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THE COGNITIVE CONTINUUM OF ELECTRONIC MUSIC

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The eight pieces of electronic music composed as part of this research can be accessed at http://anilcamci.com/thesis.

Dit proefschrift is geschreven als een gedeeltelijke vervulling van de vereisten voor het doctoraatsprogramma docARTES. De overblijvende vereiste bestaat uit een demonstratie van de onderzoeksresultaten in de vorm van een artistieke presentatie.

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INTRODUCTION

The use of the electronic medium to compose music entails a variety of cognitive idiosyncrasies which are experienced by both the artist and the audience. Structured around this medium on both practical and conceptual levels, this study utilizes a tripartite methodology involving artistic practice, cognitive experimentation and theoretical discourse to investigate these idiosyncrasies. All three components of this methodology operate concurrently and in intricate mutual relationships to address a succession of questions: How do we experience electronic music? How does electronic music operate on perceptual, cognitive and affective levels? What are the common concepts activated in the listener's mind when listening to electronic music? Why and how are these concepts activated?

In this book I will argue that our experience of electronic music is guided by a cognitive continuum rooted in our everyday experiences. This continuum will be described as spanning from abstract to representational based on the relationship of gestures in electronic music to events in the environment. I will characterize *gesture* as "a meaningful unit in electronic music", and contend that the cognition of a gesture will be positioned on the said continuum in reference to the listener's past encounters with auditory phenomena. The idiosyncrasies of the electronic music experience will be associated with the cognitive continuum through examples from my artistic practice and listener reports.

During the course of this research, I have composed eight pieces of electronic music. The theoretical constructs discussed in this book operated at various levels of their materialization. Four of these works were utilized in experiments conducted with 80 participants. I have designed the said experiment to acquire a detailed account of the listening experience. Furthermore, I have implemented software to collect and also to analyze the data from this experiment. Throughout this book, I will refer to various interpretations of these data to motivate links between theoretical models and artistic practice. Having both designed the experiment and composed the material used in it[1], I believe to have achieved an unmediated connection with the feedback from the listeners. This form of involvement has not only granted me precise control over experimental parameters, but also yielded unique insights into the experience of electronic music. A comprehensive theoretical discourse throughout the book will externalize these insights by relating them to studies from a variety of fields.

I characterize this undertaking as a cognitive study of electronic music not simply due to its incorporation of a listening experiment but also on account of its fundamentally interdisciplinary nature: in order to provide an exhaustive report on the cognitive processes instigated by electronic music, I will weave links between music composition, cognitive psychology, neuroscience, linguistics and philosophy. Furthermore, my composition practice

[1] With the exception of Curtis Roads' piece *Touche pas*, which was also used in the experiments.

and the methods used to procure and asses the experiment data rely on computer science. In these regards, current research embraces a cognitive science approach towards a study of the experiential characteristics of electronic music.

In 1977, the composer Pierre Boulez wrote that musical invention was faced with a number of challenges "particularly concerned with the relation between the *conception* (we might even say the vision) of the composer and the *realization* in sound of his ideas" (1986: 5). According to Boulez, an understanding of contemporary technology was necessary for the composer to overcome such challenges (12). Thirty-seven years later, technology today is liberated to an unprecedented extent and the divide between the artist and the engineer has all but dissolved. But as we overcame the challenges of technology, we were confronted with the challenges of the emerging prospects. In 1996, the composer Denis Smalley identified the attraction of electronic music in its "openness to maximum imaginative potential" but asserted that determining and harnessing "the fields of indicative operation" remained a challenge for the composer (101). In an article he wrote the following year, he described that a major problem for the electronic music composer is "to cut an aesthetic path and discover a stability in a wide-open sound world" (1997: 107).

Later in this book, I will ask what is to be unexpected in electronic music if everything is expected of it. If listening to music can be characterized as an artistic experience of contrasts and surprises in various dimensions, the act of composition can be regarded as building up expectations and then either meeting or evading them. I will contend that the network of expectations in electronic music is inherited from everyday life. This does not imply that all composers begin their work with an everyday narrative. Neither do I claim that listening to electronic music is rooted exclusively in representations. But as I will further discuss, abstractness is nevertheless a negation of reality and composers design the unreal based on their knowledge of the real. I will argue that when the virtually limitless vocabulary of electronic music expands that of a culturally established language of music, it instigates for the listener a profusion of references rooted in *events* in the environment.

I will characterize events as units by which perceived time moves forward. I will relate events to environmental sounds and furthermore to electronic music in order to construct an idiomatic definition of a *gesture* in electronic music. These links will be motivated with existing models of experience and research on auditory perception. Doing so will help me bind my practice as a composer with the listener reports from the experiments. To contextualize the cognitive disposition of the human mind in an artistic experience, I will incorporate a semiological model and demarcate gesture as a trace to which the poietic and esthesic processes apply. This approach will liberate gesture from a communicational hierarchy between the artist and the audience, and will place the emphasis on the complexity of listening instead.

Later in the book, I will propose the concept of *diegesis* (Çamcı 2013) to highlight both the physical and the semantic aspects of the communication between the composer and the listener. The layer of meaning attribution pertinent to electronic music will be described to form a semantic domain that is superimposed on the physical domain. I will outline a coalescence of representational modes informed by the various interpretations of diegesis, and will situate electronic music in a broad context of artistic forms. In doing so, I will attempt to devise a semantic paradigm for the contextual evaluation of the gesture/event model. By providing examples from the listener reports, I will delineate various relationships between the domains of experience on both perceptual and conceptual levels.

While formulating the aforementioned theoretical constructs, I will constantly refer to my experimental findings as well as other empirical research. As the analyses of the experiment data will further demonstrate, adopting perceptual models pertaining to everyday life serves an intuitive role in discussing the experience of electronic music. There is a significant amount of research outside of musical studies which might help us better understand the inner workings of this experience, and I will attempt to incorporate these in my own discourse in meaningful ways. The practical discussion will be in constant reciprocation with a theoretical discourse, in which I will construct arguments by combining perspectives from different paradigms: I will, for instance, bring together Nattiez's *trace* with Vaggione's *action/perception feedback loops*, Deleuze and Guattari's *affect* with Gibson's *affordances* and Plato's *mimesis* with Genette's *diegesis*. The result will amount to a rigorous portrayal of the electronic music experience in terms of the cognitive processes forming in the composer's mind, which then become embodied in the physical domain in the form of sounds, and finally get subjected to the listener's cognitive appraisal.

