematisation of an ego *the otologically normal ear* cannot lead to a universal concept of *hearing*. Instead, the intentional act of *listening-to-hearing* insists that any conception of *hearing* depends on the listening subject and the many external and internal circumstances surrounding the listening subject.

Through a phenomenological analysis of sound therapeutic instruments I have presented *the imaginary ear*. I have used my conception of *the imaginary ear* to propose a tactile conception of *hearing*. I have used Merleau-Ponty's phenomenological explorations of the pathologically disturbed body as basis for introducing a multisensorial concept of *hearing*. In my elaboration of *hearing* as a multisensorial sensation the work of artist Christine Sun-Kim has become pivotal. In her work, I have found an alternative to the historical epistemology of *hearing* which I have found repeated in much sound art. Sun-Kim deliberately creates a situation where the act of *listening* is evaporated, which intensifies a very concrete sensation of *hearing* as a tactile or bodily touch.

Finally, a post-phenomenological definition of *the mediated ear* has supported my aim of exposing *hearing* as a sensation in constant flux. Using Don Ihde's conception of embodiment, I have designated *the mediated ear* as an ear that will never form an authentic reflection of *hearing*, but rather a *hearing* that is transformative and which eventually will lead to new auditory experiences. Furthermore, I have used Helmholtz's conception of the instrumental ear to present a notion of *the mediated ear* that has offered a possibility to explore the material qualities of *hearing*. The many different shapes and forms of *the mediated ear* have initiated an exploration of how the sensation of *hearing* can be enhanced.

My attempts to reach an articulation of *hearing* through both a discursive media archaeological approach and a phenomenological approach have not led me to an objective conception of *hearing*. Rather, these approaches have added concrete methodologies for exploring *hearing* which go beyond those of traditional audiology. I will claim that these two approaches constitute an entry point for exploring the perceptual dynamics evolving in the tuned relationship between the ear and technology, which has allowed for a presentation of *hearing* as complex, variable and deviational. These two approaches

have also introduced a new awareness of how technology allows us to hear. Finally, by following the meandering discourse on the ear from ancient times to the contemporary settings of audiology, acoustics, sound art and sound studies, I have illuminated how idealised and static conceptions of *hearing* are not only a tendency of the past, but are indeed apparent in our own time.

TECHNOLOGY, THE EAR & THE OPERATOR

Return to page 9 and review the documentation of the three sound works.

Listen to the record in the box
or use the download code.
When finished,
read the following chapter.

TECHNOLOGY, THE EAR & THE OPERATOR

In my account of *the otologically normal ear*, *the imaginary ear* and *the mediated ear*, I have presented conceptions of *hearing* by investigating the discursive contexts surrounding the audiological instruments that form the basis for my sound works. In the following section, I will focus on exploring how conditions of *hearing* are produced. I will leave critical analyses of the discourses surrounding these audiological instruments behind and instead I will describe how my practical artistic exploration of these audiological instruments' aesthetic dimensions has formed a basis for exploring not only how the ear is tuned, but how a tuning of the ear might actually proceed or, one could even say, be provoked. I will conceive the aesthetic dimension of these audiological instruments as a particular perceptual experience that constitutes a contemplation and I will argue that this contemplation *tunes* the ear, in that it invites specific awareness of how the conditions of *hearing* are structured.[501]

In order to describe how an exploration of the aesthetic dimensions of particular audiological instruments can form a way of experimentally tuning the ear, I will set out to investigate the many questions that have been raised in the process of creating the three sound works of this research project. I will relate aspects of my artistic-based research practice to different theoretical and methodological positions from research fields such as media archaeology, acoustics, audiology, phenomenology, object-oriented ontology and artistic research. Thus, with regard to the audiological instruments, I will continue my methodological approach of tuning through diverse positions which share an emphasis on the practical exploration of objects as a basis for producing knowledge.

The fields I will tune into in this section all entail a specific accentuation of the word *tuning* – either as a figurative term or as a research methodology. I will make an introduction to Pythagoras' conception of tuning wherein concrete musical instruments are conceived as epistemological tools to tune the ear to specific aesthetic preferences. I will adopt this conception in order to describe the audiological instruments as tuning instruments, that is to say, as instruments that are designed to affect the physiological ear in order to create auditory ideals. Subsequently, I will turn to Helmholtz's notion of tuning. Here I will also find an emphasis on tuning as a concrete epistemic activity departing from an engagement with sonic sources, however Helmholtz' autonomous operational approach places further emphasis on challenging static ideals of *hearing*. I will describe my handling of the audiological instruments in relation to Helmholtz's research practice. This description will acquire a further layer which adds a thorough presentation of the sonic material and the technological means of the audiological instruments. I will discuss these means further through the media archaeological practice of Wolfgang

501 Within the philosophical discipline of aesthetics several different notions of the aesthetic experience have been articulated. Whilst some theorists have considered the aesthetic experience as covering superficial, stimulating entertainment others have conceived it as the product of the concentrated meeting between an artwork and a perceiver. See Stougaard (2012), p. 271

Ernst and his conception of the "cultural tuning of the ear".[502] Ernst's media archaeology and his emphasis on sound media will also form the basis for further discussion of the temporal conditions that the sound works establish and the means by which they stage both past and present auditory ideals.

I will also initiate a tentative consideration of the narrative potential of the audiological instruments, which I have explored in the sound works. Here I will use K.E. Løgstrup's conception of tuning, which will provide the basis for a broader discussion of music's ability to tune the mind to specific perceptual states. I will reflect further upon the perceptual change of focus which the sound works offer by confronting phenomenological conceptions of tuning as they have been articulated by Heidegger, Georgina Born and others. Eventually, I will leave the individual sonic articulations of the audiological instruments behind and turn to a consideration of the external conditions that I have constructed for these audiological instruments. I will introduce Gerhard Böhme's notion of tuning, which will offer a basis for considering my experimentation with the spatial frames of these audiological instruments as a way of tuning the ear.

Finally, I will make a tentative consideration of the role of the operator. Here, I will refer to Heidegger's phenomenology as well as diverse perspectives derived from the field of object-oriented ontology. The latter position proposes a conception of tuning as covering a notion of affecting causality. I will discuss this notion and use it to initiate a discussion of subjectivity within scientific research in general, and artistic research specifically.

In this section of my thesis, I will not seek to compare these different conceptions of tuning or favour one notion over another. These approaches will be mostly used to shed light on aspects of these audiological instruments which I will use as prisms to reflect and test different conceptions of tuning. Relating my practical investigation of these audiological instruments to diverse articulations of tuning will allow a multifarious perspective on these sound works and will provide a language for approaching some of the many questions regarding ability of audiological instruments to tune our ears. It will allow me to investigate the questions of this research project from a different angle, as it will propose an alternative entry point for exploring how the ear is tuned and how the simple act of operating audiological instruments can constitute an epistemic activity.

Tuning Instruments

How do the audiological instruments appear as epistemological tools for exploring hearing?

The point of departure for describing the tuning processes at stake within the sound works of this research project is found in the designation of the audiological instruments as tuning instruments. This designation will not lead to definitions of the timbres of sound apparent in the sound works or analysis of what kind of tuning systems may or may not appear. Neither will it accord any unique status to these objects where I, by virtue of my role as "the artist", have been able to tune into their "real" phenomenological

502 Ernst (2016), p. 97

essences.[503] Instead, it will allow me to define these audiological instruments' inherent characteristics and deploy them as epistemic tools.

Tuning instruments can be characterised as standard-frequency sound sources because they are designed to only emit one tone at the time which can be identified as possessing a definite pitch of frequency.[504] Many traditional tuning instruments, such as the monochord and the tuning fork,[505] were originally developed only to function as standard frequency sound sources, while others, such as organ pipes, pianos, chimes and bells, were transferred from a musical context into a scientific realm because their way of propagating sound held experimental potential. The audiological instruments which I have engaged with appear as standard-frequency sound sources as they are designed to emit a repeatable propagation or representation of sound, that is, the audiometer and the sound therapy instruments are intended to play the same tones independent of its operator and the mediating hearing technologies to make a repeatable sonic reproduction. In the audiological instruments' original setting, the repeatable production and reproduction of sound served to support the production of epistemic claims concerning *hearing.*

A further characterisation of these audiological instruments as tuning instruments can be made by relating them to the ancient tradition of using tuning instruments to form knowledge. Pythagoras' monochord stands as the first known tuning instrument, one which also served to present epistemological claims. By experimenting with the length and thickness of the string of the instrument, Pythagoras designated perfect relations in musical harmony which were later to be known as the Pythagorean tuning system. However, these relations were not considered a single phenomenon but rather testimony to the existence of a fundamental mathematics in the universe as a whole.[506] The principle of the numbers within the tuning system was a principle which could be applied to everything, even the phenomena of proportion, symmetry and harmony in nature.[507] The idea of a general tuning system for the world was common to the thinking of many Ancient natural philosophers and was developed even further during the Renaissance.[508] To the English scholar Robert Fludd (1574-1637) music was the most important art form of all.[509] In his work Musica Mundana, Fludd conceived the world as an instrument. The monochord was again used as an instrument to demonstrate the amazingly well-ordered scheme of proportions and harmonious numerical order of the macrocosmos. According to Fludd, it was God, who he also referred to as "The great

503 The conception of the artist being able to perform a pre-reflective perception is depicted by Merleau-Ponty amongst others. In the work of the painter, Merleau-Ponty sees a practical unfolding of reduction in its ideal state. The art of painting becomes a departure point for retrieving insight into the very experience of vision and, more generally, into perception itself. See Merleau-Ponty (1970), p. 53. Later in this chapter, I will discuss a similar conception of the artist through the aesthetics presented by K.E. Løgstrup and Timothy Morton.

504 Olson (1967), p. 171

505 The tuning fork was invented in 1711 by the British musician John Shore. It became a popular remedy for tuning because it was capable of producing a very pure tone, with most of its vibrational energy based at the fundamental frequency.

506 Buhl (2000), p. 11

507 Buhl (2000), p. 13

508 Amongst others by Johannes Keppler (1571-1630), Athanasius Kircher (1602-1680), and Robert Fludd (1574-1637). Also, Marin Marsenne worked extensively on harmonic theory. However, he argued against the occult and at times religious view of science, which especially the work of Fludd represented.

509 Zielinski (2008), p. 102.

pulsator", that tuned the instrument called the world.

Even though the audiological instruments within this research project do not belong to the same category of tuning instruments as the ones used by Pythagoras or Fludd because they have not been designed to reflect ideal structures within musical practices, I will argue that they indeed act *as* tuning instruments. First of all, because they reflect an ideal of *hearing*, which maintains the ambition of tuning the ear to standardised concepts. These audiological instruments represent the ideal of reaching the ear through well-ordered schemes and tangible manipulation. Secondly, these audiological instruments act as tuning instruments through their methodological ideal, in which sonic articulations are conceived as an outset for making epistemic claims. This ideal has been transferred into contemporary audiological practices where the operation of audiological instruments, as well as the consideration of their sonic output, forms the basis for making epistemic claims relating to *hearing*.

Tuning as a Sonic Condition

How does the sonic content tune the ears?

The characterisation of audiological instruments as tuning instruments was manifested in their original status as epistemic tools. Within this research project, this status has constituted an appropriate basis for making practical explorations of the act of *hearing*, however it has also offered a way of experimenting with the very act of tuning itself. The framework of the sound works has presented an entry point for experimenting with audiological instruments' function as tuning instruments. I will account for this experimentation by relating it to the research practice of Hermann Von Helmholtz.

Helmholtz incorporated several tuning instruments in his research practice. One of the most common instruments applied in Helmholtz' experiments was the organ - or more precisely individual organ pipes. Helmholtz used organ pipes to study how musical tones propagated as air streams through a hollow material - an acoustical principle that had been studied since ancient times. The organ distinguished itself as a scientific instrument because of its ability to synthesise sound, i.e. its ability to mix different frequencies and timbres together.[510] The timbre of the output sound was constructed by means of combining harmonics from different pipes, an ancient principle called additive synthesis.[511] The organ can produce both simple tones, called sine waves, which are found in wide, closed pipes as well as more complex tones rich with upper partials which are found, for example, in small tin pipes. By combining these qualities Helmholtz figured out that the more upper partials found in a sound the more dissonant the sound was perceived as being, whereas if he constructed a simpler sound it was perceived as consonant. The organ thus held the potential for a closer look at how sound was perceived as either consonant or dissonant or, as Helmholtz put it, as either music or noise.[512]

510 Helmholtz (1954), p. 216

511 By pulling different register-stops in various proportions one could add together sounds of several pipes and thereby mix different timbral qualities. See Roads (1996), p. 134

512 Helmholtz (1954), p. 7

Helmholtz's employment of organ pipes as well as other tuning instruments such as tuning forks, pianos and sirens, served to prove that the perfect relations reflected in the various tuning systems of the West were to be regarded as constructions, or as he puts it, "the work of artistic invention".[513] By experimenting with these tuning instruments he sat out to challenge the claim that Western music theory was based on a natural phenomenon occurring as a physiological reaction in the ear which created a sensation of dissonance and consonance. Helmholtz noted that although the anatomical structure of the ear could be assumed to have been the same throughout shifting fashions of musical aesthetics, the way that humans perceived these aesthetics had been subject to change:

> "The system of scales, modes, and harmonic tissues does not rest solely upon inalterable natural laws, but is also, at least partly, the result of esthetical principles, which have already changed, and will still further change, with the progressive development of humanity."[514]

Helmholtz accentuated his point by referring to the scales of Antiquity in which the range of dissonance was much richer than in modern times. This, said Helmholtz, was not the consequence of a change in our physiological ear, but rather a consequence of historical changes in taste and habits. He concluded that these same properties of the human ear could serve as the foundation of very different musical systems and that the construction of scales, keys and chords could not be construed as a scientific law.

In Helmholtz's work, the ancient practice of using tuning instruments to designate an ideal state was revived but also reconsidered. By placing the tuning instruments in an acoustic lab, and thereby at a distance from any musical or aesthetic ideal, he managed to expose stereotypical conceptions of perception and form the claim that the ear is tuned to specific listening patterns through cultural parameters. By exploring the actual physical properties of these instruments, he sought to reach an understanding of "the pure sensation of sound,"[515] referring to a sensation of sound that went beyond any intervening act of the intellect and thereby also any limitations of sensation set by Western music culture.

The practice of Helmholtz suggests a basis for describing the concrete handling of the sonic content of audiological instruments as a way of tuning the ear. I have operated the very instruments which have been used to designate standardised and normalised conceptions of the ear, however I have not followed any of the prescriptions or instruction manuals. Like Helmholtz, I have explored these instruments in ways that no longer supports their original epistemic claims. I have experimented with the inherent logic of audiological instruments by pushing buttons and turning knobs without any consideration of their intentional use.

Yet my experimentation with these audiological instruments' status as tuning instruments has differed from the practice of Helmholtz in one particular respect. Whereas Helmholtz's practice was centred around eliminating any aesthetic content in

513 Helmholtz (1954), p. 366
514 Helmholtz (1954), p. 235
515 Helmholtz (1954), p. 3

order to reach "a pure sensation of sound", I have deliberately used the sound works to expose aesthetic dimensions of these audiological instruments. I have conceived of the sonic material of these audiological instruments as articulating an aesthetic dimension. Initially, this aesthetic dimension relates to an instrumental and artistic conception of aesthetics,[516] as I have approached the sonic material in order to form and articulate an artistic expression. Subsequently, however, this artistic expression has led to a further conception of the aesthetic dimension which aligns to the tradition of conceiving the aesthetic experience as departing from the autonomy of an artwork.[517] The aesthetic dimension has been invoked not just as some kind of beautification of the instruments but rather as a specific autonomous exposition of the instruments' content, which is not be understood as an exalted presentation of this content, but rather as a free and open exploration of the technology in use.

Tuning as an Operational Approach

Can an aesthetic exposition of obsolete instruments, that is instruments whose epistemic claims are outdated, lead to new knowledge?

The media archaeological approach of Wolfgang Ernst provides the basis for a further reflection on the aesthetic dimension of the sound works and, most importantly, invites discussion of how this dimension can constitute an epistemological entry point for the exploration of *hearing*. My material consideration of these obsolete audiological instruments does not completely adopt Ernst's methodology, as his archaeological investigation relates to the engineer's signal analysis whereas my operational approach is closer to the artist's or the musician's. Nevertheless, I find myself in a constant dialogue with his methodological considerations.

