Between air and electricity : microphones and loudspeakers as musical instruments

Eck, C.H.Y. van

Cover Page

Universiteit Leiden

The handle http://hdl.handle.net/1887/22868 holds various files of this Leiden University dissertation

Author: Eck, Cathy van
Title: Between air and electricity : microphones and loudspeakers as musical instruments
Issue Date: 2013-12-17

Introduction

Scope

Are microphones and loudspeakers musical instruments?

This question has been at the core of my research work. Microphones and loudspeakers are employed in almost all music we hear nowadays: to amplify the voices and electric guitars of a rock band, to facilitate the production of a "perfect" recording of a symphony orchestra, to reproduce that recording in the living room, and as an essential component in many other musical styles and modes of presentation, from the Jamaican sound system to techno parties.

It is thus no surprise, that as a composer, I was confronted with microphones and loudspeakers. At the end of the 1990s, I started to write music that used live electronic processing of the sound of conventional musical instruments (often called "live electronics"). Evidently, microphones and loudspeakers were on stage now next to the musician. During the compositional process one of my main concerns was the possible relationships between the sounds produced by the musical instrument and the sounds as a result of the live electronic processing.

One of the aspects that bothered me, while acquiring the skills and experience to compose for instruments and electronics, was the remarkable difference on stage between musician and instrument in comparison to microphone and loudspeaker. The sound producing relationship between musician and musical instrument was obvious. Even without knowing much about the violin or the piano, it became immediately clear by hearing and seeing a violinist, what this person was doing and how the sound was changed. The sounds emitted by a loudspeaker could have theoretically been any sound: a musical instrument such as a violin, environmental sounds such as the sea, or machines such as car sounds. Besides, whereas the musician is able to communicate with the audience, the loudspeaker is just a device, a black box. Although nowadays I would judge these initial troubles with microphones and loudspeakers to be rather naïve, it was my wish to consider these devices as actively determining a performance as the relation between a musician and a common musical instrument that was at the beginning of my research. I searched for compositional situations in which both instruments and live electronics contributed equally to the material of the composition. Musical instruments as well as microphones and loudspeakers should add some of their specific characteristics to the final composition, without essential hierarchical dependencies.

This doctoral thesis thus takes the artistic use of the devices that bring air pressure waves (sound waves) into electricity and back as its central focus point. As the title states, these devices

are between air and electricity. Microphones and loudspeakers are often perceived to remain transparent; that is, "inaudible" in the final sound result: one listens to the violin playing, and not to the vibrating cardboard, which is in fact producing the sound. From the 1950s onwards, microphones and loudspeakers started to play a crucial role not only in the mere reproduction of sound, but as well in the creation of music. Composers and musicians often described these new possibilities as using microphones and loudspeakers in a way similar to when composing for musical instruments. This not only resulted in many pieces and performances that used microphones and loudspeakers in a peculiar manner, but also in new possibilities for musical composition. My thesis focuses on this kind of music, and tries, in theory and in praxis, to find answers to questions such as: what are the possible relations between musical instruments, and microphones and loudspeakers? Why are microphones and loudspeakers often heard as "transparent" devices, which do not influence the sound they transmit? What are useable parameters for composing with microphones and loudspeakers? Does the use of microphones and loudspeakers as musical instruments alter how we think of instruments, musicians or music in general? Does the use of microphones and loudspeakers as musical instruments change music itself, its performance or the relation between musician and musical instrument?

To obtain a clear picture of the possibilities of microphones and loudspeakers in music, I develop four approaches. Three of them focus on what I call "transparent" or "inaudible" use. In short, music recording is what I termed the *reproducing* approach; music amplification, the *supporting* approach; and the *generating* approach includes all kind of electronic music, without any reference to a concrete source. The fourth approach, however, focuses on the use of microphone and loudspeakers in an opaque way. They should be "audible" and function in a way similar to how musical instruments commonly do. I call this the *interacting* approach, since the music should, in contrast to the other approaches, not be transmitted "through" microphones and loudspeakers, but be formed, coloured and changed by these devices.

By analysing several compositions that use microphones and loudspeakers as essential parts of the sound shaping process, I distinguish between three different types of interaction: *movement*, *material*, and *space*. I look at how the use of these devices by musicians and composers influenced compositional form, the performance situation and the relationship between musician and musical instrument.In the final chapter I discuss the possibility of composing with microphones and loudspeakers by using combinations of all four approaches. My conclusion is that what characterises the potential of microphones and loudspeakers for contemporary compositional strategies is exactly this possibility of being both transparent and opaque.