According to Smalley, "consistent, thorough and fairly universally applicable analytical tools" are necessary for electronic music to be accepted in wider intellectual circles (1997: 108). Although I did not set out to elaborate analytical devices when establishing the theoretical framework of this study, concepts of gesture and diegesis, as defined in this book, can facilitate the discourse on electronic music not only within musical communities, but within a wider context of artistic research including such fields as fine art, theater and literature. Furthermore, cognitive idiosyncrasies of electronic music detailed in Chapter 3 and practical strategies discussed in Chapter 5 will render the current study relevant for cognitive science and design communities.

Throughout the book, I will question what we hear in electronic music, how we hear it, and what the cognitive determinants of this act are. As I answer these questions, I will delineate the cognitive continuum of electronic music as an inextricable component of the listening experience. I will characterize this continuum as a device at the artist's disposal, and one that can serve to address the challenges described earlier. In 1986, the composer Simon Emmerson suggested that even if a composer is not interested in manipulating the images associated with electronic music, the duality between mimetic and aural contents must at least be taken into account (19). In the same article, Emmerson asserts that future research must combine "psychology of music with investigation of deeper levels of symbolic representation and communication" to examine why particular sound combinations in electronic music 'work' (21). I believe that the current study addresses this appeal in its pursuit to further our awareness and understanding of the cognitive continuum of electronic music.

CHAPTER 1

ARTISTIC CONTEXT

DEFINING ELECTRONIC MUSIC

Let me begin with the most – seemingly – obvious question: what is electronic music? And furthermore, why do I prefer to use the term *electronic music* and not another of the myriad phrases used, almost interchangeably, to refer to the same piece of music? This etymological scrutiny will not only provide a historical rundown of the genre, but also establish a context for the specific flavor of electronic music this book will be focusing on.

Before the historical overview, I will first introduce two dictionary entries for the word "electronic". From the *Oxford Dictionary of English*:

> ***electronic***
> adjective
>
> 1. (of a device) having or operating with components such as microchips and transistors that control and direct electric currents: *an electronic calculator, an electronic organ*.
> • (of music) produced by electronic instruments: *electronic dance music*.
> • relating to electronics: *a degree in electronic engineering*.
> 2. relating to electrons.
> 3. carried out or accessed by means of a computer or other electronic device, especially over a network: *the electronic edition of the newspaper, electronic banking*.

This is how *Encyclopedia Britannica*'s *Merriam-Webster Dictionary* defines the same word:

> ***electronic***
> adjective
>
> 1. of or relating to electrons.
> 2. of, relating to, or utilizing devices constructed or working by the methods or principles of electronics: *electronic fuel injection*.
> • implemented on or by means of a computer; involving a computer: *electronic banking*.
> 3. generating musical tones by electronic means: *an electronic organ*.
> • of, relating to, or being music that consists of sounds electronically generated or modified.
> 4. of, relating to, or being a medium (as television) by which information is transmitted electronically: *electronic journalism*.

As seen above, there are several low-level concepts that are tightly coupled with this adjective, such as electrons, electronics, computers and transmission. Interestingly, both entries also define "electronic music". The description in the *Oxford Dictionary of English* is quite generic and easy to agree with. I would, however, replace the word "instrument" with "medium" to avoid an implication of *electronic musical instruments* which *are* electronic media but only as a subset of a larger category. *Merriam-Webster*'s definition of the phrase is also generic but it offers slightly more substance by referring to sound, and moreover to *generation* and *modification* of sound. I will soon touch upon the historical significance of these two processes.

Both of the above entries, on the other hand, are circular definitions in their core: electronic music is music that is produced electronically. The current discourse demands a higher precision than this and the following historical overview will help delineate the links between the nomenclature and the practices of electronic music.

A Brief History of Electronic Music

It is frivolous to try and place a birth-date on the genre. Ideas that propelled the earlier years of electronic music can be attributed to mankind's perennial obsession with sound making. We do, however, know approximately when the devices which established the electronic medium were developed. Such inventions as the loudspeaker, microphone, phonograph and vacuum tube were all conceived within a span of a few decades from the late 19th century to the early 20th century (Holmes 2008: 6). The transduction of sound waves into electrical charges (and back) was achieved by the advent of these technologies, and it was not long before people recognized the artistic implications of the electronic medium. If we pin down this awareness roughly to the early years of the 20th century, we can talk about a 100-year-old art form, which was in a state of becoming throughout the first half of the century, and was actively practiced from the second half on.

This relatively new form, however, has so far managed to foster a multitude of subdivisions in its course of existence. A perpetual interplay between aesthetic dispositions and technological advancements gave rise to a proliferation of styles both simultaneously and successively. The resulting bifurcations have been heavily driven by schools of thought that demarcated artistic practices through theory. While a retrospective of electronic music history might reveal less clearly articulated boundaries between these schools, visionaries of the period were – at least initially – committed to proclaiming the distinctions between their camps.

In the early 20th century, the western music scene witnessed the emergence of new ideas about sound, during a time when many other art forms were similarly questioning the concept of material. The Futurist painter and composer Luigi Russolo, in his *L'Arte dei Rumori*, put forward several predictions about the future of what he then referred to as *the art of noise*, and proposed drastic changes to the existing notions about musical material. This text is written in a fairly confident, if not commanding manner, in compliance with the Futurist attitude. A hundred years later, some of Russolo's arguments are no longer staggering, which is possibly a testimony to the accuracy of his predictions. However, not only a significant portion of his propositions have stood the challenge of time in terms of relevance, some are still yet to be realized. In 1977, roughly halfway between now and 1913, the composer Murray Schafer criticized how the decisions in city planning and architecture that impact daily soundscapes were being made arbitrarily (1994: 146). More than a hundred years after *L'Arte dei Rumori*, we are yet to find the engines of our industrial cities "skillfully tuned so that every factory is turned into an intoxicating orchestra of noises" (Russolo 1967: 12).