Like the ancient tradition of *tuning*, Ernst's media archaeological approach prompts a physical engagement with objects as a methodology for obtaining new knowledge. The objects of concern in Ernst's media archaeology are obsolete media. These media are not only approached through a contextual discursive frame, as was the case in the media archaeology performed by Huhtamo and Kluitenberg which I touched upon earlier in this thesis.[518] Instead they are examined through an operational approach where the media are opened, explored and experimentally operated.[519] Ernst proposes a close reading of media which can be carried out through a tactile and "operational"[520] approach and which, in essence, consists of practical engagement with the object of research. Ernst argues that it is only when the medium is *in operation* that it is "in its medium

516 Kyndrup notes that a material and instrumental conception of aesthetics departs from art practices rather than from aesthetic practices. The latter relates to philosophical reflections on the nature of art. See Kyndrup (2010), p. 2
517 Kyndrup has made an account of this tradition where the artwork is conceived as independent and liberated from any accepted rules. Amongst others, he relates this tradition to the aesthetics of Kant. See Kyndrup (2010)
518 See p. 108
519 Ernst is a director of The Media Archaeological Fundus at Humboldt University, which is home to a media archaeological archive that students are encouraged to engage with. Unlike museum objects, the archive's objects are operational. I visited the Fundus in January 2016.
520 Ernst (2013), p. 185

state".[521] Through the operational approach it is possible to reach new insights into media that can support the acknowledgement of media archaeology as an exact science.[522] According to Ernst, the exactness of media archaeology appears through analysis of the actual, physical and real appearance of media objects, which can expose articulations of the past.

Ernst calls for a so-called cold-gaze[523] when operating media of the past, which implies leaving feelings and semantics behind in order to reach beyond human interpretation. According to Ernst, conceiving media as measuring devices allows for a momentarily suspension of human perception from the limitations of its own subjectivity and culturality.[524] The media archaeological approach thus suggests the possibility of revealing new perspectives on media history because "the apparatus unsemantically "listens" to the acoustic event, whereas the human ear always already couples the physiological sensual data with cognitive cultural knowledge, thus filtering the listening act."[525] The media archaeological method proposed by Ernst leans on the thought of Marshall McLuhan who proposed that the medium itself, as opposed to the content it carries, should be the focus of study.[526] Likewise, in so far as the desire of media archaeological is to be freed by machines from one's own subjectivity, the medium itself can be assumed to containing a pure message of its own.

Ernst urges experimental use of obsolete machines which will exceeds their conventional uses as mass media. He suggests the approach of "reverse engineering" in order to explore perspectives on the machines that the manufacturers did not originally intend:

> "(...) media archaeology uncovers a *memoire involontarie* of past acoustic, not intended for tradition: a noisy memory, inaccessible to the alphabetic or other symbolic recording (...)"[527]

According to Ernst, reverse engineering turns the medium itself into "an active archaeology of knowledge that is able to penetrate the superficial discourse of mass media."[528] Furthermore, operating media beyond their intentions can be used to understand the early stages of mass media, where they appeared as simple measuring devices developed for experimental practice:[529]

> "To put it roughly, any listening to music on records or to radio programs is essentially experimental, a kind of reverse experimentation. (…) Tuning an analogue radio is experimenting with radio waves and their electromagnetic resonances."[530]

521 ibid., p. 185
522 ibid., p. 173
523 Parikka (2013), p. 8
524 Ernst (2013), p. 61
525 Ernst (2013), p. 61
526 McLuhan (1967)
527 Ernst (2013), p. 174
528 Ernst (2013), p. 55
529 Ernst (2013), p. 184
530 Ernst (2013), p. 184

The audiological instruments which I have operate in order to construct the three sound works of this research project are all in some sense obsolete.[531] In a media archaeological sense, the original status of these audiological instruments is that of measuring devices, in that they were developed for experimental research. In their original setting these audiological instruments all functioned as scientific, analytical apparatuses which served as genuine tools to investigate, measure and evaluate the sense of hearing. Even though I have approached these obsolete audiological instruments through artistic research I will argue that, in a media archaeological sense, this approach has also managed to turn the instruments into time machines in so far as the artistic exploration of the properties of these audiological instruments has enabled me to share and participate in the original discovery of the human hearing sense *through* operating and listening to the machines. In this regard, my artistic exploration relates to Ernst's conception of reverse engineering, as I have exposed the full sonic content of these audiological instruments, including malfunctioning sounds such as hisses and scratches appearing in the electronic circuits, sudden outbursts and uncontrollable dynamic variation of tones, detuned pitches and the mechanical sounds of buttons being pushed and knobs being turned. These sounds have amplified the poor reproduction quality of these instruments as in the operation of the instrument a sound almost always appears accompanied by a sound originating from the medium itself.

Even though my exploration of the sonic content of these audiological instruments was undertaken from an artistic perspective, I would argue that this perspective has allowed me to articulate some of the same contextual and discursive layers of these audiological instruments proposed by Ernst. In exposing these obsolete audiological instruments' concrete, physical emanations within an artistic framework they are taken way beyond their original intended use and their original epistemic claims.

My attention to the full sonic content of these audiological instruments has formed a basis for establishing what Kant has described as an aesthetic relation, a relation that accentuates a specific interest in an object, both in the object itself and in the object as the basis of an experience.[532] The sonic content which I have exposed through these sound works reveals an aesthetic dimension as it invites a specific kind of interest, a specific *listening,* which differs from that with which these instruments are conventionally approached. The sonic content creates an aesthetic experience which adjusts attention toward the conditions that have been used to present conceptions of *hearing.*

Tuning as a Temporal Engagement

Does my framing and operation of these audiological instruments enable me to hear historical auditory preferences?

Ernst's media archaeological approach takes its point of departure from the ideal of reaching an understanding of media beyond discursive context. According to Ernst, sound in

531 The audiometer is an obsolete technology, the hearing horns are reconstructions of obsolete technologies and the sound therapy instruments include imitations of obsolete instruments.
532 Kyndrup (2010), p. 16

particular holds a special status, because of its ability to "tune our ears" [533] which, in some sense, allows us to communicate *directly* with the past like a resonance phenomenon. However, the aesthetic dimension of the audiological instruments which I have explored in my sound works challenges Ernst's ideal of achieving a non-discursive research approach, primarily because this aesthetic exposition occurs as a fictionalisation of the temporal conditions of these instruments. I will account for these considerations in the following section.

Ernst argues that sound, more so than any other material or form, demonstrates how humans can be tuned to experience transient time. He argues that the media archaeological, experimental presence does not recreate the same historical conditions that the technology originally departed from. Rather it enables contact to the past through a *delayed presence* which is preserved in a technological memory. Our way of *listening*, or as Ernst phrases it, "the cultural tuning of our ears",[534] is different now, but the technology allows us to "share and participate" in the original setting of the technology.[535]

Ernst emphasises that music instruments and media artefacts have the ability to register the past in ways that not even the most developed symbolic system of writing could ever match,[536] because the act of listening activates the temporal rather than spatio-visual sense:[537]

> "In many respects sound – heard, recorded, or transmitted – is radically ahistorical. Serious engagement with the sonic – sound as sound and sound as time – opens up access to a plurality of non-narrative temporalities."[538]

In signal-based recording media, sonic memory is preserved which reveals that sonic eventuality is not simply time-based. In a more radical reading it leads humans to experience time as such.[539]

Ernst's introduces the term *sonicity* to reach a deeper understanding of the epistemological dimensions that sonic media hold.[540] *Sonicity* refer to oscillatory events and covers an understanding of sound as primarily "inaudible events in the vibrational (analogue) and rhythmic (digital) fields."[541] With the concept of *sonicity*, Ernst distances his approach to sound from the field of musicology as he is primarily interested in sound's "strict dependence on physical or technical embodiments and algorithmic implementations" rather than the physical notion of sound.[542] Thus, *sonicity* represents the area where time and technology meet, which eventually has the effect of seducing the human sense of time.[543]

Viewed through the perspective of Ernst's media archaeological conception of sound, the sound works of this research project can be conceived as a way of attending to the temporal regimes of these audiological instruments. I have explored the audiolog-

533 Ernst (2016), p. 95
534 Ernst (2016), p. 97
535 Ernst (2013), p.177
536 ibid.
537 Ernst (2016), p. 77
538 Ernst (2016), p. 94
539 Ernst (2016), p. 35
540 Ernst (2016), p. 7
541 Ernst (2016), p. 22
542 Ernst (2016), p. 24
543 Ernst (2016), p. 21

ical instruments through their operative force which allows the machines to *sound out* in a contemporary context. The sound of the past is reflected in the unintentional noises produced by these instruments which act as a filter: The mechanical sounds of pushing buttons on the audiometer, the electronic scratching of the sound therapy instruments and the sound of the mediation heard through the hearing horns. When operating the instruments, I *hear* the past sound out but it is a past that appears through the perspective of the present, through the act of *listening*. I perform a *listening-to-hearing*, but I am not *listening* to *hearing* as such, rather to the conditions that have been used to define *hearing* in the past.

Musical Tuning I

Can music form an epistemic outset?

As much as the media archaeological approach has contributed an insight into the temporal properties of the audiological instruments that I have operated, it has also made me consider discrepancies in my own methodological approach. My further manipulation of these audiological instruments' sonic output marks a clear distancing from the media archaeological approach, which is evident in the way I have structured their content into what I have termed *sonic narratives*.

In the case of the audiometer and of the sound therapy instruments, these sonic narratives appear through a deliberate operation of the instruments as musical instruments. I have structured the extended sonic content of the instruments into a planned sequence, with elements that recall melodic, harmonic and dynamic progression – however with no intention of following any standard musical form aligned to traditional tuning systems or chord progression. The specific ordering of this extended sonic material derived from the audiological instruments appoints a listening setting which no longer belongs exclusively to the audiological field but, indeed also, to the field of music. Accordingly, I have conducted what I will term a *musical tuning* of these audiological instruments, which presents the sonic content of the instruments through an aesthetic frame: We now hear the pitches of the frequencies of the audiometer as they are used to create small melodies or long drones. We hear the pulsing mechanisms of the sound therapy instruments as they are transformed into rhythms. Even the malfunctioning parts of the technology, such as the detuned pitches, the uncontrollable dynamics and the noise of the mechanics, are incorporated as compositional devices to construct a new sonic narrative of the apparatus.

Initially, my musical tuning of the obsolete audiological instruments seems to relate to Ernst's goal of presenting media archaeology as "both a method and an aesthetics of practicing media criticism."[544] Here, Ernst's conception of aesthetics appears solely instrumental, as it emphasises an austere approach to signals "resisting the temptations of premature narrative contextualization."[545] Ernst rejects any form of narrative deriving from cultural or historical modes of understanding media and sound technology which he claims music, in particular, is related to. He argues that these narratives can

544 Ernst (2011), p. 239
545 Ernst (2016), p. 129

be avoided by turning to a media archaeology by means of which it is possible to "concentrate on non-harmonic micro-figurations of temporality within the sonic event."[546]

Ernst also rejects so-called *musical objects* which lead to "semantic listening", where the focus is on, for example, detecting a melody.[547] According to Ernst, subordinating sound to a linear progression prevents a conception of sound "in time".[548] Instead he calls for a sound analysis performed by technology itself and not by a human interpreter, as this will allow the operations and sounds of a machine to be considered as "something real" [549] that exceeds any symbolic level. Ernst suggests a media archaeological *listening* in which human perception is momentarily suspended in favour of measuring instruments:[550]

> "to listen media-archaeologically is to pay attention to the electronic message of the acoustic apparatus, not primarily to its musical content as cultural meaning. The media-archaeological ear listens to radio in an extreme way: listening to the noise of the transmitting system itself."[551]

According to Ernst, this *listening* approach entails the possibility of reaching the past in a manner that historical discourse is no longer capable of.[552]

Ernst calls attention to sound analysis as performed by the technology itself and at the same time he discards the analytical forms connected to music, such as score reading or musicological form analysis.[553] Media-archaeological *listening* should pay attention to the sonic past through "techno-acoustical signifiers" rather than the "musical signified".[554]

I will claim that the media archaeological ear depicted by Ernst remains speculative, as we can only approximate the sound analysis conducted by technology, we can never actually perform it. The media archaeological ear indeed *listens*, as the sounds of the machine are congested by a subject, and, as such, it does not *hear* in any objective sense of the word. However, Ernst's rather critical perspective on the narrative structure of music should be read as a general confrontation with the tradition of western musicology, which focuses on form analysis relating to specific cultural norms or historic periods.[555] Hence, he does not dismiss music as a sonic articulation as such, but rather criticises the approach music presents for analysing sonic outputs. In a specific media archaeological approach to music he finds potential for recalling the pre-Socratic Greek philosophy *mousiké epistéme*, which holds that music is not just "an acoustic pleasure and entertainment" but also "a model of knowledge".[556] According to Ernst, music is not only a time-based art form, rather it leads humans to experience time itself.[557] In addi-

546 Ernst (2016), p. 135
547 Ernst (2016), p. 135
548 Ernst (2016), p. 94
549 Ernst (2016), p. 113
550 Ernst (2013), p. 68
551 Ernst (2013), p. 68
552 Ernst (2016), p. 7
553 Ernst (2016), p. 129
554 Ernst (2016), p. 89
555 Such as the sonata form of the early Classical period (mid 18th Century) or the rondo form popular in the last half of the 18th and the early 19th centuries.
556 Ernst (2016), p. 120
557 Ernst (2016), p. 35

tion, he argues that music comes into being "only in the process of performance",[558] as performance has the "power to generate presence" and even a specific kind of presence which constitutes a "double bind between the historic and the ahistoric sensation, between cognitive understanding and affective listening."[559] Accordingly, Ernst's approach to music serves to locate an important feature, namely the temporal sensation that music specifically generates. He uses the terms sonification and soni*fiction* to mark a comprehension of music that unfolds sound as an imagination of time:

> "when effectively (i.e. physically) implemented in instruments, human voices, or operative media, music is in itself already, *a priori,* a sonification of time - its sonic *Versinnlichung* as affect. In a more advanced interpretation, sound is even a soni*fiction* of time in the strict Latin sense as it *generates* temporality."[560]

Ernst's conception of music reveals how his media archaeological approach revolves around an ambivalent approach to aesthetics. He rejects music as a narrative form, however, when conceived beyond its sonic implementation, he finds that it "oscillates between its irreducible cultural historicity and its ahistoricity as mathematical aesthetics."[561] Ernst designates this ideal as acted out in antiquity's, and in particular Pythagoras', exploration of musical instruments which forms a "techno-physical insight"[562] into musicological knowledge.

Musical Tuning II

How does a musical exposition of these audiological instruments enable me to listen to the act of hearing?

The *musical tuning* which I conducted using audiological instruments somehow reverses Ernst's ideal of a media archaeological approach to music. Instead of conceiving musical instruments as techno-physical apparatuses, I have approached techno-physical apparatuses as musical instruments. I will present the details of this argument in the following section.

In the sound work *The Acoustic Appraiser*, the narrative progression takes its point of departure from the hearing test situation that the machine was originally intended for. The accompanying tape is used as a general framework for the narrative, as we hear a speech test announced by the voice of a man who calls out a series of numbers. His voice is slowly accompanied by the appearance of test tones at a very low amplitude. By gradually raising the amplitude of the tones and eventually shifting their pitch, amplitudes and duration without consideration of the testing situation, the sonic narrative evolves into music only to constantly revert to the test situation. This sonic narrative is

558 Ernst (2016), p. 100
559 Ernst (2016), p. 86
560 Ernst (2016), p. 35
561 Ernst (2016), p. 97
562 Ernst is in particular interested in Pythagoras' experiments with the monochord. He argues that when we pull the string of a monochord, we "share the techno-physical insight of the relation between integer numbers and harmonic musical intervals that once led the Greek philosopher to muse about the mathematical beauty of cosmic order in general." Ernst (2016), p. 91

constructed upon a tuning which lies between an original audiological listening setting, in this case a hearing test situation which cultivates an approach to sound as pure signal - and a new musical setting, which approaches the sound as an aesthetic expression. A similar narrative progression evolves in the sound work *Maskinel Terapi*, which is also based on instruments which have no connection to a conventional musical setup. Here the new sonic narrative is extended between the realm of music and the realm of sound therapy. In *Maskinel Terapi* the ambiguous scientific status that sound therapy holds is amplified through the sound and the visual appearance of the instruments. Most of the instruments used in this setup do not actually have any connection to sound therapy but are only staged as such. By deliberately including objects whose sonic and visual appearance evoke imaginaries regarding the healing properties of sound, the scientifically ambiguous character of the instruments is enhanced. The new sonic narrative of these therapeutic instruments does not serve to expose the sound technology as simply fraudulent. Rather, it constantly encourages the listener to alternate between the act of *hearing* (perceiving the sound as physical stimulants) and the act of *listening* (following a musical linearity).