Artistic research

My research takes place in what is nowadays called artistic research. There are many different ideas on what artistic research is or might be. I chose to define my artistic research as "an endeavour in which the artistic and the academic are united" (Borgdorff 2012, 3) and describe my way of undertaking this research here.[1]

The results of my research are offered in two parts: my own praxis as a composer and sound artist, resulting in 28 musical works, and a reflecting theory, written down in five chapters. The development of both parts was a single process though. By working in the electronic studio or atelier, performing my own pieces as well as others, I was, often literally, in touch with microphones and loudspeakers. This praxis gave me insights into compositional strategies for these devices, which I articulated in my thesis. For example, due to working on the project *Hearing Sirens*—a performance with big, yellow loudspeaker horns attached to the back of the performer—I discovered the differences between the *movement* and *space* parameters (see the works *2. Hearing Sirens*, *3. Oefening in stilzwijgend zingen* and *7. Hearing Sirens (for a solo performer)* as well as chapter 4). The work process on the composition *Im freien* (nr. 14) was a revelation to me. This piece disclosed that if I want the specific characteristics of microphones and loudspeakers to be perceptible in the final composition, I should not seek out the ways in which it is possible for them to act in a fashion similar to musical instruments, but rather use combinations of different approaches (a detailed description can be found in chapter 5). It is this, which makes compositional strategies for "perceptible" microphones and loudspeakers significantly different than composing for conventional instruments.

But the reverse also happened: assumptions I made in theory could be demonstrated or disproved in the praxis. When I was getting to know the work of Hugh Davies, I started to use contact microphones in my compositions as well, resulting in pieces such as *Blik na blik* (5) and *groene ruis* (8). Discovering the different kind of spatialisation techniques used in the compositions of Alvin Lucier and Luigi Nono, resulted in trying out different loudspeaker configurations in (small) spaces (see for example *6. Büchsen für Pandora*, *9. dazwischen, 13. Mit Luft gebaut - Musik aus der Dose* and *17. Ein Oktett für das Quartett*). The use of drivers to bring objects into vibration in *Rainforest* by David Tudor was an inspiration to start working on *12. In blik*, *20. Music Stands* and *22. Stumme Diener*. Exchanging ideas on compositional strategies for microphones and loudspeakers with Ute Wassermann, Wolfgang Heiniger, Paul Craenen and Lara Stanic (whose works are discussed in chapter 5) influenced pieces such as *2. Hearing Sirens*, *8. groene ruis*, *9. dazwischen*, *10. Luftschlösser im Bau*, *11. Wings*, *12. in blik* and *18. Song No 3*.

---

[1] See for an analysis of contemporary artistic research: *The Conflict of the Faculties: Perspectives on Artistic Research and Academia* (Borgdorff 2012).

The thesis localises the field of research (chapter 1), gives an overview of microphones and loudspeakers and their relation to musical instruments (chapter 2), describes how microphones and loudspeakers became transparent devices that should ideally not influence the sounding result (chapter 3), investigates on how artists used microphones and loudspeakers as musical instruments (chapter 4) and concludes by addressing what compositional strategies for the unique characteristics of microphones and loudspeakers could be (chapter 5). This work resulted in a theory on composing with microphones and loudspeakers, in text form with online audio and video examples of the pieces (www.cathyvaneck.net/videoexamples/).

My artistic praxis remains much more open-ended. There is not a clear line from the beginning to the end, but rather many different lines. On the website documenting these works (www.cathyvaneck.net/ownworks/), several of these lines can be followed by choosing a "tag" from the right menu (tags are, for example, *horns*, *data feedback*, *tin cans*, and *contact microphones*). The pieces can also be viewed along the categories of the thesis they belong too, by choosing an interacting parameter (*movement, material* and *space*, see chapter 4 for an in-depth discussion of these) or the combination of approaches that is used in the piece (*interacting* in combination with *reproducing*, *supporting* and *generating*. Some pieces use more than two approaches, and are listed under, for example, *reproducing* as well as *supporting*).