"We must enlarge and enrich more and more the domain of musical sounds" (11). This is one of the clearer messages in the 1913 text, which calls for an expansion of the vocabulary of those sounds which are deemed to be musical. A very similar sentiment was shared by the composer Edgard Varèse in an interview with the New York Morning Telegraph in 1916 when he stated that "our musical alphabet must be enriched" (Chadabe 1996: 59). This idea, at the time, had of course been resonating in a much broader field, not only as a precursor to electronic music, but also as a new philosophy towards music composition in general. For Russolo and Varèse, the device with which to materialize this vision was the *non-musical sound*.

But what exactly is a non-musical sound? The negation of *musical sound* can be viewed as a criticism of the then prevailing status quo in Western music. The "alphabet of musical sounds" at the time has been described by Varèse as being "poor and illogical" (Varèse and Wen-chung 1966: 11). Throughout the following decades Varèse, arguably ahead of his time[2], would promote the electronic means of producing sounds. Accordingly, he expresses that "[o]ur new medium has brought to composers almost endless possibilities of expression, and opened up for them the whole mysterious world of sound" (18).

Russolo, in his brief hypothesis on the origins of music, relates mankind's initial fascination with the sound of an instrument to the prevalent quietness of life in early history (Russolo 1967: 4). He suggests that this amazement encouraged people to attribute a divine origin to musical sound: "Thus was developed the conception of sound as something apart, different from and independent of life. The result of this was music, a fantastic world superimposed upon reality, an inviolable and sacred world" (5). He then extrapolates his theory to the modern world and suggests that the "proliferation of machinery" in the 19th century mandates a "revolution of music" (5). At the time these sentiments were voiced, mankind had recently gone through the Industrial Revolution and was heading rapidly towards the first world war. People hence were acclimatized to a new and louder soundscape, and according to Russolo, music was supposed to follow suit: "We must break at all cost from this restrictive circle of pure sounds and conquer the infinite variety of noise-sounds" (6). His suggested means of achieving this was the "intonarumori"s (noise intoners). These were mechanical devices designed to produce a specific vocabulary of non-musical sounds, which were categorized into groups of what Russolo referred to as "fundamental noises" such as roars, whistles, cracks and bellows. The sacrilege against musical sound was to be perpetrated by a "futurist orchestra" of the noise intoners[3].

In 1937, the composer John Cage expressed a view similar to Russolo's but more of its own time: "If the word "music" is sacred and reserved for eighteenth- and nineteenth-century instruments, we can substitute a more meaningful term: organization of sound" (Cage 2004: 26). Here Cage echoes the terminology of Varèse, who is credited for coining the term *organized sound* in the 1920s. During a lecture at Yale University in 1962, Varèse refers to his interpretation of this concept as follows:

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[2] During the first half of the 20th century, Varèse made several appeals to organizations like the Guggenheim Foundation and the Bell Laboratories, as well as various production studios in Hollywood, to advise them to invest into the electronic medium (Chadabe 1996: 59; Doornbusch 2013). These attempts, however, were to no avail. Said organizations would become significant proponents of electronic music in the second half of the century.

[3] The first concert of *intonarumori*s caused a rampage, prompting the police to arrive at the venue only to arrest the performers for inciting a riot. Marinetti, who also performed and got arrested alongside Russolo that evening, described the performance as "showing the first steam engine to a herd of cows" (Holmes 2008: 15).

> Although [electronic music] is being gradually accepted, there are still people who, while admitting that it is “interesting," say, “but is it music?” It is a question I am only too familiar with. Until quite recently I used to hear it so often in regard to my own works, that, as far back as the twenties, I decided to call my music “organized sound” and myself, not a musician, but "a worker in rhythms, frequencies, and intensities." Indeed, to stubbornly conditioned ears, anything new in music has always been called noise. But after all what is music but organized noises? (Varèse and Wen-chung 1966: 18)

Although such discourse is largely on breaking away from musical dogmas, the problematization of how the artistic outcome of this movement should be categorized dates back to as early as the first decades of the 20th century. Music was evolving – as it had always done – into something new, *but was it still music?* Electronic music was one of the forms that grew from these cerebrations, and it has engendered its own share of taxonomical entanglement.

Around halfway through the 20th century, some of the predictions of the future of music from previous decades had already begun to materialize in the context of electronic music as a result of technological innovations. Public broadcasting agencies around the world were taking an interest in the possibilities of this new form of artistic expression (Chadabe 1996). In a postwar Europe, the electronic music studio was born and furnished with phonographs, magnetic tape machines, reverberators, filters and oscillators. Schools of aesthetic thinking emerged along with these studios, and gave rise to an initial wave of stylistic and philosophical divisions.

French and German studios lead the way for a significant period of time. Under the leadership of Pierre Schaeffer, the studio of Radio France, and subsequently the *Groupe de Recherches Musicales*, promoted the concepts of *musique concrète*, *sound objects* and *acousmatic music*. Established in Cologne under the initiative of the physicist Werner Meyer-Eppler, the engineer Robert Beyer and the composer Herbert Eimert, the Westdeutscher Rundfunk studio embraced the *serialism* extrapolated from the music of the Second Viennese School as its stylistic direction (Chadabe 1996: 37). While modifications of recorded sounds constituted the material of most early pieces of musique concrète, oscillators and noise generators were the principle instruments for composers of the Cologne studio, who referred to their output simply as *elektronische Musik.* The sense of *play* inherent to musique concrète stood in significant contrast to the absolute determinacy of serialism, and this ideological difference was voiced clearly in the writings of the members of the two groups. For Eimert, musique concrète was “fashionable and surrealistic” and consisted of “incidental manipulations or distortions haphazardly put together” (Holmes 2008: 58). Conversely, serialism as a method of music composition has been criticized to varying degrees by prominent members of the French studio such as Schaeffer and Xenakis (Holmes 2008: 58; Xenakis 1992).