The sonic narratives of these audiological instruments have evolved through an exploration of sound as an alternating sonic signal which encourages us to *hear*, that is, to approach the sound without attaching further meaning to what is *heard* beyond its aspect of being *heard* and also as part of an artistic expression in the form of music which encourages *listening* to the content of the *heard*.

The sonic narratives evolve through an abstract storyline constructed with sound in which the technology is unfolded almost dramatically, as the sinusoidals transform into variegated dynamics and linear progressions. These sonic narratives structure the sound of the machines into a form, not a sonata or a rondo but, nonetheless, a form that has a beginning and an end. Whilst these sonic narratives also display an experimentation with the temporal regimes of the technology, as suggested by Ernst, they constitute a form of experimentation that also incorporates the contemporary context of the technology allowing their cultural and historic implications to be restaged in a new setting. These new sonic narratives expose the narrative practices of sonic articulation which, I would argue, are not only present in the Western conception of musical progression but can also be found in the cultural-historic reading of sound as signal as it appears in diverse audiological practices such as hearing tests, sound therapy and hearing aid calibration. As such, I would claim that even aesthetic approaches to sound are infiltrated by narrative.

In conclusion, the sonic narratives which I have constructed have become a literal interpretation of Ernst's term soni*fiction* as they unfold a reading or an interpretation of these audiological instruments which exposes their narrative content. The sonic narratives expose these obsolete audiological instruments through a fictional sonic setting extended between music and sonic signals, by means of which I am not aiming at reaching the past objectively. Rather, I have used the musical setting to literally explore the material aspects of these instruments in order to expose their aesthetic dimension. The aesthetic dimension creates a new relation to the heard. It offers a different sensation of the heard as it invites a particular kind of contemplation of the sonic content of these audiological instruments which stands in contrast to the cool registration of sound

which their original audiological frame insisted on, and which I will argue, is adopted by the media archaeology of Ernst. The aesthetic dimension not only stages the audiological instruments within a new framework extending between different temporal and scientific fields, it also stages an auditory attention which constantly tunes between the act of *hearing* and the act of *listening*, thereby creating a new awareness of the differences in sensibility that are found in these two modes of auditory sensation.

Tuning as Interpretation

Can music form a basis for perceptual explorations?

Historically, aesthetic contemplation has been related to a specific kind of purposelessness.[563] Art for art's sake.[564] The sound works presented in this research project have made me consider another conception of aesthetic contemplation. In the philosophy of K. E. Løgstrup (1905-1981) and his conception of *tuning*, I have found an argument for considering the aesthetic dimension as a particular sensorial experience that forms a point of departure for studying the conditions of *hearing*.

Løgstrup proposes music as a basis for exploring human perception. In Løgstrup's philosophy, music does not serve to uncover physiological reaction patterns but rather human mental states. Løgstrup uses the word *tuning* to designate the perceptual potential of music. According to Løgstrup, art, and in particular music, articulates a certain kind of *tunedness* (tr. from Danish: Stemthed), as it translates an attitude into a specific expression. He emphasises that music not only tunes our ears, but furthermore the mind. In this tuned relation, we are open to the impact of what we sense, which goes beyond any prior acquaintance with the things or events.[565] This tuning can be communicated, amongst other ways, through music's structuring of tones,[566] where, for example, the scale allows for a momentary conception of the sensation of sound which goes beyond its source.[567] According to Løgstrup, the form that structures music is what leads to new knowledge about the world.[568]

Løgstrup's conception of *tuning* opens a new perspective on the sonic narratives of the sound works presented as part of this research project. By structuring the sounds of the audiological instruments into musical narratives, the sensation of sound has been compressed into a form. If we are to follow Løgstrup's argument, it is exactly in this ordering of the sounds produced by the audiological instruments into a form that activates an accentuation of the technology because it forces the listener to enter into a specific mode of perception. In this perceptual mode, a new contemplation of the sensation of sound is activated which exceeds the intentions of the technology.

Even though Løgstrup's conception of *tuning* is based upon a conception of the artist as a sensitive mediator of impressions, which appears rather old fashioned or

563 Stougaard (2012), p. 270, Kyndrup (2010)
564 This saying is rendered from a French slogan from the early 19th Century used to express a philosophy where the intrinsic value of art lies in its detachment from any didactic, moral or utilitarian function.
565 Løgstrup (1983), p. 10
566 Paahus (2017), p. 9
567 Løgstrup (1983), p. 9
568 Løgstrup (1983), p. 10

even romantic in the context of this research project, he opens up the conception of the artist's role as an interpreter. His conception of *tuning* suggests that the sonic narratives that I have constructed constitute only one interpretation out of many possible interpretations of these audiological instruments, however they do allow for a new sensation of the technology. These sonic narratives form an immediate impression of the technology which mobilises the listening subject to *listen* to the technological conditions that form the basis of *hearing*.

Tuning as Narrating

How can a sonic narrative lead to a new consciousness of hearing?

Whereas Løgstrup places an emphasis on music as a specific basis for exploring perception, many philosophical as well as artistic practices have rejected the perceptual potential of musical narrative. I have already provided an account of the media archaeological method of Ernst, which does not leave much space for further consideration of the perceptual potential of musical narratives. My insistence on exploring the nature of audiological instruments through sonic narratives that incorporate musical interpretation runs the risk of presenting anachronistic artistic values. However, I will argue that the resistance to musical narratives is partly derived from an anachronistic ideal, which I will relate to the musical avant-garde of the 1950s and 1960s.

The Western musical avant-garde of the 1950s and 1960s,[569] disassociated itself from musical practices that endeavoured the use linear narration. In industrial, scientific, or medical test equipment, such as tone generators, EEG electrodes, differential amplifiers and audio transducers, composers such as John Cage, LaMonte Young and Alvin Lucier found a method for directing attention away from "traditional" musical concerns such as timbre, dynamic or temporality. The composer Alvin Lucier described this approach as follows:

> "Acoustical test equipment is, by its very nature, free of content. What goes into a material or environment to be tested must be neutral so that the results are unbiased."[570]

This industrial technology fostered a programme of what music historian and sound artist Peter John Blamey has called "impersonality",[571] where composers such as Lucier associated electronic technology with the context of instrumentality relating to science and testing rather than with the particular aesthetic context in which they were employed. Composers such as Cage and Lucier worked towards the perception of acoustic phenomena which fostered a revolt against a narrative structuring of sound. An encouragement from Cage indicates this intention:

> "(…) one may give up the desire to control sound, clear his mind of music, and

569 The beginnings of the Western musical avantgarde movement is often associated with 20th century composers such as Luigi Russolo, Edgar Varese and Pierre Schaeffer. I have focused on the 1950s and 1960s because this period introduced a new approach to technology resulting from its incorporation in both everyday-life and scientific practices.
570 Lucier (1995), p. 456
571 Blamey (2008), p. 175

> set about discovering means to let sounds be themselves rather than vehicles for man-made theories or expressions of human sentiments. This project will seem fearsome to many, but on examination it gives no cause for alarm. Hearing sounds which are just sounds immediately sets the theorizing mind to theorizing, and the emotions of human beings are continually aroused by encounters with nature."[572]

Likewise, Lucier's primary concerns were to "uncover sounds or aspects of sounds which we seldom hear because of our concern with musical language".[573] Lucier considered it important that his works cultivated a "timeless kind of depth," inducing the feeling of "going into a sound-space, rather than moving horizontally along it."[574] Lucier aimed for a form of sonic expression in which the experience of perceiving the piece became "an experience of being aware of yourself perceiving it".[575] He elucidated this goal through a comparison with a Beethoven symphony:

> "you are really not aware of yourself perceiving a Beethoven symphony, you're aware of what Beethoven is doing, but in this situation [Lucier's own work] I hope you are aware of yourself going through the particular process of hearing."[576]

Both Cage and Lucier present the argument that narrative presentations of sound privilege subjective interpretation because the sonic narrative is constructed around decisions regarding progression (harmonic, dynamic etc.) which lead back to a subject. These subjective parameters prevent explorations of the perception of sound. In this disassociation from narrative practices, which Ernst's media archaeology also supports, I find the clear ideal of reaching an objective sensation of sound mediated by technology which promises an approach beyond subjective parameters. However, I will argue that these artistic practices uncritically adopt the discourse surrounding audiological instruments as presented in the previous part of this thesis (Technology & The Ear*)* in which technology represents an objective assessment of *hearing*.

I will claim that the sonic narratives which I have constructed present an alternative sound analysis, which is neither based on traditional musicological form analysis or the interpretation of scores. However, it is not an ascetic or puritan sound analysis performed by oscillography or sound analysis software, as suggested by Ernst. Neither is it an exploration of sound as space or time, as suggested by Lucier and Cage. The musical tunings which I have conducted do not adopt the epistemic claims connected to audiological instruments. In contrast to Cage and Ernst, I have not worked with state-of-the-art technology. The instruments I have engaged with have lost their scientific status and become outmoded as they have already been replaced by technology capable of ever finer measurement. This temporal gap has allowed for a further distancing from the original epistemic claims of the instruments as their malfunctioning elements now allow us to *listen* to the conditions of *hearing*.

572 Cage (1961), p. 10
573 Blamey (2008), p. 248
574 Ashley (1975)
575 Ashely (1975)
576 Lucier quoted in Blamey (2008), p. 232

Tuning as a Perceptual Strategy

How does a physical extension of the ear lead to a new consciousness of hearing?

In the previous section, I have accounted for how the sound works of this research project tune the ear. I have described the aesthetic dimension of the audiological instruments as forming a perceptual basis for raising an awareness of the conditions of *hearing*. I wish to unfold these perspectives further by accentuating some aspects of the sound work Shouting Out Loud!

Shouting Out Loud! differs from the other two sound works in this research project as it does not unfold a so-called sonic narrative. It might not even be possible to categorise as a sound work as it does not produce any sound. Rather, it revolves around the moulding or affecting of a sound environment.

The sound work consists of horns which function as physical enlargements of the ear. The horns enable the listener to immediately hear *more*. However, this *more* is not be understood in a literal sense, as the reflective surfaces of the horns' aluminium coating amplifies some frequencies while others are omitted. The horns' physical material emphasises how the act of *tuning* proceeds by focusing the act of *listening* in order to make the listeners become conscious of their *hearing*. The simple act of *listening* through a horn makes the listener aware of how *hearing* is formed and moulded through media. The hearing horns reflect a perceptual strategy for uncovering aspects of *hearing* which would otherwise be left unheard.

The perceptual strategy that the hearing horns evoke can be characterised further by turning to Georgina Born's conception of *attunement*, which has clear phenomenological aspirations.[577] Born describes *attunement* as follows:

> "I find I can move into and out of awareness of, attunement to, the sounds — as a companion entity or process. (…) But I cannot block out the rain sounds; I am ineluctably situated in relation to them, subjectified by them, albeit with a certain freedom of reverie, of enjoying a range of potential affective responses."[578]

From Born's perspective attunement refers to a relational circumstance. Attunement covers an act of focusing one's attention towards what would otherwise be overheard. It is a subjective focus , which allows for a sound or occurrence to "shift from perceptual background to foreground."[579] This perceptual shift of focus that *attunement* may evoke, is also proposed by James Ash and Lesley Gallacher. They develop a concept of *attunement* from the language of sound in order to cover relations between human bodies and their environments.[580] In their perspective, *attunement* reflects an entry point for engaging

577 Born's notion of *attunement* is, amongst others, derived from Jean-Luc Nancy and his concept of resonance, which links sound and listener. Nancy considers the listening subject a resonant subject because both the object and subject of listening, in his account, resonate. See Born (2017), p. 7

578 Born (2017), p. 2

579 Born (2017), p. 4

580 Ash & Gallacher develops a methodological concept of *attunement* derived from the theoretical positions of Heidegger, Cavel and Manning. According to Ash & Gallacher, *attunement* holds a key to approach "the crossing that occur between the human and the non-human", because its sonic connotations generate connections between seemingly disparate realms in order to open up new ways to think and understand social life. Ash & Gallacher's concept of attunement is inspired by the object-oriented ontology, which I will describe later in this chapter, as they argue that attune-

with the non-representational background, as it constitutes a basic capacity to sense, amplify and attend to differences shaped by the atmosphere which together act as "the conditions of possibility for what and how something appears in the world, before it is organized through internal self-narration, the representational logics of language or a theoretical account of the senses as a series of discrete faculties".[581]

The perceptual notion that Ash & Gallacher and Born attach to the notion of attunement can be taken even further through Heidegger's conception of *stimmung*. *Stimmung* is often translated as *mood* or *attunement.*[582] The term relates directly to the sonosphere, however it does not refer explicitly to acoustics as a physical sound event or to music as a conceptual art form in culture, but rather to the implicit, epistemological meaning of sound as vibrating space.[583] Ernst interprets Heidegger's assessment of sonic vocabulary as an alternative way of expressing the microtemporal structure of the 'event' of being. As such, *stimmung* exceeds connotations of feeling or emotion which the English translation of *mood* might suggest.[584] Heidegger stresses that *stimmung* is not experienced as a state of mind possessed by psychological subjects. *Stimmung* constitutes a sense of being part of a world that is pre-subjective and pre-objective. [585] *Stimmung* reconciles Heidegger's concept of *Dasein*[586] in that it reflects a way of *being in the world,* which Heidegger uses as an existential condition of its definition.[587] *Stimmung* suggests that the way we approach things are shaped by a fundamental being in the world, which acts as the condition of possibility for what appears in the world and how it appears.

The concepts of *attunement* and *stimmung,* as I have found them articulated by Born, Ash & Gallacher and Heidegger, open up consideration of how the sound work Shouting Out Loud! tunes the ear. The hearing horns of Shouting Out Loud! do not just offer a possibility for *hearing* more. They offer a perceptual change of focus that makes us *listen to* things that would otherwise be left unnoticed. The hearing horns uncover new perspectives on the sonic landscapes surrounding us, but foremost they make us *listen* to our way of *hearing* through a mediating hearing technology. The metallic timbre that the horns entangle the sonic environment in, encourage for a focus on how our *hearing* is modified by technology. Applying the aluminium horns on the ears suddenly makes us *hear* how the technology colours our sonic experience. By physically enhancing the mediated sensation of *hearing,* the hearing horns make us *listen* to the conditions that form *hearing.* The perceptual change of focus that the hearing horns offer transforms the act of perceiving sound through a set of reconstructed hearing horns into an act of

ment ask us to speculatively inquire about how objects appear to and shape each other. Here object-object relations are seen as equally important as human-object relations. See Ash & Gallacher (2015), p. 82

581 Ash & Gallacher (2015), p. 70

582 In the 1962 translation of *Being & Time,* Macquarrie and Robinson opt for "state of mind" and "mood", and occasionally "being-attuned" (Macquarrie & Robinson, 1962, p. 173). Other translations include "affectedness" (Dreyfus, 1991), "attunement" (Stambaugh, 1996), and "disposedness" (Blattner, 2006).

583 Ernst (2016), p. 38

584 A point which has also been presented by Dyson (2009), p. 86

585 In this regard, I propose that *attunement* is a more appropriate translation than *mood,* in that *attunement* underlines the acoustic/musical relation and as well distancing itself from a conception of a mental mood as being, as for example, happy or sad. This translation matches Heidegger's emphasis that *stimmung* "comes neither from 'outside' nor from 'inside', but arises out of Being-in-the-world, as a way of such being". Heidegger (1962), p. 176

586 Heidegger's concept of *dasein*, which is a central element in *Being and Time* from 1927, stands as a reflection upon mortality that ultimately asks the question of what it means to be human. See Heidegger (1992), p. 11E

587 Ernst (2016), p. 38

becoming aware of ourselves as auditory-oriented beings in the world.