What surprised me was that there is not necessarily any coherence between an interesting outcome of my artistic research and a "good" art work. Some compositions, for example *Im Freien*, led, as I mentioned above, to important modifications in my theory work. The artistic value is, in my view, not as high though. The opposite was also sometimes the case: a work such as *Mit Luft gebaut – Musik aus der Dose* was an important achievement in an artistic sense, since it was a large scale musical theatre piece. For my artistic research, there was little knowledge gained though, since most of the compositional strategies used were already tested by me in earlier compositions. The composition was thus based on research results but not much new research was done for this piece. The knowledge gained by composing a piece such as *Im Freien* is not transmitted by the piece itself, since what I learned through composing this piece does not necessary have to be demonstrated by the piece itself. It needs a text to transmit this knowledge. This is what makes artistic research highly valuable for me: expertise, which would otherwise not be communicable solely through the artwork, can now be transmitted in a textual form.

Evidently, I am not the first composer to connect praxis and theory. Illustrious artists, such as Pierre Schaeffer, Trevor Wishart and Dick Raaijmakers, have been describing in their theoretical work what I would like to call the categorisation of certain compositional aspects. Representing compositional ideas with the help of these kinds of models was helpful for me. Although their compositional strategies do not always touch my topic, their ideas and types of categorisation

have been very helpful to me. Pierre Schaeffer develops many different categories for composing "objets musicales" in his *Traité des objets musicaux – Essai interdisciplines* (Schaeffer 1966, 475–560) and develops audio examples of these categories (Schaeffer 2005). Of Trevor Wishart, I have notably looked at his methodology described in chapter 8 "Sound-image as Metaphor: Music and Myth" in *On Sonic Art* (Wishart 1996, 163–176). Wishart describes well why the use of categories is a helpful tool for composing: "The procedure I shall describe [...] is meant therefore to be merely a heuristic tool, an enabling device to force the imagination to consider possibilities which might not otherwise have occurred to it". How this kind of imagination might be functioning in my research is what I will describe at the end of chapter 4 in the "Overview of strategies for interacting with microphones and loudspeakers". Reading the texts of Dick Raaijmakers has been highly inspiring for me in many ways. His text on microphones (Raaijmakers 2007, 316–335) and on loudspeakers (Raaijmakers 1971) are both outstanding texts on the nature of these devices. His investigation of these devices portrays them in an extremely unique way, expressing very original thoughts on this subject. I discuss his ideas only in chapter 1, though his use of microphones and loudspeakers could be the subject of an entire dissertation.

For my written thesis, I decided to work with examples by other composers, instead of describing my findings with the help of my own compositions. I believe that applying my thoughts and ideas to the work of others makes my findings more understandable for my readers. One of the aims of research should be that the outcomes are valuable for others. By applying my theories on works other than my own, I am able to check the validity of this theory. In addition, by discussing the works of different artists, the aesthetics will cover a much broader scope than what would be the case if my compositions were the sole examples. The reader can of course apply my theory to my own compositions.

Context

Experimental music using electronic means has been omnipresent during the last decades. Electricity did become an increasingly important element in music during the beginning of the twentieth century. It became common during the 1960s for composers to visit an electronic studio to compose sounds, or for musicians to play synthesisers. Several good overviews of how electronic music evolved during the last hundred years have been written (Chadabe (1996), Holmes (2008), Manning (2004), Ruschkowski (1998) or Supper (1997)). Other books focus on more specified topics of electronic music, with contributions by various authors (Braun (2002), Collins (2007) or Emmerson (1986)). Many books explain how creating electronic music is done in a technical way, nowadays mostly focusing on using computers (Cook (2002), Farnell (2010), Miranda (2002), Roads (1996) or Roads (2004)). In all these books, the role of microphones and

loudspeakers, and especially how they, instead of electronic devices such as synthesisers or computers, could "shape" the sound, is often discussed not at all or just in the margin, since their scope is mostly on the electrical signal itself. My research tries to fill this lacuna. Although there is thus no existing theory on composing with microphones and loudspeakers as musical instruments, many of these books were helpful by giving details on certain microphone or loudspeaker technologies, musical instruments or compositions.