These articulated approaches gave an impetus to the genre and encouraged many composers to tread into uncharted territory. The stylistic principles adopted by the studios guided the composers, most of whom came from pen-and-paper composition, through their initial encounters with the electronic medium. *Etudes* of musique concrète or *studies* of elektronische Musik were, to the most part, timid stabs at an entirely new mode of music making, and mirrored the distinct aesthetic inclinations of the studios. But at the same time these exercises granted the composers a much-needed technical sensibility. Those who imagined a long-standing relationship with electronic music were quick to integrate the unique implications of the medium into their craft, and it was not long before *composers' instincts* began to unravel the predetermined credos of the studios. The stylistic barriers were to dissolve in a matter of few years.

This evolution marks the emergence of the musical style this book will be focusing on: a view of electronic music which gives precedence to the composer's instincts; a form of composition that thrives on imagining one's way through the endless possibilities of sound; a form of music whose practicalities and boundaries are intrinsically delineated by the electronic medium. This medium defines both the structure and the sound of the music that emerges from it (Barrett 2013, personal communication). The pioneering composer of electronic music Morton Subotnick reflects a similar view when he describes his first contemplations of electronic music in the early 60s:

> I didn't know what kind of music it would be. I did believe that it should be a music for that medium, not just any old piece of music that got recorded and put out — a whole new kind of music. I used as a model for myself the metaphor of Chopin and the piano. He used the concert grand in a way that just wouldn't have made sense as anything but solo piano pieces. It was (media theorist Marshall) McLuhan's idea that "the medium is the message," that his piano music and the piano were linked together in a very special way. I was looking for something equivalent with a record. What would a record be if (the piece) never got performed on the stage, just for the record? (quoted in Rosenbloom 2011)

The reciprocation between what is imagined and what is perceived impacts upon compositional strategies in real time and at various formal scales. This situation effectively prioritizes listening in a feedback loop between actions and perceptions (Vaggione 2001: 60). The result is a music that is "fundamentally different in character and in aspiration from any music that preceded it" (Demers 2010: 12); a music which "opens access to all sounds, a bewildering sonic array ranging from the real to the surreal and beyond." (Smalley 1997: 107).

Why Call it *Electronic Music*?

When thinkers and composers from the early periods of electronic music coined phrases to describe their craft, they had clear ideological bases for what they meant to communicate with these terms. But as the stylistic borders between the so-called schools of electronic music began to blur, the etymological precision of these terms started to degrade. I will now overview the electronic music nomenclature, including both modern and historical phrases, and discuss the accuracy with which these phrases are capable of describing the music under discussion here. Obviously, some of the terms discussed below have gained their prominence not purely on the basis of their etymological aptness, but also by their wide-spread usage. My intention with this discussion is not to disregard some of these phrases, but rather to establish a context for what I will call *electronic music* throughout this book.

The part of my artistic practice which relates to this book can be described as *computer music*, since I compose my music on a computer and I play it from a computer. But the computer is not an instrument for this music in the sense that a piano is an instrument for *piano music*. The modern computer is a wide-open platform; a *tabula rasa*. The more it can get out of the way of composing, the more useful to the composer it becomes. Hardware is less of a limiting factor than it has ever been; for an artist working in the audio domain, today's computers are vastly capable. This was indeed not the case 30 years ago. The burden of the routines performed to operate an early computer was significantly entrenched into the nature of what could be achieved with it. The artist was forced to bear actively in mind what can retrospectively be described as the shortcomings of early computers: losing an entire day waiting for a piece of code to be compiled was a part of the composition process. Fortunately, this is no longer the case. A computer today is an infinite playground, equipped with all the tools of the early electronic music studios and much more. Techniques which spearheaded the various historical styles of electronic music are implemented side-by-side within the frame of a single software environment.

Furthermore, the phrase *computer music* lacks a historical comprehensiveness. Most obviously it abstracts itself from any electronic music which existed before the computer. From a listener's standpoint, a piece of electronic music composed on tape in 1958 might well display the same experiential qualities as a recent piece of computer music, yet fall into a different category purely on a taxonomic basis. On the other end of the spectrum, *tape music* is a nostalgic phrase still used on rare occasions when referring to fixed pieces of electronic music, even though the amount of music produced on tape today is next to none.

Electroacoustic music is another widely-used name for the music that I compose. *Electro-acoustic* is an acoustic engineering term defined by the *Oxford Dictionary of English* as "involving the direct conversion of electrical into acoustic energy or vice versa". Based on the concept of energy transduction, the term is associated with the working principles of loudspeakers and microphones. Treating the phrase as the adjective that it is, electroacoustic music translates to "music involving the direct conversion of electrical into acoustic energy or vice versa" or "music involving loudspeakers and microphones". By this definition, *electroacoustic music* is an apt contender for specifying the genre. However, I maintain that the word *electronic*, in comparison, is a more comprehensive indicator of the medium, based on the word's generic description discussed earlier.

Another popular phrase in this vernacular is *acousmatic music*. In my experience, this phrase is most commonly used when categorizing content for concert programs to differentiate fixed pieces from live performances of electronic music. From this perspective there might be an apparent justification for this expression in relation to Pythagoras' use of the phrase *acousmatic* when referring to his lectures given behind a veil so that the sound of his voice would be abstracted from its *visible* source. In a performed piece, the audience is able to discern an acoustic (or a causal) source for the sounds they are experiencing. In fixed pieces, however, there will only be speakers. Here is the caveat though: the speakers *are* the sources for the sounds, and I will further discuss this in the fifth chapter.

Schaeffer's usage of the word "acousmatic" proposes an entirely different theoretical perspective. The recorded sound is already detached from its visible source but the *sound objects* in acousmatic music are also to be abstracted from any *symbolic sources* which the sounds themselves may instigate. Acousmatic music is defined through the listening experience, regardless of whether it is the composer or the audience who is listening. This interpretation of the term therefore falls further out of place when differentiating fixed pieces from live ones, since a piece of electronic music can be fixed but not acousmatic in the Schaefferian sense. Furthermore, the fact that a listener can choose to experience even a live performance as an acousmatic piece by merely ignoring visual cues implies a greater complication. Acousmatic sound is in the ear of the beholder and imposing it onto music taxonomically can cause inaccurate representations.