Tuning as a Spatial Condition

How do spatial conditions affect the epistemic and aesthetic claims of the audiological instruments?

The tuning of the ear that the sound works of this research project produce is not only a result of the concrete handling and structuring of the sonic content derived from the audiological instruments. It is also a consequence of the specific spatial conditions that I have placed the audiological instruments in. In Gernot Böhme's conception of *atmosphere,* I have found an entry point for exploring how the spatial conditions of the sound works support an aesthetic conception of these audiological instruments, and, furthermore, of how spatial conditions have implications for the conditions of *hearing* and conceptions of *hearing.*

The spatial conditions of these sound works are imposed by the venues in which I have presented them, which include concert venues, art spaces and art festivals. These venues accommodate aesthetic experiences in that they are designed to present art-works, performances or music. These settings necessarily afford specific expectations and preferences in relation to the heard. The specific physical properties of these spaces create what Gernot Böhme in his considerations of aesthetics has termed *atmosphere* or *tuned spaces*.[588] Böhme operates with a so-called broad concept of aesthetics, where aesthetics is conceived as a particular prism through which one can perceive objects and situations. As such, aesthetics is not confined to artworks but also appears in chairs, magazines, houses etc. [589] In Böhme's view, the notion of *tuned spaces* present a specific aesthetic-perceptual experience. *A tuned space* is something we find ourselves in when we are "tuned by an atmosphere".[590] Atmosphere does not necessarily refer to a specific architectural room, but rather to a state or a condition which can occur in the relationship between an object and a subject. Böhme explains:

> "Another important aspect of the theory of atmospheres is the fact that atmospheres can be produced. They are, then, not just something one feels but something that can be generated deliberately by specific, indeed material constellations. The paradigm here is the art of scenography, where stage designers habitually produce a climate by arranging things, spatial constellations, light and sound in specific ways. As a result, a space of a particular basic mood arises on stage, within which the drama can then unfold."

Atmosphere does not manifest itself as a projection from a subject. Rather, the subject can step into an atmosphere. Thereby the subject contributes to the production of atmosphere without being its author. The physical presence of a subject creates an attraction and a centre of gravity. Böhme notes, that "The bodily presence's room is always a tuned room", that is, the space is penetrated by a specific *tunedness* which appears in the

588 Böhme (2017), p. 1
589 See Stouggard (2012), p. 269
590 Böhme (2017), p. 118

relationship between subject and object.

Böhme's concept of *tuned spaces* invites a further consideration of how the spatial conditions of the three sound works of this research project can be characterised and how they appear as *tunings*. In the sound work The Acoustic Appraiser, I have placed an audiometer in the context of a musical concert. The concert format obviously differs markedly from the original context in which the audiometer was used which could be characterised as an intimate situation unfolding between an operator and a hearing test subject. Nevertheless, I have attempted to reflect the intimacy of the original atmosphere by allowing the setup to deviate from a traditional musical setting where the performers are situated on a stage. When performing with the audiometer at various music festivals the performance has taken place on the floor with the audience surrounding me and the audiometer. By means of this strategic placement, I have aimed to invite the audience into an intimate listening situation despite the context of the concert situation which gathers many people in the same room. However, I have constructed a very different intimacy than the one that was connected to the original setting in which the audiometer was used. In the original context, the hearing test subject was placed at a distance from the machine (sometimes even in a separate room) in order to avoid influencing the subject's answers by what he or she saw. To the contrary, I have allowed the audience to come close to the instrument, thereby giving them a chance to observe how the sound they hear, the technology they see and the gesture I perform are interrelated.

The concert venue encourages reception of the sounds emanating from the audiometer as musical in the sense that sound produced in this setting normally appears through artistic expression. However, by placing the audiometer (and myself) on the floor surrounded by the audience, the spatial frame of the audiological instruments also disturbs the conventional cultural codes connected to music. This staging of the audiometer creates an aesthetics that forces the listener to tune between a musical conception of the sounds and an audiological conception. Where my aesthetic exploration of the audiometer has occurred in a musical context, I have staged the hearing cure artefacts through what I will call a performance/installation. I have performed with the hearing cure artefacts at both music venues and art galleries. I have placed the artefacts in a circle on the floor with myself and my colleague in the middle. By placing the artefacts in a circle, I have made exhibited these devices both as historical artefacts relating to hearing cures and as aesthetic visual objects or sculptures. As the performance begins, these visual objects are turned into musical instruments, as the artefacts are operated in order to form a sonic narrative. Displaying these hearing cure artefacts in a circle has fostered ritualistic connotations to the sound, and the design of the setup has activated questions regarding the imaginary state of these sound therapy instruments. This ritualistic setup has supported the production of imaginaries concerning these devices' capacities for acting as more than music instruments but, at the same time, this artistic setting has fostered distrust of the instruments general claim of being able to cure the ear or even the whole body and mind.

The reconstructed hearing horns have appeared in a context that differs from the other two performative settings. Here I staged the instruments as part of a performance that encouraged the audience to use the instruments themselves. By allowing the audience to take the hearing horns with them while walking in a landscape, the setting

of the performance was not limited by the frames of a concert hall or an exhibition space. Instead, the landscape and the weather conditions, as well as the audience's individual approach to the instruments, determined the conditions of this performance. The frame in which this performance was presented was intended to encourage a focus on sounds in the landscape that would otherwise go unnoticed, thereby requesting a new consciousness of the heard. However, at times the frame has suggested a revaluation of the perceptual means of the horns, as some users have applied the horns to their eyes instead of their ears, transforming them into telescopes.

Even though Böhme's conception of atmosphere has been criticised for its poetic nature and lack of concrete substance,[591] I will argue that his conceptions of *atmosphere* and *tuned spaces* open up a further articulation of the aesthetic dimension of the audiological instruments and, furthermore, a consideration of how this dimension tunes the ear. The aesthetic dimension of the audiological instruments is undeniably determined by the spatial frames, in the sense that the frames constitute a specific subject-object relation which affords a particular perception. The aesthetic conception is thus not just something that one feels, but something that is generated in a relationship afforded by an atmosphere. The spatial frames which the sound works operate within emphasise the fact that the audiological instruments not only tune the ear through their material form. These spatial frames cultivate the conditions for *hearing*. They create an attitude towards the heard, where expectations of the heard are produced even before any sound is emitted.[592] Accordingly, these spatial frames support an aesthetic conception of the audiological instruments of this research project which once again invites *listening* to the conditions of *hearing*.

The Operator

How is the conception of hearing determined by the perspective of the human body?

Operation of audiological instruments has traditionally been handled by trained personnel in a closed arena such as a lab, medical room or therapy session. As I have already accounted for, I have approached the audiological instruments of this research project through a musical tuning which has challenged their status as "scientific, analytical apparatuses". In order to explore the epistemic articulation that the musical tuning of the audiological instruments offers, I will proceed to describe how I have not only experimented with the instruments and their sonic output but, also, with the role of their operator. I will develop this perspective by digging further into the arguments that Heidegger's phenomenological concept of *stimmung* revolves around, which emphasises that our experience of the world, our being in the world, takes place through human bodily and practical relationships.[593]

In a traditional audiological setting, whether a hearing test situation, a hearing aid consultation or a sound therapy session, the operator holds an authoritative status in so far as scientific conclusions are based upon the operator's ability to manage the

591 Amongst other by Anders Troelsen (2012), p. 245

592 This conception of aesthetic relates to Iser's conception of aesthetics as reflecting a perspective one can choose to pertain in order to conceive artefacts aesthetically or not. See Kyndrup (2008), p. 9

593 Heidegger (1996), p. 69

audiological devices and interpret the reactions expressed by the listener, patients or test subject. In the setting of these sound works, the operator takes on new prerogatives, as the technology is operated according to a different set of prescriptions and procedures relating to artistic practice. In a performative context, these devices are no longer handled by skilled audiological personnel, nor are they operated in order to reveal pathological disorders or to affect the ear in new directions. Instead, they are operated in order to expose the audiological instruments through new sonic narratives.

As such the role of the operator, as I have practiced it, introduces another conception of *tuning* as a methodological stance, which can be explored further by turning to Heidegger's *tool analysis*. Like Ernst, Heidegger regards practical experience as part of epistemic knowledge production, however, contrary to Ernst, he argues that the *being* of objects can only be perceived through human understanding.[594] This understanding is developed in *Being and Time* (1927), where Heidegger argues that our primary relation to the world is not initially or primarily conceptual but practical, emphasising that our experience of the world takes place through a bodily and practical relationship with it.[595] This practical relationship is formed by the use of tools. In Heidegger's terminological use of the word tool, it is aligned with other words such as equipment, instrument or things subject to the all-encompassing notion of "something in-order-to",[596] meaning an object that has an assignment, a task. In this definition, a tool is not necessarily analogous to a tool used, for example, in carpentry such as a hammer or a nail but rather. As Graham Harman has emphasised, Heidegger's notion of tool encompasses a broader notion of anything which belongs within a referential context.[597] The tool thus contains the possibility of revealing the meaning of being.

It is through its assignment, through its use, that the tool "undisguisedly" becomes "encountered as what it is".[598] As an example of a tool with an assignment, Heidegger takes the hammer. The hammer reveals its specific "handiness"[599] through the act of hammering. Thus, the hammer is understood through its relational context, its specific use. The hammer's actual use displays a peculiar kind of practical knowledge; one must know how to use the hammer, and once having learned, the hammer in use withdraws as an object and becomes "the means of the experience itself".[600] With this example Heidegger demonstrates that our primary interaction with objects comes through "using" them, through simply counting on them in an unthematic way.[601] Only when the hammer suddenly does not live up to its intended use, when it is malfunctioning or broken, does it reveals itself as an object of knowledge that exceeds our practical understanding. Thus it is in the shift between the various states of functioning and malfunctioning that a tool reveals its being-in-the-world.

If we are to follow Heidegger's tool-example the essential nature of technology

594 Højlund & Riis (2015), 250
595 Heidegger (1996), p. 69
596 Heidegger (1996), p. 64
597 Harman (2002), p. 42
598 Heidegger (1996), p. 65
599 Heidegger (1996), p. 65
600 Ihde (1993), p. 40
601 Harman (2002), p. 18

is not itself technological.[602] Rather the essence of technology is "En-framing",[603] which supports an understanding of technology's driving force as located in the way it orders our understanding of the world. From this perspective, technology becomes a way of revealing or "bringing forth".[604]

The audiological instruments that I have engaged with in this research project can be described as *tools* in a Heideggerian sense, in that they belong within a specific context and their operational design is assigned to perform specific tasks (testing the ear, enhancing hearing etc.). The structure of the sonic narratives that I have constructed explore the many *tool-beings* of this audiological technology in order to reveal new perspectives on this technology. One of these *tool-beings* arises from the malfunctioning state of the audiological instruments which allows the possibility of grasping at a further essence of these devices. The erratic functioning and faults of these audiological instruments actually become a force within the new aesthetic setting, as it is these characteristics that turns these devices into more than scientific measurement apparatuses. They turn them into musical instruments. Experimenting with these audiological tools demonstrates how the operator's approach to the equipment determines the essence of the technology. Accordingly, following the thoughts of Heidegger, the essence of this technology is not to be found in the technology itself, as suggested by Ernst. Rather, the essence of the technology lies in the way it orders our experience the world which becomes apparent in the constant shifts between various tasks and various states of functioning and malfunctioning.

Consequently, the role of operator, as I have defined it, has come to deconstruct the scientific status of the instruments as objective measuring devices for reaching *hearing*. We now hear the insufficiency of the equipment and, moreover, we hear the sounds of the technology unfolded within an aesthetic and performative form of expression. However, as the operator uses the insufficiency of the technology to form an aesthetic expression, this insufficiency is suddenly transformed into something sufficient. The role of the operator that I have explored reintroduces the human subject. The operator becomes a *human decoder*[605] of the sonic signals. However, as opposed to the analysis of a musical score or the conducting of a hearing test, the operator does not at any point reach any uniform *facts* regarding the technology. The operator does not hold any uniform truths.

Within my sound works the operator handles the audiological instruments in order to reveal them through an aesthetic exposition which evolves a sonic narrative. My experimentation with the role of the operator has reintroduced the operator as an aesthetic position that leads to a specific framing of the technology, a tuning. However, the aesthetic position that the operator holds does not lead to any firm conceptions of *hearing*, but instead introduces the aesthetic dimension as a basis for the exploration of *hearing*.

602 Heidegger (1977), p. 4
603 Heidegger (1977), p. 19
604 Heidegger (1977), p. 12
605 Ernst introduces the term *human decoder* when describing the process of interpreting musical scores. See Ernst (2016), p. 133

Tuning as Affecting Causality

Does a human being constitute an authoritative basis for reaching conceptions of hearing?

In the object-oriented ontology of Graham Harman, I have found a point of departure from which to explore the relationship between the operator and the audiological instrument even further. This philosophical approach encourages a conception of the operator and the instrument as *artists* on equal levels.[606] The object-oriented ontology allows for a deconstruction of the authoritative position of the operator, and also of the romanticized artist. However, as I will argue in the following section, it is also based upon highly speculative claims which invite discussion of how the human-object relations are tuned within my sound works.

There are many different interpretations of the practice and goal of object-oriented ontology. Graham Harman has coined the term object-oriented ontology to cover the philosophical practice of studying the causal relations residing between objects. According to Harman, the subject matter of OOO is "the shifting communication and collision between distinct entities".[607] In an object-oriented view, objects exist independently of human perception. However, in OOO all objects have a phenomenological experience of other objects.[608] This claim sets out an alternative programme for philosophical enquiry, since "being", no longer is considered through a human perspective (recalling the phenomenological claim of the transcendental subject) but from the causal relations between objects. As such, this assumption is aligned to the media archaeological approach of Ernst, where technology is to be approached beyond human interpretation. However, where media archaeology proceeds through an investigation of the object in itself, OOO takes form as an investigation into causality, that is to say an investigation of the relationship between objects.[609] In this investigation the human perspective is not neglected, rather its status is re-evaluated.

In OOO everything is an object. Organs, butterflies and humans are objects. Even the universe is one big object that contains other objects.[610] This doesn't mean that it is possible to detect one object that overrules all other objects. Similarly, it is impossible to detect the smallest part of everything. In an object-oriented view, an object cannot be reduced to its parts ("undermining"[611]) or to a whole ("overmining"[612]). Rather, OOO is focused on detecting objects in all their forms and scales. OOO seeks a conception of the world where all objects rule on equal terms, which Ian Bogost has named a "flat ontology".[613] In a flat ontology the privileged status of human recognition is adjusted

606 The artist researchers Højlund & Riis propose an analytical mode where objects are perceived as artists on same level as humans. As an example they take a vinyl record, where "the specks of dust that gather on the record are as much an artist as the composer of the music that is inscribed as modulated spiral grooves in the rotating polyvinyl chloride." Højlund & Riis (2015), p. 160. I will argue that this mode is also highly speculative, in that it dismisses the intentionality of the perceiver, and thereby the authority for perceiving the dust on the grooves as artists.
607 Harman (2005), p. 2
608 Morton (2013a), p. 35
609 Morton (2013a), p. 30
610 Ibid., p. 42
611 Ibid., p. 44
612 Ibid., p. 44
613 Bogost (2012), p. 189

in line with other objects,[614] and the human/world relation is just a special case of a relation between any two objects whatsoever.[615] According to Harman, an object can never be fully explored in a way that will reveal its full essence because objects are always "withdrawn".[616] Morton understands withdrawal as an unbreakable code, irreducible to perception or meaning, which makes it impossible for any knowledge to replace the object in question.[617] He notes that the withdrawal of any object limits what can be thought about it.[618]

An initial OOO-perspective suggests that audiological instruments do not emit privileged epistemic articulations and that the operator does not control the audiological instruments. If we are to adopt this claim for a moment we become aware of the fact that the impact of the operator within my sound works is actually limited. At no point is the operator in full control. The actions that the operator performs are affected by the instability of the audiological devices, such as the unsteady rhythms of the sound therapy instruments or the noisy sounds of the mechanics of the audiometer. The operator can affect the audio devices in different ways, however the devices will react unpredictably to the operator's input. These circumstances dismiss any conventional power structure implicit in either musical performance or the scientific practice, as both objects are now *tuning* into each other.