One of the rare books on experimental electronic music practice that has whole chapters devoted to the artistic use of microphones and loudspeakers is *Living Electronic Music* (Emmerson 2007). Simon Emmerson dedicates a part of his chapter 5 to microphone use ("Microphones and other Human Activity Transducers"). He gives some insights into different microphone technologies in this chapter and as well as developing a highly interesting categorisation of the different musical functions of live amplification. His chapter 6 is called "Diffusion–Projection: The Grain of the Loudspeaker" and its scope is merely on spatialisation—the emission of sound through a multiple loudspeakers system—a practice I discuss to some extent in the *space* part of chapter 4. Another book, which was of great help, especially for the practical part of my research, is *Handmade Electronic Music: The Art of Hardware Hacking* by Nicolas Collins (Collins 2009). This book inspired me in many ways to "touch" microphones and loudspeakers, instead of having them just placed on stands or hanging from the ceiling. Besides offering many insights into his decades-long experiences with experimental and artistic use of microphones and loudspeakers, Collins relates these methods to existing artistic works, such as *Rainforest* by David Tudor (which I discuss in chapter 4) and *Windy Gong* by Ute Wassermann (which I discuss in chapter 5), thereby making this book very valuable for my topic. The ideas on musical instruments as formulated by Aden Evens in the book chapter "Sound and Digits" (Evens 2005) and by Paul Craenen in *Gecomponeerde uitvoerders: het musicerende lichaam vanuit compositorisch perspectief* (Craenen 2011) have been important for the development of my ideas on musical instruments. Caleb Kelly discusses many ways artists used sound reproducing technology, such as phonographs and CD players, in *Cracked Media: The Sound of Malfunction* (Kelly 2009). Although this book does not cover much of microphone and loudspeaker "malfunctioning", approaches towards phonographs and CD players could be compared with my *interacting* approach, since both manipulate devices originally used for reproduction of sound. The notions on nineteenth century sound reproduction technology have been heavily influenced by Jonathan Sterne's *The Audible Past: Cultural Origins of Sound Reproduction* (Sterne 2003). I borrow his concept of the tympanic principle and develop the tuning fork principle as a juxtaposition in my chapter 3.

The thoughts that probably influenced me most are expressed in the book *Klang (ohne) Körper—Spuren and Potentiale des Körpers in der elektronischen Musik* (Harenberg and Weissberg 2010b). Since I teach at the faculty of Music and Media Art in Bern, where this research project was

conducted, I experienced the development of the concepts and ideas of *Klang (ohne) Körper* not only through the book itself but as well by many conversations with my colleagues Michael Harenberg and Daniel Weissberg.

Evidently, much has been written on the technological aspects of microphones and loudspeakers and how to use them for applications in the recording, hifi and sound reproduction industry (Ballou (2009), Borwick (2000), Eargle (2003), Eargle and Gander (2004), Hopkin (2002), Newell and Holland (2006) and Rayburn (2011)). This literature is not of much help for my research though, since I focus on how artists shape their music by using microphones and loudspeakers in unforeseen ways, whereas those books concentrate on appropriate ways to use these devices for what I called the *reproducing*, *supporting* or *generating* approach. An exception is *Getting a Bigger Sound: Pickups and Microphones for Your Musical Instrument*. In his book, Bart Hopkin (2002) includes what could be called "lo-fi" microphone technologies.

My understanding of the microphones and loudspeakers as musical instruments was extended as well in practice, not only by developing my own pieces, but as well by experiencing the pieces by others, which I analyse in chapter 4 and 5. In addition to hearing most of these pieces in concert, I also attended rehearsals of several pieces or played them myself.

In both my practical and my theory work, I concentrate mainly on works that have a timeline (a beginning and an end) and are rather performance based. Especially in sound art though, there are many works that focus on artistic uses of microphones and loudspeakers. But in the context of these works, microphone and loudspeaker are rarely defined as musical instruments. To become musical instruments objects have to be "played", and this does not very often happen in sound art. On top of that, as I will make clear in my thesis, the compositional strategies I discuss in chapter 5 would not be possible without a timeline. Nonetheless, the border between sound art and music is not that clear, and I would argue that many of the pieces I discuss here could be termed "performative sound art".

What might be another remarkable omission in the existing literature is the absence of information about the influence of the amplifier in music, which is shaped by microphones and loudspeakers. Indeed, amplifiers do have an enormous impact on the sound emitted by loudspeakers. My subject, though, is the devices that are converting air pressure waves to electricity and back. The amplifier only modifies the electrical signal. Besides, there are not so many ways to "play" the amplifier. Whereas the sound can be heavily coloured by this device, not so much *interaction* is possible other than changing the amplitude of the signal. Nonetheless, it should be kept in mind when studying my research, that the amplifier is inseparable from microphones and loudspeakers.

Evidently, my research process was full of surprises. Nowadays, my scores no longer contain notes, but the scores—if they exist at all— are principally notations of gestures. Also, during the last years, I started to perform myself. Probably most astonishing aspect for me was that, at the end of this process, my compositions excluded conventional musical instruments. The research that started to find a way of using microphones and loudspeakers in dialogue with instruments resulted in omitting these instruments entirely.