An obvious pitfall in using the phrase *electronic music* could be its implications when translated into German, which gives us the name with which the composers of the Cologne studio referred to their music. But *elektronische Musik* is such a historically and stylistically distinct form that I do not foresee a risk of exclusively summoning up the (beautiful) serialist organizations of oscillator sounds from 1950s when I say *electronic music*.

This book will discuss works of electronic music that have been described – accurately or not – as acousmatic music, computer music, electroacoustic music, tape music or elektronische Musik. It is the music that aligns with the visions of those like Russolo and Varèse. It is the outcome of an expanded musical language that is inherently coupled with the implications of the electronic medium. I therefore conclude that *electronic music* is an appropriate phrase to refer to this form of artistic expression. When referring to the listening experience of electronic music, I will not draw a distinction between the encounters with the musics of Stockhausen, Vaggione, Parmegiani or Ferrari. From the perspective of the listener, different works originating from the electronic medium can display similar characteristics regardless of their underlying methods of production. What is common to the experience of all this music will become more evident in the third chapter when I discuss the cognitive idiosyncrasies of electronic music.

COMPOSITION PRACTICE

Composition practice represents one of the three pillars of this study alongside experimentation and theoretical discourse. In this section, I will provide descriptions of the compositions that are attached to the research discussed in this book. These descriptions will range from program notes to composition reports. I will provide more comprehensive analyses of the four pieces, namely *Birdfish*, *Element Yon*, *Christmas 2013* and *Diegese*, which were used in the listening experiments.

As I will further detail shortly, the pieces described below rely on a variety of compositional intents, materials and techniques. This variety originates from my artistic practice on the one hand, and the goals of this research on the other. In that sense, every piece was composed with a hypothesis built into it. This may as well be considered a quality of all artistic processes. The artist, as a perceiving body, inevitably develops assumptions as to how his or her work will be perceived by an audience. Although my assumptions could have turned out to be severely inaccurate, they nevertheless helped me construct this thesis from the inside out: these works were composed around the underlying concepts of this thesis, were utilized in the experiments and later analyzed to delineate practical applications of some of these concepts.

As I mentioned in the previous section, I refer to a broad field of practices when I use the phrase *electronic music*. Works of other composers that I will refer to throughout this book come from considerably different styles. Electronic music can be performed or composed through micromontage, algorithms or chance, with recorded or generated sounds, to count just a few of the methods and materials made available by the electronic medium. The current study focuses on fixed works both for practical reasons pertaining to experiment methodology, and in order to concentrate on the theoretical constructs discussed throughout this book by eliminating the unknowns of live performance situations. Nevertheless, the fixed works at the core of this study utilizes a great variety of production techniques. While some of the pieces were composed entirely with synthesized sounds, others incorporated recorded sounds. Some of the compositions were rooted in pre-determined narratives, while others emerged from different kinds of processes. Sections that were produced algorithmically were juxtaposed in the same piece with those that were composed stochastically. Some movements of these works were created with generative software while others were performed with instruments. This variety was not necessarily intended to investigate the experiential effects of these techniques in isolation, but to achieve a gestalt of techniques afforded by the modern electronic medium.

My ability to reflect upon my own works evolved as I observed other people reflecting upon them in the context of the experiments, and moreover as I established the links between the data from these experiments and the theoretical constructs of the thesis. As a practitioner and teacher of electronic music, I have been dealing with the analysis of other composers' works for a long while. However, it has become clear to me that artistic research differs from a musicological stance in that it provides an intimate connection between the artistic work and its analysis. Both of these components transform as the research proceeds, and this transformation reveals new insights. My account of the creative processes of each piece as provided below merely disclose the perspectives from which these pieces originated. These works will be subjected to further scrutiny throughout the book. The report in the current section will serve as an initial point of reference for the reader.

Birdfish

2012, 4’40”

Birdfish was composed during the 9 months between October 2010 and June 2011. The piece was revised during an additional 2-month period in early 2012. It is the third piece of a tetralogy on evolutionary phenomena. The sequence of the works in this tetralogy (in the order which they adhere to the tetralogy's narrative arc) is *Let the World End* (2012), *Nautik* (2011), *Birdfish* (2012) and *Insectarium* (2013). The latter is an interactive audiovisual piece, a second version of which is in development at the time of this writing. While these pieces belong to a preconceived sequence, they vary greatly in material, form and language. The tetralogy is therefore not intended for a compound performance: each piece stands on its own and is performed individually. What connects these works is the inheritance of research across the pieces. *Nautik*, for instance, is a 3-movement live-performance of about 12 minutes during which I synthesize various forms of liquid sounds. The methods used in this performance greatly informed the composition of water-like textures in *Birdfish*. Certain phase modulation techniques developed to create organic structures in *Birdfish* were later used in *Let the World End* to form the central gestures of the piece. Furthermore, the research on aerial and avian sounds conducted during the composition of *Birdfish* was utilized to design the interactive sounds of *Insectarium*.

Birdfish unfolds in two movements which in itself are composed of two and three sections respectively. The 38-second opening acquaints the listener with the sound world of the piece with an abstruse exposition of the bird, water, and other creature sounds as well as intermittent melodic material. The first instance of a leitmotif which will recur throughout the piece marks the end of this section with an E-flat resolution. The following development section, which lasts until the 2’04” mark, accommodates more concrete incarnations of the water, fish and amphibian sounds. This section builds up on the representationality of its sound elements, yet at the same time introduces more abstract objects such as brief glides of discernibly synthesized sounds. This section also reveals the spatial design of the piece with articulated reverberant fields, low frequency rumbles and gestures which traverse the implied spaces. These spaces are designed to enhance the contextual coherence of the previously introduced representational sounds. The leitmotif marks the end of the section, this time in D-flat.

The second movement begins with a 30-second section of fast-paced mutations between the actors introduced so far (i.e. birds, water-like elements, amphibians and abstract structures) and ends with an almost evaded cadence-like reincarnation of the leitmotif which *dissolves* into the ensuing reverberant field as the pitch decomposes around D. The collage of bird sounds then sinks into the background. This opens up several compositional prospects: while the gestural pace of this background matches that of the previous sections, these gestures are now pushed away spatially to distance the listener from the texture which has persisted throughout the piece so far. This was one of the revisions I have applied upon the first series of experiments I conducted with the first version of *Birdfish*. In this first version, the consistency of textures between movements, although implying a sustained richness of the sound elements, for lack of contrast, negatively caused a staleness in the piece.