OOO indeed proposes a revaluation of the roles of operator and technology as they appear in my sound works. I will argue that within these sound works the operator and the technology neither possess or retain elevated status as both are objects that govern the outcome on equal terms. However, in practice, I have found that this flat ontology is hard to maintain. The OOO-perspective emphasises how the operator's means are limited within the sound works that I have presented but I still maintain that the operator holds a particular status which is distinct from the status of that which is operated. The operator is able to turn the unpredictability of the audiological instruments into a force, as the sonic narratives evolve in order to expose the epistemic claims which originally have been attached to the instruments. Furthermore, I will argue that the operator is capable of transforming the unpredictability of the audiological instruments into predictability. In the process of creating the sound works, I have consciously worked on repeating a specific malfunctioning operation or shortcoming of the audiological instruments in order to use it as a sonic characteristic, or aesthetic effect, which is part of the narrative. Accordingly, I will claim that the operator's actions depart from an authoritative position, as the operator is able to adjust and control the content of the audiological instrument, even when the content appears unstable. The audiological instruments cannot, however, adjust to or avoid the use they are exposed to or even the contextual frame they are put in.

Harman outlines another possibility for reaching an extended understanding of an object. Although it is impossible to reach a homogenous insight into the essence of an object, as the object will always be riven between its withdrawn essence and its ap-

614 Bogost (2012), p. 189
615 Ibid., p. 6
616 Harman (2002), p. 5
617 Morton (2013a), p. 17
618 Ibid., p. 28

pearance to other objects, he designates specific situations which enable us to approach an extended understanding of an object:

> "When objects fail us, we experience a negation of their accessible contours and become aware that the object exceeds all that we grasp of it."[619]

This allegation reminds us of Heidegger's *tool analysis*. But Harman emphasises that the experience of failure cannot lead to an exploration of the essence of an object. Rather it makes us aware that not even our practical relation to objects allows us to grasp them fully.[620] This perspective can be transferred to a further discussion of the operator's authoritative role within my sound works. The operator within my sound works has handled the malfunctioning parts of the audiological instruments by structuring them into a sonic narrative. It is the "mistakes" of the audiological instruments that make up the aesthetic dimension that in the end allow us to form a contemplation of the heard that exceeds habitual thinking or cultural ideals. However, the aesthetic dimension only unfolds one perspective on these audiological instruments. Thus, even though OOO indeed articulates a speculative conception of the relationship between operator and technology, I will claim that the perspective of OOO accentuates the fact that audiological instruments can never reveal the essence of *hearing*. However, they do offer the possibility of revealing different perspectives on *hearing*.

Tuning as Negotiation

How do the relational settings surrounding the ear let us hear?

Object-oriented ontology opens a speculative perspective on the relationship between the operator and the audiological instruments, which I wish to discuss further through the object-oriented ontology of Timothy Morton which evolves the theoretical position from a conceptualisation of the term *tuning*. The object-oriented ontology of Timothy Morton invites consideration of the many causal relationships appearing in the context of the sound works presented in this research project and is a departure point for a further discussion of the power structures residing between the audiological instruments and the operator.

Morton uses the term *tuning* to denote an act of "affecting causality".[621] In Morton's object-oriented ontology *tuning* is used to cover the act of creating something new, or as he puts it: "When you tune you are making another object."[622] This principle recalls the basic acoustical notion of tuning, which I introduced in the introductory chapter of this thesis, where the collision between two frequencies creates interference. But for an object-oriented articulation of *tuning*, Morton emphasises that it is essential that no object truly contacts another, they only share some notes.[623] He accentuates the

619 Harman (2007), p.193
620 Ibid., p. 192
621 Morton (2013a), p. 22
622 Ibid.
623 Ibid.

fact that objects will always be able to affect each other through those aspects they might share. They constantly *tune* into each other but they never become a singular entity.[624]

From Morton's perspective, *tuning* represents a way of demonstrating how objects, whether humans, birds or technology, can affect each other in different situations. As such, Morton's object-oriented ontology aligns with Harman's conception of a flat ontology. However, Morton introduces a new emphasis on the metaphysical character of objects, as his concept of *tuning* comes to relate to a way of "attending to the inner structure of the object, allowing yourself to be taken over by it".[625] Morton describes the inner structure of an object as characterised by its "nonhumanness".[626] He regards the inner structure of an object as situated within its own technological means. Morton emphasises that humans now - "at the very moment of their most powerful technical mastery on a planetary scale" - are gradually realising that "they are not the conductors of meaning."[627] Technology reveals a new relation between humans and objects. Instead of controlling appearance, *tuning objects*, humans are now tuning *into* objects and tuning *into* technology as such. Morton emphasises that this new relationship between humans and objects is apparent in music,[628] where composers are "hearing the equipment itself" and hearing music that is "a tuning to the equipment".[629] As examples he takes the music of composers and performers such as La Monte Young and John Cage who have introduced new ways of creating music through technological means which has created a new sonic output.

Morton's conception of *tuning* reveals a pivotal aspect of the relationship between the audiological instruments and the operator as it appears within my sound works. The sonic narratives I have constructed are indeed structured around a specific technological setup. It might be said that in the role of the operator I am framing the instruments' appearance and possible progressions, as I have placed the instruments within an artistic setting and, furthermore, I have decided which sounds to play and in what order and form they should proceed (volume, variation and duration). By approaching the audiological instruments with an open-minded attitude, I am able to share some aspects with them for a short while, namely the construction of sound. But I will never, as Morton underlines, *become* the audiological instrument. My control is limited. The relationship that I have established is not a one-way relationship. Rather, it can be characterised as a negotiation in which I tune *into* the audiological instruments by touching their buttons or adjusting their controls. Simultaneously, the audiological instruments *tune* my ears in that they send out sound waves which lead to a physiological reaction inside my ear, where tiny hair cells are raised sending signals to my brain to analyse them as either signal, noise, music, malfunction or something else. This analysis makes me take new decisions and choices of how to tune into the audiological instruments.

Morton's conception of *tuning* emphasises that I can by no means *tune* the sound of the audiological instruments to any known tuning system or any other con-

624 Ibid.
625 Morton (2013a), p. 23
626 Morton (2013b), p. 167
627 Morton (2013b), p. 164
628 Morton refers to the music of the avant-garde, where composers and performers such as La Monte Young and John Cage have introduced new ways of creating music where technological means become pivotal for the sonic output.
629 Morton (2013b), p. 167

stant state. The sound cannot be moulded into any constant pitches or reliable durations as the instrument contains faults, noises and unpredictable sounds. By the mere condition of being human I cannot, as Morton underscores, rely on accepted power structures such as equal temperament which imitates the relationship "residing between a master and a slave",[630] to create "a system that turns them into fudge".[631]

However, the tuning process between the audiological instruments and myself may be more complex than the object-oriented ontology of Morton would suggest. I have at no point attempted to tune the audiological instruments to any known tuning system or harmonic progression. Neither have I approached the audiological instruments solely in order to gain access to new aesthetic sound material (which was one of the main arguments behind the musical avant-garde movement). Rather, I have taken control over the audiological instruments by attending to their aesthetic dimension in order to activate a consciousness about the many conditions and relations that form *hearing*.

OOO has been widely criticised for its speculative claim that objects can have a phenomenological experience of the world, or that the inner structure of an object can be approached through *tuning*. Andrew Cole has described the anthropomorphic vocabulary of OOO, where the use of phrases such as 'objects speak, listen, feel' leads to "an unfruitful speculative anthropomorphism of things that have no further foundation."[632] Højlund and Riis have also noted that OOO entails a potential pitfall as the perspective of the objects will always be delivered by a human. However, they argue that in an object-oriented ontology "it becomes the philosophers job to write the speculative fiction of non-human objects", as it "presents us with an expanded perspective of what agencies are at stake within the objects."[633] They further emphasise that, when trying to take on the perspective of objects, we may broaden our insight into the sounding objects that constitute our present auditory reality but only if we recognise "that they are not consistent entities exhaustible within a single ontological conceptualisation."[634]

Despite these attempts to defend the speculative basis of OOO, I will argue that the relationship between audiological instruments and their operator cannot be conceived as being based upon a flat ontology. The operator will always occupy the most powerful position in relation to the audiological device because ultimately it is the operator who controls the power button. Accordingly, it is the operator, the human being, who controls when the instruments can sound out, if at all. Thus, in my sound works the human perspective on these audiological instruments is not eliminated. This perspective does not, however, lead to a definitive exposition of the instruments' inner states. Instead, I will argue that it is the human perspective which leads to an aesthetic exposition which in turn offers an entry point for exploring the conditions and conceptions that form *hearing*.

630 Morton (2013b), p. 164
631 Ibid., p. 163
632 Cole (2013(80)), pp. 106-118
633 Højlund & Riis (2015), p. 260
634 Højlund & Riis (2015), p. 171-72

Tuning as Aesthetic Investigation

How does the aesthetic dimension of audiological instruments allow me to listen to hearing?

As outlined in the preceding section, object-orientated ontology provides a viable basis for a critical discussion of the tuned relationship residing between the ear, the operator and the technology as it occurs within my sound works. In the OOO of Morton, I have also found an entry point for a discussion of how the aesthetic dimension of these audiological instruments might be defined.

Earlier in this chapter, I touched upon a definition of the aesthetic dimension put forward by Løgstrup. In his view the aesthetic dimension, as articulated by the artwork, takes form as an accentuation, or tuning, of a sense impression. This designation of the aesthetic dimension incorporates a specific conception of the artist as a human being who is particularly open to impressions and able to transform them into a distilled expression.[635] However, in my emphasis on the operator's role within the sound works presented as part of this research project, I have focused on reaching beyond definitions of *the artist* as possessing any unique access to sense impressions. By characterising my own methodological approach of *tuning* through the role of the operator, I have attempted to reach beyond the privileged cultural status of the artist and instead emphasise how human participation and intention form the perception of any object.

As I have already argued, an aesthetic comprehension of the audiological instruments only represents one way of ascribing meaning to the *heard*. It allows one way of *listening* to how the audiological instruments let us *hear.* The aesthetic perspective is, as Wolfgang Iser has also noted, a modelling operation, where you can choose to conceive artefacts aesthetically or not.[636] Thus, the aesthetic dimension is one perspective amongst many and, as such, does not constitute a privileged position.[637]

Morton offers a basis for exploring the aesthetic dimension of the audiological instruments beyond any romanticising of the artist. According to Morton, the aesthetic dimension is not a specific kind of expression or colour selection. Instead, the act of *tuning* entails the aesthetic dimension as such, as the tuning process reveals a *rift* in the audiological technology. For Morton, objects are ontologically riven between their withdrawn essence and their appearance to other objects.[638] He emphasises that if things are irreducible to their perception or uses "they can only affect each other in a strange region out in front of them", which he defines as "the aesthetic dimension."[639] The rift between an object's appearance and its withdrawn essence becomes central to the development of an expanded form of causality in OOO, where causality *is* the aesthetic dimension.

Morton argues that when you study or make art you are actually exploring causality. However, Morton not only aligns artistic engagement to the act of painting or composing, for example. An exploration of the aesthetic dimension takes place when

635 Løgstrup emphasises that the tuned impression can only be articulated through a form which demands a talent, which is the talent of an artist. Løgstrup (1983), p. 11

636 Iser quoted in Kyndrup (2008), p. 9

637 This argument differs markedly form the phenomenological arguments of Merleau-Ponty, where the aesthetic dimension in particular forms a privileged position for exploring perception. See Merleau-Ponty (1970), p. 16

638 Morton (2013a)., p. 5

639 Morton (2013a), p. 18

studying any causal event, including events occurring between non-human objects.[640] The aesthetic dimension is like a rift in that we cannot specify exactly "where" the rift is located or "when" the rift occurs.[641] As Morton concludes, appearances (relations between objects) are deceptive.[642] As such the aesthetic dimension is ungraspable as causality and remains, basically, "a secretive affair".[643] According to Morton, the OOO perspective stages art as "a workshop of experimentation in and on actually existing causes and effects."[644]

Even though Morton's object-oriented assertions on the aesthetic dimension remains on a metaphysical level, I will argue that it designates a new departure point for exploring the tuned relationship residing in my sound works. The audiological technology oscillates between essence and appearance, as the operator constantly takes on new prerogatives when approaching the technology as alternately musical instruments and audiological instruments. These new sonic narratives forge as well as break links between music and science and stage the *rift* in the object itself as it persistently shifts between many different appearances. From an OOO perspective, these sonic narratives become an exploration of an aesthetic dimension, where relations appear but never directly encounter the autonomous reality of their components.[645]

Taking an OOO perspective on the aesthetic dimension of these sound works leads to a conception of their aesthetic as something which not only emerges from expressivity or from the form of the new sonic narrative, in which, as suggested by Løgstrup, the listener can follow a melodic line or dynamic progression. Form becomes pivotal in another respect for an object-oriented conception of the aesthetic dimension. According to Morton, form is what produces time and space as it becomes "records of causal-aesthetic decisions".[646], Morton uses poetry as an example. According to Morton, the form of a poem produces time as it comes to function as a memory that contains records of what has happened to it.[647] Following this perspective once again designates the aesthetic dimension of the sound works of this research project as departing from their form. However, whereas Løgstrup conceives of form in a musical sense as relating to the actual structuring of sounds into scales or chord progression, OOO proposes a conception of form as a generator of time.[648]

If we are to transfer the conception of form introduced by Morton to the forms in which I have deployed the audiological instruments, the form can be said to be "that which remembers". As an aesthetic exposition of the audiological instruments, the sound works of this research project come to express a form that remembers how the operator touched the buttons on these devices and of how they reacted by producing a specific set of frequencies. It remembers how the operator turned the amplitude control and the apparatus reacted with a dynamic progression, just as it remembers how the

640 Morton (2013a), p. 24
641 Morton (2012), p. 212
642 Morton (2012), p. 212
643 Morton (2007), p. 17
644 Morton (2012), p. 205
645 Harman (2007), p. 189
646 Morton (2012), p. 219
647 Morton (2012), p. 220
648 Morton (2012), p. 214

operator gained and equalised the sonic output in order to emphasise specific sounds.

Morton argues that the form contains the past because it reveals how the object in question is interrelated to or has interacted with other objects,[649] however, he also claims that the real meaning of objects lies in the future, as the form of an object allows for returning interpretation which will deduce new meanings from them.[650] This argument proposes that new meanings of the audiological instruments can be found within the sound works that I have created, as they offer a frame that accommodates new operations of the technology where the sound appears in new relations.

Morton's object-oriented conception of the aesthetic dimension places an emphasis on form and, as such, reflects the Aristotelian maxim: "Form is how things appear."[651] Adopting an object-oriented conception of the aesthetic dimension provides new perspectives as to how the audiological instruments *tune* our ears. It suggests that it is the audiological instruments' production of time and space, which Morton defines as *spacetime*,[652] which can enable exploration of an aesthetic dimension. The forms in which I have structured the audiological instruments has enabled me to explore their temporal and spatial extensions. The sonic narratives produced in conjunction with these audiological instruments have forced me to *listen* repeatedly to a specific type of sounds which has allowed for a reinterpretation of the technology in use but also for a focus on how the epistemic claims on *hearing*, that the technology has produced, is formed by an operator. The reinterpretation has deduced new meanings from the audiological instruments, as the goal is no longer to define *hearing* but rather to become conscious of how conditions of *hearing* are formed.

Tuning as Constructing

How does my methodological approach create a basis for exploring hearing and how does it tune the ear?

Hitherto, OOO has offered a metaphysical exploration of the tuned relations residing between the ear, the technology and the operator. Morton has aligned this exploration to a conception of the aesthetic dimension. However, I have also found an object-oriented conceptualisation of tuning which proposes a means of studying the relations occurring within the sound works through practical engagement. This notion of tuning can open a further perspective on my general methodological approach of using these sound works as a basis for experimenting with tuning the ear.