The shifting of the figure gestures to the ground sets a stage for a new foreground, which I populate with a more sparse distribution of sounds that evolve over time from abstract pitched elements back into creature sounds. Further into the section, the *sunken* gestures of bird and amphibian sounds swing in and out of reverberation to ephemerally reclaim their foreground roles. The reverberations and the low frequency pulses are reminiscent of the first movement but are much more articulated to create a spatial tension for what is to come. The representational sounds progressively manage to break through the screen of reverberation. Following the most articulated submersion into reverberation between 3'35" and 3'45", a brief reprise of the textural density and the representational clarity of the first movement lends itself to a final resolution involving a climactic build-up in various dimensions of the piece such as spatial, spectral and textural densities, and representational variety. The effect I wanted to achieve here was to shift the perspective from the third person to the first person and have the piece *wash over* the listeners, as if they were amongst the creatures who were trying to transcend the surface of the ocean. A final repetition of the leitmotif concludes the piece in D-flat.

Despite its representational intents, *Birdfish* does not contain any recorded sounds. The processes to generate its constituent sounds comprise complex combinations of pulsar, granular and frequency-modulation syntheses, modulated delays and various frequency-domain filters executed with both custom-designed and off-the-shelf software devices. The granulations to create the textural elements of the piece were carried out using stochastic processes. Once I created the actors and the settings via several generations of the processes described above, I have montaged these elements into the temporal structure of the piece in a variety of layers.

Element Yon

2011, 3'45"

Element Yon[4] was composed concurrently with *Birdfish* during the 9-month period between October 2010 and June 2011. I devised this piece to emulate several structural characteristics of *Birdfish* but in an entirely different language. This differentiation in language is achieved with a change in vocabulary rather than in grammar. Just like *Birdfish*, *Element Yon* is composed entirely of generated sounds. The main difference is that I have conceived *Element Yon* as an abstract counterpart of *Birdfish*. In *Element Yon*, one can clearly discern that the sounds originate from oscillators and not from recordings. To establish a non-representational quality for the sounds, I have mainly worked with synthesis and filtering methods that maintained the pure characteristics of simple waveforms.

Except for this choice of material, *Element Yon* shares similar temporal and spatial organizations with *Birdfish*. The micro-montage strategies used to sculpt phrases are also highly analogous between the two. As a result, the gestural grammars of the pieces are homogenous. While this homogeneity benefitted from the concurrency of their compositions, it is at the same time significantly obscured by the differences in sound material. To achieve

[4] The word "yon" (here written in Romaji) represents the number 4 in Japanese.

the specific sound characteristics of *Element Yon*, I have implemented modulation matrices across various synthesis modules. These are the same modulation matrices which I have used during my studies on the synthesis of avian vocalizations for *Birdfish*. As a result, certain gestures in *Element Yon* verge on the organic sounds in *Birdfish* in terms of their structural complexity. In contrast with the aforementioned harmonic evasion in *Birdfish,* which transpires in a representational sound world, the evasions in *Element Yon* are those of representationality within an abstract context.

While the structuring of the piece does not share the same binary model, its macro structures are comparable to those of *Birdfish* in terms of their length and their use of interim silence. The piece begins with a 20-second exposition of its vocabulary followed by a 33-second section which explores the frequency spectrum of the piece. Here, the listener is acquainted with the gestural characteristics of *Element Yon*. During the development section between 0'57" and 2'57", the texture so far is augmented by stereo separation and audio decorrelation techniques used in *Birdfish*. The segments between 2'57" and 3'05", 3'07 and 3'25", 3'27 and 3'35", and finally 3'36 and 3'45" constitute the four elements which give the piece its title. The second segment accommodates a harmonic resolution in the vaguely implied key of the piece. These elements are structurally consistent with the development section but are intended to obfuscate any motivic closures to the piece, in the manner of moment form[5].

Christmas 2013

2011, 2'16"

The sound material of *Christmas 2013* is extracted out of the jazz trio *Tin Men and the Telephone*'s 2011 album, *The Very Last Christmas*, which consists of avant-garde jazz interpretations of famous Christmas songs. Since the band's instrumentation comprises a piano, a double bass and drums, the sonic vocabulary of the piece is based on frequency and time-domain manipulations of these specific instruments. In late 2011, the band kindly offered me the uncompressed stereo mix-downs of every track in the album. Having decided to animate a post apocalyptic tale with this material, I have *mined* the album for sound chunks of certain spectral and temporal characteristics. Once I had sound material sorted, the composition of *Christmas 2013* was completed and revised in the relatively short period of two months.

Inspired by the ill-conceived prophecies about the world's expected end in 2012, *Christmas 2013* is set in a post-apocalyptic world, about a year after the demise of mankind. A main theme for me during the composition of the piece was *future nostalgia.* The selected chunks were therefore processed to sound electronic, organic and antiquated at the same time. From a structural point of view, the piece exhibits a temporal unfolding marked by distinctive staccato sounds. The recurrence of these sounds in various timbres establishes an obscure rhythm which operates at various time scales. The spatiotemporal organization of the staccato sounds is formed so that they reveal a collective behavior of spatial causality, akin to flocking, to give the listener a sense of observing a landscape populated with animate objects.

Following a first instance of the impulse which will mediate the temporal progression of the piece, *Christmas 2013* begins with a quotation of the well-known Christmas carol *Silent Night*.

[5] When describing his conceptualization of moment form, Stockhausen writes: "a given moment is not merely regarded as the consequence of the previous one and the prelude to the coming one, but as something individual, independent and centered in itself, capable of existing on its own" (translated in Kramer 1978: 179).

This part is kept true to its form in the recording (apart from added reverberation) to prime the listener with an instrumental reference which they can clearly recognize as a song, if not as the specific carol that it is. The reverberated melody is then layered with a harmonically related layer which furthers the ambient feeling of the introduction. At this point, a spatial play of impulses takes over the foreground and immerses the listener in a vast environment. The sporadic appearances of the piano sounds are placed amongst its highly processed siblings in an ornamental fashion. Narrative function of these appearances are to remind the listeners of the now, in a future from where they are looking back. The now therefore becomes an object of nostalgia through the contrast between an unsettling post-apocalyptic landscape and a happy memory. The ending of the piece returns to the clearly identifiable sound of the piano now playing a progression fabricated from processed recordings to compliment the tonal and temporal threads of the piece.

> A Christmas song for a world that no longer exists, as crooned by the anti-Santa strolling a wasteland formerly known as Earth: A repurposing of Tin Men and The Telephone's celebrated Christmas album. (Çamcı 2012, concert program notes)

Diegese

2013, 1’54”

Diegese was composed and revised between June 2012 and February 2013. The initial motivation behind this piece was to illustrate several concepts discussed in my article *Diegesis as a Semantic Paradigm for Electronic Music*, published on Canadian Electroacoustic Community’s journal *eContact!* in May 2013. The sound material of the piece is mostly synthesized with the exception of a brief piano recording.

In *Diegese*, I specifically intended to explore the placement of musical quotations within electronic music as *diegetic actors*[6]. To materialize this idea, which I had previously experimented with in *Birdfish* and *Christmas 2013*, I incorporated two musical quotations into the composition of the piece. The quotations are blended into the narrative flow of the piece rather than being juxtaposed with the remainder of the sonic textures. The first of these quotations is from my former teacher Curtis Roads’ 2009 piece *Touche pas*, which was also used during the listening experiments upon Curtis’ kind permission. During the period I studied with him in Santa Barbara, I witnessed Curtis finish the first version of this piece and later perfect it into one of the most impressive displays of modern electronic music. Here are the program notes for *Touche pas*:

> In April 2008, I was experimenting with the granulation of a brief sound file when I noticed that its opening looping sonic texture was reminiscent of the classic electronic music work *Touch* (1969) by my former teacher Morton Subotnick. I know this work well, having produced and remastered it in 1986 for the Wergo label. In homage, I decided to dedicate this work, whose French title means “touch not,” to Morton Subotnick. The title proved apt, as after months of work, *Touche pas* sounds nothing like *Touch*. (Roads 2009, concert program notes)

[6] This is a concept which I will discuss extensively in Chapter 5.

As a quotation, I chose the sonic texture mentioned above in an homage to Roads' homage to Subotnick. For this, I developed a simple granulation algorithm which re-synthesized its input material into arhythmically juxtaposed loops of sound grains. I later layered processed instances of this material to give the texture a spectral variety similar to that of *Touche pas*. This quotation begins at 0'49" mark and lasts for 18 seconds before it lends itself to another quotation.

The second quotation was a phrase from Ludwig van Beethoven's Piano Sonata No. 27 in E minor (Opus 90). The choice of instrument here sets a clear parallel with *Christmas 2013*. The main difference between the two quotations is that while *Christmas 2013* incorporates an external musical form as a whole (i.e. a Christmas carol), *Diegese* uses the piano as a structure which can be associated with the instrument but not a musical form. In other words, the latter offers a decontextualized quotation which functions as a gesture. The pairing of the particular quotations in *Diegese* is motivated by the metaphorical similarities between the motion trajectories of both textures.

Temas

2014

I began developing *Temas* in the fall of 2013 in support of my composition *Autounfall*, which I had started planning in 2009 and have been actively composing since 2012 with an expected completion in 2015. A point in *Autounfall*'s narrative makes it necessary to create an illusion of a car crash, which I could slow down and speed up, zoom in and out of, and alter its representationality by manipulating the sonic elements which would emanate from the mechanical causalities of a car crash. Besides investigating the physical properties of impacts and frictions on metal surfaces for this scene, I also studied the sound characteristics of glass deformations. To create the intended effect, broken pieces of glass in various sizes would have to originate from different locations and impact the ground at different speeds and angles. The size variations would cause the impact sounds to exhibit different motion and damping characteristics. It soon became clear to me that an algorithmic implementation would be necessary to achieve a convincing level of sonic complexity for this texture. I figured the software I had developed for *Diegese* mentioned earlier could serve as a starting point by virtue of its ability to simultaneously granulate a variety of input sources and do so in an arhythmically correlated fashion in accordance with the intended motion of glass particles in *Autounfall*.

During the first month of programming devoted to expanding the functional complexity of my initial software, the stochastic approach to its development began to take a life of its own. Furthermore, I had started integrating signal processing chains designed for the sounds in *Birdfish* and *Element Yon* into this new software. By the end of 2013, *Temas* had taken form of a stand-alone stochastic performance platform, design of which was innately informed by the strategies I have devised for the works composed during the course of the research discussed here.

Stochastic musical systems allow for the incorporation of a seemingly infinite number of parametric possibilities in humanly perceivable musical forms. Accordingly, *Temas* too offers minute control over probabilities which, in combination, amount to an endless variety of gestural and textural structures. Although *Temas* emerged from an attempt to stochastically emulate the sound of an environmental phenomena, in its final form it is capable of producing highly abstract sounds. The first version of *Temas* was completed in March 2014 and was premiered in a concert in April 2014.

> *Temas* (tr. *contact*, *touch*) is a stochastic performance. The software underlying the performance integrates the artist into a generative system as a module of analysis. The software interface affords control over probability distributions instead of immediate parameters. Sound acts as a seed; the artist listens, and in return, performs probabilities. All sounds are generated in real time. *Temas* draws inspiration from Karlheinz Stockhausen's *Kontakte*, Morton Subotnick's *Touch* and my former teacher Curtis Roads' *Touche pas*. *Temas*, which generates purely electronic sounds, stochastically traverses the fine line between the organic and the synthesized as it forms contacts with representationality. The initial design principle behind *Temas* was motivated by an algorithmic implementation of the sonic texture from Subotnick's 1969 piece *Touch,* which prompted Roads to name his 2009 piece *Touche pas* as an homage to his former teacher. All instances of *Temas* emerge from the same origin but evolve into unforeseen sonic territories. An optimal performance of *Temas* lasts 8 to 10 minutes. (Çamcı 2014, concert program notes)

Shadowbands

2010, 2'48"

> The human mind has an uncanny power of recognizing symbolic forms; and most readily, of course, will it seize upon those which are presented again and again without aberration. The eternal regularities of nature, the heavenly motions, the alteration of night and day on earth, the tides of the ocean, are the most insistent repetitious forms outside our own behavior-patterns (…) They are the most obvious metaphors to convey the dawning concepts of life-functions — birth, growth, decadence, and death. (Langer 1948: 155)

Shadowbands builds on the idea of a sonic Rube Goldberg Machine. I first explored this concept in my 2009 piece *Hajime*, which I will discuss shortly. The sound material of *Shadowbands* is purely synthetic. Inspired by the total solar eclipse of March 29, 2006, the piece narrates a story of machines witnessing a disruption in the most ceaseless pattern in daily life: the rising and setting of the Sun. In doing so, the piece draws a parallel between the systematic behavior of a machine and the "eternal regularities of nature".