The object-oriented ontologist Ian Bogost has proposed the term *Carpentry* to refer to a practical approach to studying causality. The term *Carpentry* resonates with the traditional understanding of the word and its association with a craft such as woodwork. But Bogost stresses that, as a philosophical methodology, *Carpentry* refers a broader notion of creating things in praxis. A hands-on approach is central in that it can serve to open up new knowledge derived from the objects themselves:

649 Morton (2012), p. 220
650 Morton (2012), p. 220
651 Paraphrase of Aristotle, Morton (2012), p. 207
652 Morton derives the definition of spacetime from post-Einsteinian physics, in which space-time is the product of objects, Morton (2011), pp. 149–55.

> "I give the name Carpentry to this practice of constructing artefacts as a philosophical practice (...) making the object itself become the philosophy."[653]

According to Bogost, *Carpentry* encompasses an understanding of making things that explains how things make their world.654 *Carpentry* encourages a practical relation with objects, as this activity can form a direct examination of causality. Although acknowledging that it will never arrive at a definitive understanding of any object, *Carpentry* nevertheless sets out to exhaust the object through an examination of the object's effects on the surrounding world. Thus, what *Carpentry* seeks is to create a practical basis from which speculations or ideas can emerge.655 Like experiments and engineering prototypes, the material produced by *Carpentry* is not accidental but rather "earnest entries into philosophical discourse".656 Bogost underlines the notion that *Carpentry* differs from other practical disciplines such as art, because it is exercised with philosophy in mind. That is to say, that when something is created it is done with the objective of reaching new philosophical insight into a certain phenomenon.657 This does not mean that *Carpentry* cannot deploy aesthetic or productive methods but rather that the generation of theory or questions forms the basic objective of the practical engagement.658 *Carpentry* can reveal a new philosophical creativity that can take on many practical forms. Bogost emphasises that any philosopher who conducts *Carpentry* must work with a specific material resistance that is located within an object.659

Carpentry describes a research method in which questions arise directly from an engagement with a material. Carpentry thus represents a practical notion of tuning, as it becomes a concrete, physical exploration of causality. As such, *Carpentry* opens up a more general understanding of tuning as it departs form the sound works of this research project. Tuning now not only describes the actual tuning of the ear that the sound works provoke, but a practical-based research methodology that tune our attention towards new scientific perspectives. The sound works may reveal an aesthetic dimension, as suggested by Morton, however what also becomes pivotal is that the sound works are more than artworks. Entering into a practical exploration of the aesthetic dimension of selected audiological instruments has presented a new basis entering into dialogues with objects and their effects. This dialogue has opened op new conceptions of the audiological instruments and moreover it has created a new attention towards the conditions that form conceptions of *hearing*

Tuning as Artistic Research

Can art make epistemological claims?

By following the methodology of *Carpentry* even further, and by introducing the field of artistic research, I will develop a further conception of tuning as a methodology that

653 Bogost (2012), pp. 92-93
654 Ibid., p. 93
655 Ibid., p. 100
656 Ibid.
657 Ibid.
658 Ibid.
659 Ibid., p. 93

not only suggests new approaches for exploring the conditions of *hearing*, but which also suggests alternative formats for presenting research on *hearing*.

In *Carpentry*, I have found an ideal method for confronting accepted and static approaches to the production of knowledge which conceive of writing as the only accepted method of scholarly production. Bogost has outlined this confrontation:

> "The long-standing assumption that we relate to the world only through language is a particularly fetid, if still bafflingly popular, opinion. But so long as we pay attention only to language, we underwrite our ignorance of everything else."[660]

Bogost stresses that language is only one tool for describing relations and writing is only one form of being.[661] It is not that writing is inherently wrong but that it is just *one* way amongst many of furthering intellectual enquiry.[662] Practical engagement of any kind can reveal new representational forms and Bogost urges further representational investigation through the methodology of *carpentry*, where a non-semiotic or extralinguistic approach can be pursued.[663]

Bogost's conception of *Carpentry* touches upon a central issue in the field of artistic research where the presentation of new representational research formats is widely discussed. Within the contemporary field of artistic research questions concerning form have appeared as a recurring theme which has been used to frame discussion of the epistemic potential of the art work and its scientific foundation. In the anthology *The Exposition of Artistic Research: Publishing Art in Academia* (2014), Michael Schwab and Henk Borgdorff define the tension between the written form of the academic tradition and artistic production as a product of the status of the written word which, in traditional academic practice, constitutes the basis for academic judgement, whereas art is defined as a form of communication that needs no further explanation or analysis.[664] Artistic research within sound and music has demonstrated some of the issues of representation that contemporary artistic research faces in a very clear fashion. Darla Crispin emphasises the problematic nature of doing artistic research within a sonic field:

> "That the majority of 'serious' scholarly research in music has been conducted apart from music's sounding is one of music scholarship's most perplexing ironies. Even innovative, alternative approaches have yet to solve in a consistent manner this core problem for artist-researchers in music."[665]

When sound or music is part of an artistic research it is often represented by a score or sheet music or other graphical imprints of sound. Ernst has argued that this kind of representation animates *structural listening*,[666] which refers to listening practices relating

660 Bogost (2012), p. 90
661 Ibid., p. 90
662 Ibid., p. 111
663 Ibid., p. 90
664 Schwab & Bergdorff (2014), p. 9
665 Crispin (2014), p. 150
666 Wolfgang Ernst's conception of structural listening is derived from a conception of score reading as an intellectual practice that takes place in the mind "without the physical presence of an external sound source." Ernst refers

to musical score reading, where the actual articulation of sound becomes superfluous. The score becomes a "stand-in" for the sounding material and in many cases, especially within musicology, the written notes become the actual work of art.[667] The score or graphical notation activates a specific form of listening that is not dependent upon the physical presence of an external sound source. As such, the very object of research has taken on a new structure as it only appears in a transcribed form.

In this research project I have admittedly performed what Ernst termed *structural listening*, as I have spent much time approaching sound through narrative descriptions independent of the actual physical vibrational presence of a sound source. However, I have also explored the possibilities of presenting my research within a format that corresponds to the content, or at least forms a dialogue between content and form. I have presented the issues raised by these sound works through textual articulation but also through concrete sensorial inputs where an accompanying auditory track consisting of hearing tasks has reminded the ear of its own physical limitations. These tasks have formed a proposition for experimenting with the reading situation. By targeting a physical sensation of the ear, the actual reading situation, the format, has been transformed into an experiment in tuning the ear.

Experimenting with Tuning

This section has taken its point of departure from the many questions which have been raised in the process of approaching selected audiological instruments in order to construct three sound works. I have explored these questions by *listening* to the sound works through the perspective of diverse fields of knowledge, such as musicology, media archaeology, audiology, acoustics, object-oriented ontology, phenomenology and sound studies. These fields have formed a multifaceted perspective for presenting how the aesthetic dimension of these audiological instruments might be approached as a basis for exploring and experimenting with the conditions of *hearing*. Furthermore, they have offered a way of *listening* to my own methodological approach, which has made me consider the epistemic potential of a practically-based and aesthetically oriented research methodology.

In this section, I have described these audiological instruments as tuning instruments, that is, as instruments that are primarily constructed to establish specific conceptions and even ideals of *hearing*. However, I have not used these audiological instruments to present ideal tunings, as proposed by Pythagoras. Rather, I have followed the research practices of Helmholtz and Ernst and I have *listened* to the full sonic content of these audiological instruments by operating them beyond any original intent of use. However, whereas the methodological approaches of both Helmholtz and Ernst claimed to present a non-discursive research approach, my methodological approach has been derived from a narrativisation of these audiological instruments which has served to enhance a

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to a remark made by Theodor Adorno that the "silent, imaginative reading of music could render the actual playing superfluous as speaking is made by reading of written material." Ernst notes that it does matter that sound takes place as "a physical vibrational event that is distinct from mere symbolization, because sound and music have the ability to let us experience transient time." Ernst (2016), p. 24

667 ibid.

sensation of *hearing* as an auditory state, which is always constructed through the act of *listening*.

The account I have provided of my artistic exploration of these audiological instruments has proceeded through descriptions of how I structured the output of these instruments into sonic narratives. Taking inspiration from Løgstrup, I have conceived these narratives as aesthetic imprints that could transform these audiological instruments into perceptual objects for studying the conditions of *hearing*. These sonic narratives have encouraged a *tuning* between the act of *listening* and the act of *hearing* and, thereby, an awareness of the act of sensing sound as well as how and when sense is made out of sound.

My artistic approach to exploring *hearing* through an operation of selected audiological instruments has included an investigation into the spatial conditions of *hearing*. I have claimed that the spatial frames which the sound works of this research project operate within cultivate a specific attitude towards the heard, where expectations are produced even before any sound is emitted. These spatial frames form the conditions of *hearing* and the sound works invite *listening* to these conditions.

My artistic exploration of the selected audiological instruments has also invited consideration of the role of the operator of these audiological instruments – that is, it has invited scrutiny of my own role as both artist and researcher and what consequences this role has for the conditions of *hearing*. The field of object-oriented ontology has contributed a revaluation of the causal relations residing between the ear, the technology and the operator. It has emphasised that the operator cannot secure any firm claims on *hearing*. Neither is the technology in itself a guaranty of a static conception of *hearing*. However, contrary to the flat ontology proposed by OOO, my investigation into the role of the operator has placed an emphasis on the significance of human participation in the act of making epistemic claims concerning *hearing*. Exposing an aesthetic dimension to these audiological instruments has led back to a subject, as an aesthetic conception of any object necessarily depends upon an aesthetically oriented perceiver. However, these sound works have not served to expose the intentions of an exalted or privileged perceptual position. Rather, they have aimed at exposing how subjectivity governs any epistemological exploration of the ear.

Exploring the aesthetic dimension of these audiological instruments has articulated the weaknesses of the instruments' epistemological claims on *hearing*, however it has also emphasised that my methodological approach for exploring *hearing* can never be more or less neutral, scientific or comprehensive than any other research method. Rather, in appealing to many different methodological approaches without ever fully adopting any of them, I have necessarily accentuated the fact that a uniform and definitive notion of *hearing* can never be attained.

Does the aesthetic dimension then create a relativism or – ultimately a scepticism – wherein we are forced to acknowledge that the ear can never be constituted as an epistemological outset? I will argue that this is not the case. The aesthetic dimension of these audiological instruments forms a new epistemological outset, as it facilitates exploring and experimenting with the wider perceptual frames of the audiological instruments. Exploring the aesthetic dimension of these audiological instruments has emphasised that any epistemological claims concerning *hearing* will depend upon the relation it

is part of. The aesthetic dimension offers a fresh perspective on these audiological instruments that invites contemplation of the heard and, more importantly, contemplation of how the heard is perceived.

Historically, aesthetic contemplation has been related to a specific kind of purposelessness.[668] I have conceived the sound works presented in this research project as independent aesthetic articulations which offer specific sensorial reflections on the problematics concerning conceptualisations of *hearing*. However, I have also conceived them as methodological objects which offer new ways for conducting research on *hearing*, where the act of perceiving sound is not only approached through textual representation but through the actual experience of *hearing* and *listening*.

668 Stougaard (2012), p. 270, Kyndrup (2010)

TUNING OUT

Find box #1
Place ear plugs in ears

Read the following chapter

CONCLUDING REMARKS & PERSPECTIVES

I opened this thesis by describing my own motivation for conducting research into obsolete, reconstructed and imaginary audiological instruments. For me as a composer, sound artist and researcher, these instruments contained an aesthetic which promised direct access to the ear through purely physiological and tactile parameters. Throughout my research process, my initial presumptions regarding these audiological instruments' sonic capabilities have been challenged. Primarily because my research has proceeded through an artistic attempt to use these audiological instruments to construct three sound works. These sound works have enhanced the general performative character of these audiological instruments and they have ultimately counteracted any ideal of reaching a static conception of *hearing* through purely physiological or objective means. However, the sound works have also revealed new layers to these audiological instruments in a tangible manner which has raised key epistemological issues regarding fundamental aspects of *hearing*, but also with regard to methodologies pertaining to research on *hearing*.

In this thesis, I have presented a further investigation into issues regarding the conditions and conceptualisations of *hearing* which have been raised through my artistic exploration of selected audiological instruments. I have traced notions of *hearing* through an exposition of the wider historical and discursive frame of the audiological instruments. I have also offered an extended narrative of *hearing*, as I have related particular aspects of the audiological instruments to many different fields of knowledges, which has enabled me explore notions of *hearing* beyond the epistemological claims that these audiological instruments have conventionally presented. I have not used these diverse approaches to form firm definitions of what *hearing* is. Rather I have used them to expose how conditions and conceptions of *hearing* and of hearing research are produced through the use of audiological instruments.

The main research questions which I have explored have been:

How does technology tune our ears, that is, how does it let us hear and how does it frame our conception of hearing?

And how can the simple act of operating and listening to specific audiological instruments become an epistemic activity?

In the following, I will make an account of how I have approached these questions and I will reiterate my findings. Moreover, I will point out how these questions have raised further research perspectives.

Using Tuning as a Unifying Term

To a large extent, this research project has been informed by a specific notion of tuning.

I have conceived of tuning as a concrete activity that relates to how *hearing* is physically and psychologically affected by technology. I have used acoustical and musical conceptions of tuning to place an emphasis on technology's impact on our senses and I have thereby accentuated the mediating effect that technology, and in particular hearing technologies, have on *hearing*. Tuning has also been used to refer to the production of imaginaries of *hearing* that the audiological instruments generate. I have exposed this notion by revealing the auditory ideals that the audiological instruments have produced, and my presentation of these ideals has underlined the fact that technology indeed produces persistent auditory ideals that are transferred into contemporary auditory preferences.

I have also used tuning as a metaphor for the research methodology that I have conducted where I have approached the audiological instruments through many diverse theoretical and methodological positions, and where I have used the audiological instruments as prisms with which to test and reflect upon different statements regarding both notions of *hearing* and of hearing research. My method of tuning into the audiological instruments has enabled me to approach the research questions of this research project from multiple angles and, furthermore, has allowed me to present a research into *hearing* that exceeds the standardised presentations that both the field of audiology and sound studies operate upon.

I will state that it is in the general methodological concept of tuning into selected audiological instruments through a kaleidoscopic diversity of perspectives that the originality of this research project lies. Using the audiological instruments as prisms to test and discuss notions of *hearing* has contributed a variegated perspective on the epistemic potential of the audiological instruments. These approaches have not exhausted the knowledge that lies inherent in these audiological instruments and they have not led to any conclusive statement regarding what *hearing* is. Yet, they have opened this project up for discussions and reflections – both regarding the epistemic value of using audiological instruments to conduct research on *hearing* and regarding the validity that different theoretical and methodological positions hold when related to practical experimentation. Whilst this multidisciplinary research approach may run the risk of only touching fleetingly on substantial subject matters, I will state that, within this research project, it has constructed a dialogue across scientific fields, and, in particular, has enabled me to trace new approaches for conducting research within the field of sound studies.

New Attention towards Terminological Constructions

The general hypothesis of this research project has stated that technology not only imposes physical constrains on the ear but also cultural ideals, aesthetic principles and social demands. By presenting three perspectives on the ear, I have traced this hypothesis and I have pointed towards specific instances in which technology tunes the ear, that is, in which technology forms both the conditions and conceptions of *hearing*.

The first perspective which I applied to the ear was formed by a terminological differentiation between the two words most commonly used to cover the act of sensing and perceiving sound, namely *listening* and *hearing*. I have conceived of these terms as referring to concrete tunings of the ear. I have described the tunings that these two terms represent as a culturalisation and education of the ear. I have traced a notion of *listening*

primarily through phenomenological analyses offered by scholars such as Pierre Schaeffer, Barry Truax and Salome Voegelin. Here I have found an accentuation of *listening* as a particular auditory attention which has been cultivated in order to offer guidance for attending to sounds, and especially sounds produced by technology. I have claimed that these scholars have used *listening* to present an ideal of enhancing the ear's subjective analytical means in order to constitute sound perception as a genuine approach to knowledge production. Contrary to this ideal, I have outlined *hearing* as a tuning of the ear that aims at reaching a so-called natural state of auditory sensation through quantifiable and physical means. I have found this ideal represented within the audiological field, where technology has been used to reach *hearing* as an objective assessment of sound.

Through my exposition of the terminological differentiations of *listening* and *hearing*, I can conclude that any attempt to verbally define the sensation of sound runs the risk of losing nuances in describing the sensibilities involved in its reception. I will claim, that definitions such as *hearing* and *listening* foremost present idealised conceptions of sound perception, as they operate upon a pure conception of sound which is reached either through discursive or non-discursive means, that is, by including or intervening subjective judgements. Nevertheless, in this thesis I have maintained a constant emphasis on the terminological differentiation of *hearing* and *listening*. I will argue that this insistence does not support idealized conceptions of sound perception. Rather, it has fostered a new attention and understanding towards how these ideals are constructed.

This new attention towards the idealised categories of *hearing* and *listening* has been raised, amongst other reasons, as I initiated a further investigation into *hearing*. I have taken the first steps towards an exposition of *hearing* beyond cultural ideals by introducing Helmholtz's instrumental research approach, which centres around an investigation into the physiological sensation of sound. In Helmholtz's writings I have found that *hearing* is regarded as a deviating auditory state. Helmholtz encourages the implementation of specific instruments in the listening practice in order draw attention to the various states that *hearing* may occupy. I have found another preliminary entry point for reaching an extended notion of *hearing* in phenomenological framing, which I have used to represent *hearing* as a pre-reflexive bodily encounter with sound. I will conclude that, by investigating *hearing* through these two approaches, I have managed to present a preliminary basis for approaching *hearing* beyond the static and passive state it has occupied within both audiology and sound studies.

Presenting Complexities of *Hearing*

The second perspective from which I have studied the ear was derived from a further investigation into the relationship between the ear and technology. With this perspective I have presented how the ear is tuned through both the physical constrains and the social demands that technology imposes on it. Furthermore, I have accentuated for how the ear is tuned through the imaginaries of *hearing* that technology historically has fostered. By initiating a discursive media archaeological investigation of selected audiological instruments, I have presented three technology-dependent ears: *The otologically normal ear, the imaginary ear,* and *the mediated ear.* I have used these ears to show concrete examples of how technology tunes the ear in order to normalise, standardise or optimise *hearing*. *The*

otologically normal ear reflected a tuning of the ear that departed from a hearing test situation, where a specific sonic content, specific spatial demands, specific operational skills and responsive techniques cultivated an auditory attention of *listening* to the efficiency of one's own *hearing*. *The imaginary ear* presented a tuning of the ear in which specific sounds and vibrational forces were used to normalise or even enhance *hearing*, amongst other within sound therapy sessions or retraining therapy. *The mediated ear* presented a tuning of the ear that derived from mediating technologies such as hearing horns, hearing aids and even cochlear implants, which imposed concrete physical modifications on the physiological ear as well as new auditory perceptual modes and ideals.

I have used these three technology-dependent ears to illuminate the many performative traits that these audiological instruments impose on *hearing*. However, I have also used them to present a historical narrative of *hearing*. I have outlined a historical discourse relating to audiological instruments that relies on an attempt to overcome subjectivity through the implementation of technology. I will conclude that the three technology-dependent ears have offered an entry point for articulating a criticism of technology as they comment on the validity of this technology as epistemological tools for reaching firm and even objective definitions of *hearing*. However, as I also underlined in the introduction of this thesis, the aim of this research project has at no point been to criticise or ridicule the scientific practices of the past. I have deliberately placed an emphasis on the specific auditory attention produced by audiological instruments and I would argue that it is through the characterization of the auditory attention of these three technology-dependent ears produce that I have managed to present an alternative basis for conceiving *hearing* that goes beyond the epistemic claims that the audiological instruments have traditionally presented.

By juxtaposing a media archaeological excavation of these audiological instruments with phenomenological analyses, I have shown how these three technology-dependent ears offer a new awareness of what *hearing* is and how *hearing* can be approached. Through phenomenological analysis, I have argued that *the otologically normal ear* tunes the ear into considering the very moment at which *hearing* appears as a bodily registration of sound. I have presented *the imaginary ear* as an auditory attention that tunes the ear into conceiving *hearing* as a multisensorial appreciation of sound. And I have exposed *the mediated ear* as an auditory attention that tunes the ear into an act of double-sensing in which we are both *hearing* and also listening to the conditions that the technology sets for *hearing*. Even though the phenomenological approach has stressed the impossibility of reaching *hearing* in itself because it will always lead back to a thematisation of the ego, I conclude that this specific approach has illuminated the ability of technology to make the listening subject aware of their own role in defining notions of *hearing*

I will conclude that the three technology-dependent ears referred to in this thesis have shown that *hearing* can by no means be considered a passive or static auditory state. Together with various categories of the ear (such as the hyperacute ear, the natural ear and the optimised ear etc.), I have used these three technology-dependent ears to form an argument that *hearing* takes on many forms depending on the conditions and the frames that are set and on the listening subject's intentionality towards the heard. I will state that these many categories of ear proposed a basis for approaching and exposing the complexity of *hearing* and, as such, my research has presented a method for

approaching and systemising the complexity of the ear.

With the three technology-dependent ears I have initiated a merger between science and art, and in particular a merger between the field of audiology and sound art. My analyses of particular audiological situations as sharing performative structures with both musical, theatrical and performative practices, suggests the potential an extended investigation of other scientific apparatuses and their aesthetic potential. However, moreover I see an opportunity for extending my performative analyses of the audiological situations. This extension could depart from an incorporation of performance or theatre theory or it could go through Latour's conception of the research lab, which might allow further investigation of the many "routines", as Latour designates them, which are employed in order to reach scientific results. Accordingly, such an extension might lead to the more general aim of investigating how scientific facts are constructed.

Methodological Contributions

The final perspective on the ear which I have presented within this thesis, differs markedly from the former two in that it has unfolded a further consideration of the methodological experiment that this research project departs from, namely my artistic exploration of selected audiological instruments. By including my own personal experience of operating the audiological instruments within an artistic setting and constructing three sound works, I have introduced an alternative entry point for exploring the performative traits connected to the research conducted with these audiological instruments. This perspective has enabled me to regard the sound works as not only artistic expressions, but also as concrete ways of experimenting with tuning the ear. The sound works have presented an aesthetic dimension of the audiological instruments which has tuned the ear into a specific contemplation towards the heard and not least into a contemplation towards how the conditions of *hearing* are defined in the tuned relationships residing between the ear, the technology and the operator.

I have described my artistic-based research approach by aligning it with other practical-based research methodologies. In many of these methodologies I have found an articulation of *tuning*, which I have associated with the physical act of tuning the ear that I have practiced as part of constructing the three sound works presented as part of this thesis. I have used Pythagoras' conception of tuning instruments to describe these audiological instruments as tuning instruments, that is, as instruments that are designed to affect the physiological ear in order to create auditory ideals. I have accounted for how I have experimented with using these audiological instruments as tuning instruments. I have described my own operational approach by aligning it with the autonomous operational research approaches of Helmholtz and Ernst which I have used to demonstrate how the physical handling of specific technology also forms a way of tuning the ear. Furthermore, I have used Ernst's media archaeological approach to expose how the obsolete character of these audiological instruments tunes the ear by imposing specific temporal conditions on it. By addressing the full sonic content of the audiological instruments as part of the sound works, including faults and mistakes, I have deliberately tuned the ear into noticing auditory preferences of both the past and the present. I have

also experimented with tuning the ear by using the audiological instruments to evoke a musical narrative. I have related this aspect of the sound works to Løgstrup's notion of tuning as a specific perceptual circumstance which is enhanced through musical parameters. I have referred to Böhme's concept of atmosphere in order to account for how I have experimented with the particular spatial conditions surrounding the audiological instruments as a way of tuning the ear. And finally, I have used phenomenological perspectives, the field of object-oriented ontology and, not least, the field of artistic research to outline how I have experimented with the role of the operator in order to reveal how a tuning of the ear departs from this agency.

The diverse theoretical and methodological positions have not uncovered *hearing* in itself. Rather, these positions have emphasized, that any condition and conception of *hearing* will remain short-lived, as it will change according to the tuned relations it appears within, and as such I will conclude that my implementation of these positions supports a conception of how research as such constitute as specific frame, or tuning, for producing knowledge. The multiple positions have opened for a discussion of the second research question of this research project. This question pertained to a consideration of how the simple act of operating and listening to specific audiological instruments can form an epistemic activity. By introducing the sound works as methodological objects, I have challenged a persistent ideal of presenting an objective research practice through the use of technology. This ideal is inherent in the audiological setting that the instruments depart from, but I have also found it articulated in particularly Ernst's media archaeological approach and the object-oriented ontology, which have presented an ideal of overcoming subjectivity either by attending to the perspective of the technology or by initiating what Graham called a flat ontology, where the human perspective no longer constitutes an authoritative perspective. I have also found that this ideal of objectivity is reflected in the aesthetic programmes of several artists that have worked intensively with scientific instruments. Artists such as Alvin Lucier, John Cage, Jacob Kirkegaard and Kaffe Matthews, whose work I have presented within this thesis, have adopted the epistemological claims related to *hearing* and derived from audiological instruments in order to exceed traditional Western musical parameters. Unlike these positions, I have used my sound works to expose a discrepancy between the audiological instruments' aesthetic manifestations and epistemological claims. The sound works presented as part of this research project have made the epistemic claims of these audiological instruments audible and they have presented a new admittance for exploring *hearing*. I will state, that my artistic-based research has created a basis for exposing the consequences of the subject's presence and precedence in the scientific research lab, and as such it has inscribed itself within a broader tradition of discussing the subjective and performative frames of scientific research.[669] By staging the audiological instruments in an artistic setting, and thereby articulating an emphasis on the intentional act of perceiving these objects as aesthetic, these sound works have constituted a research lab which has enabled an experimental approach to the status of the subject in research.

By describing my artistic research approach through diverse theoretical and

669 Earlier in this thesis, I have accounted for this tradition by drawing attention to the research practice of Robert Boyle, whose experimental practice during the 17th century fostered a discussion upon the subjective means of research.

methodological perspectives, I have also found an entry point for articulating the knowledge that lies inherent in my artistic research approach. These positions have literarily supplied me with a language for describing my own artistic practice. Accordingly, I have performed what Ernst has termed *structural listening*, as I have used these positions to approach sound through narrative descriptions independent of the actual physical vibrational presence of a sound source. Methodologies such as phenomenology, media archaeology and object-oriented ontology, as well as individual practitioners such as Pythagoras, Helmholtz and Lucier, have encouraged me to analyse my own practice – an action which is traditionally not considered the role of "the artist". As Schwab and Bergdorff point out in *The Exposition of Artistic Research: Publishing Art in Academia* (2014), art has traditionally been conceived of as a genre of presentation rather than representation, in which the artwork speaks for itself. I have distanced myself from the myth of "the great artist" who is incapable of reflecting on praxis, and instead followed the example of artists such as Alvin Lucier, John Cage, Pauline Oliveros, Cathy Van Eck, Morten Riis and Shintaro Miyazaki who have articulated their practice through writing. I have deliberately avoided discussions of artistic value and taste, as my aim has not been to discuss how the artwork can preserve its autonomy when entering into a research practice, despite the fact that this has been a central theme within artistic research.[670] Instead, I have presented my processual thoughts in regard to working with audiological instruments in an artistic setting because I will argue it is here that the actual transfer of knowledge occurs. It is in the experience of handling the instruments and pursuing the questions raised by artistic practice that I have found a basis on which to discuss epistemological claims pertaining to *hearing*.

Presenting New Narratives and Formats to the field of Sound Studies

The three perspectives on the tuned ear, which I have now accounted for, make up the central findings of this research project. Initially, because they present the first steps towards what I described in the introduction as a new narrative of *hearing*. This narrative is foremost characterised by a new interest in the act of *hearing* which has led to a tracing of representations of *hearing* across scientific platforms and across historical epochs. I will also conclude, however, that this narrative has taken *hearing* beyond the passive and static status to which it has been assigned in the fields of audiology and sound studies and even within the field of sound art. All three perspectives on the tuned ear have underscored that any notion of *hearing* is dependent upon the performative traits that the audiological instruments ascribe to it, whether these traits derive from cultural codes, the sonic content, the structuring of the content or the spatial circumstances. Moreover, these three perspectives on the ear have emphasised that any conception of *hearing* will always arise from the act of *listening*, that is, as an intentionality originating in a particular subject's perspective. I have also suggested an extension of the narrative of *hearing* to incorporate bodily attention towards sonic inputs and even a multisensorial attention that requires an understanding of *hearing* as something which is not only derived from the physiological organ of the ear, but from the whole human body. Furthermore, I have

670 See Schwab & Borgdorff (2014), Borgdorff (2010), Busch (2009), Crispin (2014), Barrett (2007)

argued that any notion of *hearing* must be derived from an attention towards the physical as well as psychological conditions that shapes *hearing*, whether these are room conditions or concrete extensions or manipulations of the inner and outer ear. These three perspectives on the tuned ear have certainly not exhausted *hearing*, and they have not led to any definitive conception of *hearing*. Instead, they have contributed with a sense of the complexity of *hearing*.

To some extent, it can be claimed that the goal of my research has followed a tradition within sound studies of exploring the perceptual qualities of the ear, as I have investigated how sound perception unfolds and how it can be characterised. However, where many scholars within sound studies have been concerned with describing sound perception through a consideration of *listening* as a particular analytical auditory mode that can be used to reach sound objects, this research project has proposed a new starting point for sound studies which is derived from the technology that has been used to present definitions, understandings and ideals of *hearing*. Furthermore, my point of departure for conducting research on *hearing* has been characterized by an implementation of an artistic use of technology. It is through my artistic practice that I have enabled to explore *hearing* beyond solely historical accounts and theoretical positions, as I have approached the exploration through an actual testing of the epistemic claims which have been produced through the use of audiological instruments. The artistic outset of this research project has proposed new grounds for doing research within the institutional frames of Aarhus university, and it has formed a concrete response to an actual situation within the field of artistic research as it stands right now in Denmark. Despite the fact that in recent years artistic research has grown in Denmark, the field must still be considered as in its early stages. Artistic research in Denmark is still trying to find its feet, especially concerning methodology and format. I will argue that I have introduced an attempt to present sonic research through a methodology and a format that correspond to the content or at least forms a dialogue, a tuning, between content and form. It is my argument that the three sound works of this research project accentuate the findings which I have presented within this text in an auditory manner. Moreover, I have proposed a perceptual exposition of the issues raised within my research, as I have presented an accompanying auditory track, where the reader has been asked to perform hearing tasks during the cause of reading. These tasks have formed a proposition for experimenting with the reading situation and for experimenting with a phenomenological act of listening to the conditions that form *hearing*. By targeting a physical sensation in the ear, I have transformed the reading situation into an auditory situation and introduced a preliminary attempt to explore sonic research beyond the written word.

As a final concluding remark, I wish to accentuate that it is in the experiments with methodologies as well as with formats I find a basis for future research. I am interested in pursuing even more radical format experiments, especially within a Danish context because artistic-based research in Denmark, both within the art academies as well as universities, is still searching for appropriate forms of expression. In November 2016, Aarhus University made a significant update of the PhD regulation which introduced the possibility of including non-written material as part of the PhD project.[671] This reg-

671 *Rules and Regulations, Rules for the PhD Programme at the Graduate School, Arts* (2016)

ulation indeed announced an acknowledgement of practice as research, however it did not introduce an actual revitalization of the research format as the textual part still was to be assessed as the actual product of knowledge. I am convinced that an experimentation with representational formats for research projects that deal with sound can lead to a reconcilement between theory and practice. Furthermore, I see a potential in making further format experiments that include meetings with sound and its non-sounding representations in order to foster discussions regarding how to talk about sound and deduce meaning from it when constantly having to translate it into other forms, such as notation of the written word.

Remove ear plugs from ears

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APPENDIX

Box 1:
Silicone Ear Plugs Anti Noise Snore Earplugs (black), produced in China

Box 2:
HumanCharger light device produced by Valkee

Box 3:
Axon Hearing Aids, model K-86, sold by Global Medical Shop via Amazon.com

Record:
The Acoustic Appraiser, compositions made with an audiometer by Sandra Boss, released November 2018 by BIN.

At stemme øret

En undersøgelse af betingelserne for og forståelser af hørelsen

Denne afhandling undersøger, hvad det vil sige at høre. Ved at se nærmere på den teknologi der historisk set er blevet brugt til at udforske og påvirke hørelsen, adresserer afhandlingen de problemer, der opstår, når teknologi bruges til at skabe standardiserede repræsentationer af hørelsen. Hypotesen, som afhandlingen udgår fra, er, at det at høre ikke kan defineres udelukkende på baggrund af fysiske parametre. Også sociale krav, idealiserede forestillinger og æstetiske principper må medregnes som aspekter, der *stemmer* øret, dvs. aspekter der både skaber forestillinger om, hvad det vil sige at høre, og konstituerer rammerne for hørelsen.

Afhandlingen udgår fra en kunstnerisk undersøgelse af udvalgte audiologiske instrumenter, som oprindeligt er blevet brugt til at standardisere, normalisere eller optimere hørelsen. Et forældet audiometer, en række imiterede lydterapiinstrumenter og et sæt rekonstruerede hørehorn er blevet brugt til at skabe tre lydværker. Lydværkerne har genereret en række spørgsmål angående de audiologiske instrumenters validitet som epistemiske værktøjer, dvs. deres evne til at generere viden om hørelsen, men de har også skabt et praktisk afsæt for at diskutere metodiske aspekter ved den forskning, der berører hørelsen. Det er ud fra den kunstneriske praksis, afhandlingens primære forskningsspørgsmål er opstået:

Hvordan stemmer teknologi øret, dvs. hvordan lader teknologien os høre, og hvordan skaber den betingelserne for og forståelser af, hvad det vil sige at høre?

Hvordan kan den simple handling at operere og lytte til udvalgte audiologiske instrumenter forme en epistemisk aktivitet?

Konstruktionen af de tre lydværker og de forskningsspørgsmål de har genereret har ført til yderligere udforskning af, hvad der passende kan benævnes som *hørelsens* narrativ. *Hørelsens* narrativ fremkommer gennem en præsentation af de definitioner af og forestillinger om *hørelsen*, som er blevet artikuleret inden for en række forskellige felter, heriblandt inden for audiologi, sound studies og lydkunst. Denne narrativ har til formål at udfordre den passive position, som *hørelsen* har indtaget inden for det audiologiske felt, hvor den ofte er blevet karakteriseret gennem standardiserede parametre, men også inden for sound studies, der har været optaget af at udpege *lytning* som et analytisk og epistemologisk redskab.

Stemning

I denne afhandling bruges ordet *stemning* som en gentagen figurativ term. Akustiske og musikalske forståelser af *stemning* overføres til en forståelse af *det stemte øre*, hvilket har til formål at accentuere den fysiske påvirkning, som de audiologiske instrumenter har på øret, hvor specifikke lyde, materialer og rumlige forhold skaber betingelserne for *hørelsen*. *Stemning* bruges også til at understøtte en forståelse af, hvor-

dan teknologi producerer forestillinger om, hvad det vil sige at *høre*. Endelig bruges *stemning* som en metafor for denne afhandlings generelle metodiske praksis, hvor de audiologiske instrumenter er blevet undersøgt ved at holde specifikke aspekter op mod forskellige teoretiske og metodiske positioner. *Stemning* som et metodisk princip har ført til belysningen af en udvidet narrativ om *hørelsen*.

Øret

Det stemte øre undersøges gennem tre perspektiver, hvoraf det første udgår fra en terminologisk udredning af begreberne *høre* og *lytte*. *Lytte* præsenteres som et begreb, der især er blevet udviklet inden for sound studies, hvor det er blevet brugt til at understøtte og kultivere en bestemt auditiv opmærksomhed. Det argumenteres, at den auditive opmærksomhed, som *lytte* repræsenterer, til dels har tjent til at vejlede øret i, hvordan det skal tilgå lyde produceret af ny lydteknologi. Endvidere bliver *lytte* relateret til idealet om at kunne forstærke ørets subjektive analytiske evner for herigennem at skabe en egnet adgang til at producere viden. *Høre* præsenteres som et begreb, der dækker over en forestilling om at kunne nå en objektiv vurdering af, hvordan lyd opfanges af øret. Denne forestilling bliver primært relateret til audiologiske beskrivelser, hvor teknologi ofte er blevet brugt til at nå hørelsen uden om subjektive vurderinger. For at opnå en udvidet forståelse af *høre* som begreb, undersøges mulighederne for at bruge en fænomenologisk analysemodel, da denne model tidligere er blevet brugt til at udvikle begrebet *lytte*, bl.a. af teoretikere som Pierre Schaeffer, Barry Truax og Salome Voegelin. Den diskursive og fænomenologiske udredning af *høre* og *lytte* fører til en forståelse af disse termer som konkrete stemninger af øret, da ordene kommer til at dække over konkrete forsøg på at kultivere bestemte auditive opmærksomheder.

Teknologi og øret

Det næste perspektiv, som bruges til at undersøge *det stemte øre*, fremkommer gennem en yderligere undersøgelse af de audiologiske instrumenter, som indgår i lydværkerne. Der benyttes en diskursiv mediearkæologisk metode, hvor reklamer, aviser, manualer, fotos, websider, chatfora, salgsmateriale og historiske kilder tilgås med det mål for øje at præsentere tre auditive opmærksomheder. Disse auditive opmærksomheder knytter sig til tre teknologiafhængige ører: *Det otologisk normale øre, det forestillede øre,* og *det medierede øre. Det otologisk normale øre* fremkommer gennem en undersøgelse af de historier, der relaterer sig til audiometre og høretests, dvs. teknologier og metoder der er blevet brugt til at definere såkaldt "normal" *hørelse*. John Drevers forståelse af det "auraltypiske" introduceres, hvilket medfører en diskussion af det ideal, der betragter audiometret som en teknologi, der er i stand til at nå *hørelsen* gennem standardiserede ideer om lydperception. *Det imaginære øre* udfoldes gennem en præsentation af de fremherskende forestillinger, der knytter sig til hørekure og lydterapiinstrumenter. Her bruges Eric Kluitenbergs forståelse af *imaginary media* og Erkki Huhtamos forståelse af *topos* til at redegøre for, hvordan lydterapeutiske instrumenter og praksisser har produceret idealer om at normalisere *hørelsen*. Endelig fremkommer en forståelse af *det medierede øre* gennem en præsentation af de historier, der knytter sig til høreteknologier – fra hørehorn til cochlear implants. Disse historier bliver sat op imod Marshall McLuhans medieringsteori og Don Ihdes postfænomenologi, der bruges til at undersøge idealer om at optimere *hørelsen* gennem teknologi. Præsentation af de tre teknologiafhængige ører leder til en udvidet

forståelse af *hørelsen*, hvilket understøttes af fænomenologiske analyser af de audiologiske instrumenter. Disse analyser genererer en forståelse af *hørelsen* som kropslig, præ-refleksiv og multisensorisk.

Teknologi, øret og operatøren

Det sidste perspektiv på *det stemte øre*, som præsenteres i denne afhandling, udfoldes gennem metodiske overvejelser omkring forskningsprojektets operationelle og kunstneriske afsæt.
Personlige erfaringer med at operere forældede audiologiske instrumenter inden for rammerne af en kunstnerisk praksis inkluderes, og den kunstneriske praksis diskuteres i relation til andre lydpraksisser af bl.a. Pythagoras, Herman Helmholtz og Alvin Lucier. Derudover beskrives den kunstneriske praksis ved at relatere den til flere forskellige forskningsfelter, herunder mediearkæologien, fænomenologien og den objekt-orienterede ontologi. Disse mange forskellige perspektiver igangsætter en diskussion af, hvordan en udforskning af de audiologiske instrumenters æstetiske dimension kan fungere som et udgangspunkt for at eksperimentere med, hvordan øret kan stemmes. Desuden fører dette perspektiv til en overvejelse omkring, hvordan audiologiske instrumenter kan blive tilgået ud fra det formål at forstærke bevidstheden omkring, hvordan teknologi rent faktisk lader os *høre*.

Stemme ud

De tre perspektiver på det stemte øre afspejler dette forskningsprojekts centrale aspekter. De præsenterer en narrativ omkring *hørelsen*, der tilfører et fornyet blik på *hørelsen*, og som afslører *hørelsen* som langt mere kompleks og tvetydig end den passive position, den er blevet tildelt inden for audiologien og sound studies. Ydermere bibringer narrativen et fokus på, hvordan forskning omkring *hørelsen* kan udføres, og hvordan denne forskning i sig selv kommer til at stemme *hørelsen*.

Tuning the Ear

Exploring the Conditions and Conceptions of Hearing

The objective of this thesis is to explore the conditions and conceptions of *hearing*. By exploring the technology that has traditionally been used to study and affect *hearing*, this thesis addresses the problems arising when technology is used to determine or manifest standardised representations of the faculty of *hearing*. The main hypothesis of the thesis is that *hearing* cannot only be defined through physical parameters but must include social demands, imaginary ideals and aesthetic principles in that these criteria *tune* the ear.

The thesis is derived from an artistic exploration of selected audiological instruments which were originally used to investigate the faculty of *hearing* and form conceptions of *hearing*. An obsolete audiometer, a series of sound therapy instruments and a set of reconstructed hearing horns have been operated in order to create three sound works. These sound works have functioned as methodological objects to raise questions regarding fundamental aspects of *hearing* and they have also formed a practical basis for discussing how research on *hearing* might be conducted. The main research questions which the artistic practice has generated are:

How does technology tune our ears, that is, how does it allow us to hear and how does it frame our conception of hearing?

And how can the simple act of operating and listening to specific audiological instruments become an epistemic activity?

The three sound works and the research questions they have generated have led to a further exploration and exposition of the narrative of *hearing*. This narrative appears through a presentation of the definitions and imaginaries of *hearing* that have been articulated within many diverse fields such as audiology, sound studies and sound art. The presentation of this narrative serves to introduce *hearing* beyond the fixed sense-characteristics and ratios that the field of audiology has attached to it, and beyond the passive position that *hearing* has occupied within the field of sound studies, which has primarily been concerned with designating *listening* as an analytical and epistemological auditory attention.

Tuning

In this thesis, *tuning* is used as a repeating figurative term. Acoustical and musical notions of *tuning* are transferred into a conception of *the tuned ear* in order to accentuate the physical impact that technology has on the ear, where particular sounds, materials, spatial settings and performative rules are cultivated in order to standardise, normalise or optimise *hearing*. *Tuning* also supports a conception of how technology produces imaginaries of *hearing* and, thereby, how it not only forms the conditions of *hearing* but also conceptions of *hearing*. Finally, *tuning* appears as a metaphor for the specific research methodology that

characterises this research project as a whole, where different aspects of the audiological instruments have been approached through diverse theoretical and methodological positions in order develop an extended narrative of *hearing*.

The Ear

The tuned ear is explored through three perspectives. The first perspective traces a terminological difference between the two most common words used to describe the act of perceiving sound through the ears, namely *listening* and *hearing*. *Listening* is presented in relation to conceptions developed within sound studies, where it has been used to relate to the ideal of enhancing the ear's subjective analytical means. *Listening* is primarily derived from phenomenological representations, as introduced by scholars such as Pierre Schaeffer, Barry Truax and Salome Voegelin, who have contributed by constituting *listening* as a specific auditory attention. This auditory attention has offered guidance for attending to sounds, especially sounds produced by technology, but it has also presented auditory perception as a genuine basis for knowledge production. The notion of *hearing* is derived from the field of audiology. Within this discipline, technology has been used to present *hearing* as an objective assessment of how sound is perceived by the ear. In this thesis, *hearing* is related to an ideal of reaching a so-called natural auditory state which can be described through a quantifiable, physical conception of sound. In order to reach a notion of *hearing* beyond the passive and idealised state that it has occupied within both audiology and sound studies the phenomenological analytical model, as used within sound studies, has been adopted. This discursive and phenomenological investigation of *hearing* and *listening* has led to an exposition of these terms as concrete tunings of the ear, that is, as referring to concrete attempts to cultivate specific auditory attentions.

Technology & the Ear

The second of the three perspectives on *the tuned ear* presented in this thesis is a discursive media archaeological investigation of audiological instruments conducted in conjunction with the sound works presented as part of this research project. Commercials, newspapers, manuals, photos, webpages, chat forums, sales material and historical depictions are explored in order to outline three specific auditory attentions which are attached to three technology-dependent ears: *The otologically normal ear, the imaginary ear* and *the mediated ear.* The notion of *the otologically normal ear* is developed through histories surrounding audiometers and hearing tests, that is, technologies that have been used to define so-called "normal" hearing. John Drever's conception of the auraltypical is introduced to enable a critical discussion of the ideal attached to audiometers as a technology that is capable of reaching hearing as a standardised conception of sound perception. The notion of *the imaginary ear* is presented through histories surrounding hearing cures and sound therapy instruments. Here Eric Kluitenberg's conception of *imaginary media* and Erkki Huhtamo's notion of *the topos* are used to designate how therapeutic sound instruments and practices have produced ideals of normalising *hearing*. Finally, a conceptualisation of *the mediated ear* is developed through histories of hearing technologies – from hearing horns to cochlear implants. Here the histories of these hearing technologies are set against theories of mediation presented by Marshall McLuhan and Don Ihde which are used to investigate ideals

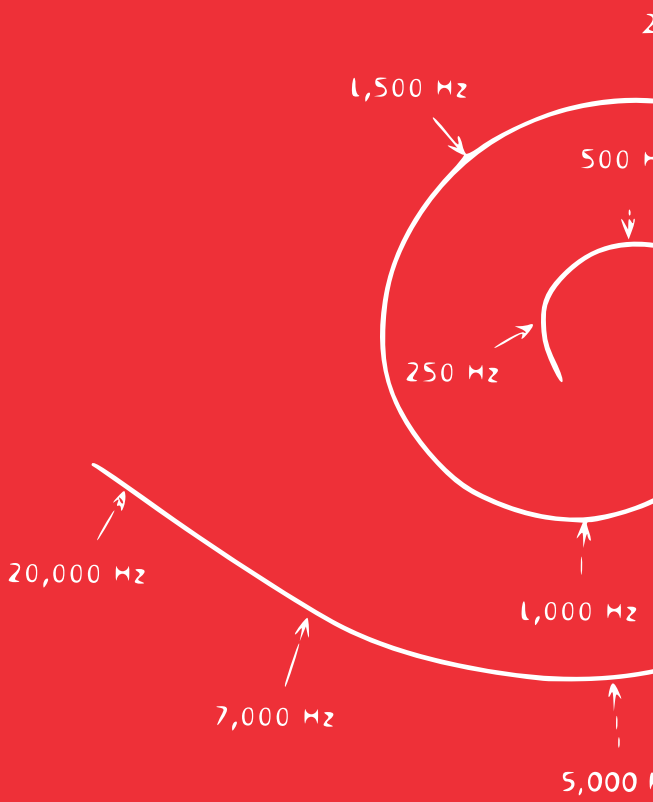
of optimising *hearing* through technology. An extended notion of *hearing* is also pursued, primarily through phenomenological and post-phenomenological analyses of audiological instruments. These analyses direct attention to a bodily, pre-reflexive and multisensorial conceptualisation of *hearing* which presents *hearing* beyond idealised states and standardised parameters.

Technology, the Ear & the Operator

The final perspective on *the tuned ear* which this thesis presents unfolds as a methodological consideration of the operational and artistic basis of this research project. This consideration accounts for how an exploration of the aesthetic dimension of these audiological instruments has functioned as an incitement for experimentation with the act of tuning the ear. This perspective places an emphasis on the relationship evolving between not only the ear and the technology, but also the operator. Personal experiences of operating these obsolete audiological instruments within an artistic setting is included, and this artistic practice is discussed in relation to the practices of a series of individual sonic researchers such as Pythagoras, Herman von Helmholtz and Alvin Lucier, as well as in relation to diverse fields of research including media archaeology, phenomenology and object-oriented ontology. These various positions initiate a discussion of how obsolete audiological instruments can be approached in order to enhance a new awareness of how technology actually allows us to *hear*.

Tuning Out

These three perspectives on *the tuned ear* make up the central findings of this research project. They present a narrative of hearing which occurs through a tracing of representations of *hearing* across scientific disciplines and historical epochs. This narrative proposes a renewed interest in the act of hearing and presents the complexity that governs it. Moreover, the narrative of *hearing* is characterised by a focus on discussing how research on *hearing* can be conducted and how the research may, in itself, constitute a tuning of the ear.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