The first 23 seconds consist of a vocoded speech which sets a narrative context for the piece. The following section until 0'44" is an exposition of the synthetic sound world of the piece. In awe of the disruption in this most persistent pattern that moderates their utility, the machines attempt to break away from their daily routines. At 0'44" we hear a repeat of the initial instigator of the causality chain, implying a futility of these attempts. The repeat, however, does manage to progress into an alternative route. A more consistent repetition of the initial sequence reiterates this futility before the machines descend back into order at 1'37". The metaphor of order is conveyed by the harmonic organization of sound elements and the reduction of inharmonic content from the individual sounds. Musical incarnation of this metaphor is further established when a rhythmic grid is introduced in the temporal structure.

A distinct loop of 2 seconds at the end of the piece declares the unmistakable defeat of the machines in their attempts to break the pattern.

> The opening speech to the piece is from a broadcasting of the 2006 solar eclipse which was viewed in its totality at various locations in Turkey. As an out-of-place experiencing of this bewildering event not through the eyes of the man but the machine, the piece depicts "a phenomenon impossible to photograph". (Çamcı 2010, concert program notes)

Hajime

2009, 6'09"

Hajime is an octophonic[7] study on sonic causality. As the sound material for the piece, I recorded my own voice saying "My name is Anıl" and processed it through several generations of filtering, granular synthesis and micro-montaging. In composing the micro forms of the first movement, I intended to create a sonic Rube Goldberg Machine. A Rube Goldberg Machine is a mechanical contraption designed to execute a physical task through chain reactions across its constituent mechanical parts. Since Rube Goldberg Machines often perform redundant tasks, they can be considered as kinetic sculptures rather than functional devices. My idea with the first movement of *Hajime*, was to create an auditory representation of a similar behavior. Throughout the movement, the timbre of the human voice is discernible for the most part. Each sound behaves like a physical object which sets other objects in motion by interacting with them in various ways. Objects spring, stretch, spin, bounce and impact each other in a linear causal chain similar to that of a Rube Goldberg Machine. This behavior, which dominates the first movement of *Hajime*, is a metaphor for the almost predetermined routines of an acquaintance process between two people, as witnessed by a third person. In accordance with this choice of perspective, the movement is composed for the front stereo speakers.

The second movement portrays a zoomed-in moment of contemplation during which I dread announcing my name. This is a humorous comment on the myriads of polite attempts at pronouncing my name, hindered to the most part by the vowel "ı", which is non-existent in many languages and therefore virtually impossible to vocalize for non-Turkish speakers. In compliance with the narrative, the second movement unfolds in first person view and therefore incorporates the rear stereo speakers as well to create an immersive depiction of inner thought with quadraphony.

The third movement is another humorous take on what I imagine could be my addressee's experience as I announce my name. The movement therefore shifts the perspective to second person. It begins in a frontal monophony and soon develops into a confusingly exaggerated spatialization of octophonic sound to create a sense of turmoil. The final utterances of my name no longer instigate a spatial turmoil, yet they are still equally unintelligible.

> Traversing a voice recording of the composer introducing himself, this work depicts an acquaintance process in a foreign land in 3 movements, each observed from a different perspective (third, first and second person respectively). (Çamcı 2009, concert program notes)

[7] *Hajime* has been adapted for quadraphonic systems in late 2009, and for stereo systems in 2010.

Do You Remember Rob Nolasco?

2007, 4'31"

Although I had already been experimenting with cognition by the time *Do You Remember Rob Nolasco?* was composed, this piece from 2007 is the earliest work I prefer to associate with the current study. Retrospectively, I can describe it as a precursor to *Shadowbands*, *Element Yon* and *Birdfish* in terms of the sound worlds they exploit. Also composed purely of synthesized sounds, *Do You Remember Rob Nolasco?* utilizes a blend of pulsar and frequency-modulation syntheses. On its surface, the piece embodies two instances of a basic tension-and-release structure. These two instances, which are similar in form, are differentiated by their musical languages.

In composing it, I was experimenting with the role of anticipation in listening, and the perception of the inevitable. The first 2 minutes and 49 seconds of the piece present a gradual build-up of crackles, insect-like organic sounds and occasional melodic figures. At the 2 minute mark, the build up arrives at a state of relative climax. From 2'35" on, a further escalation in what had seemingly been at the upper threshold of its density implies an inevitable release. Without any intentions to induce physical pain, I wanted the listener to be under the impression that the build-up could not progress any further and it would have to resolve any time now. The resolution is a low frequency pulse, which incites an unmistakable bodily experience when played through a capable sound system. This gesture is aimed at surprising the audience with what they had been anticipating. The second half of the piece imitates this tension-and-release form but with a melodic line and a harmonically related texture. The same bass pulse, which was designed as a corporeally articulated sonic experience for the first movement, now serves a function of harmonic resolution.

> *Do You Remember Rob Nolasco?* is an unresolved mystery in two movements that mimic each other. (Çamcı 2007, concert program notes)

A Relational Map of the Pieces

Seen below in Figure 1.1 is a map of the pieces described in this section (with the inclusion of Curtis Roads' piece *Touche pas*) situated in relation to the common themes and techniques used in their compositions as described above. While the links between these works can be much more complex and multi-faceted than seen below, this representation is useful in summing up the common aspects across the pieces which are relevant to the discussion in this book.

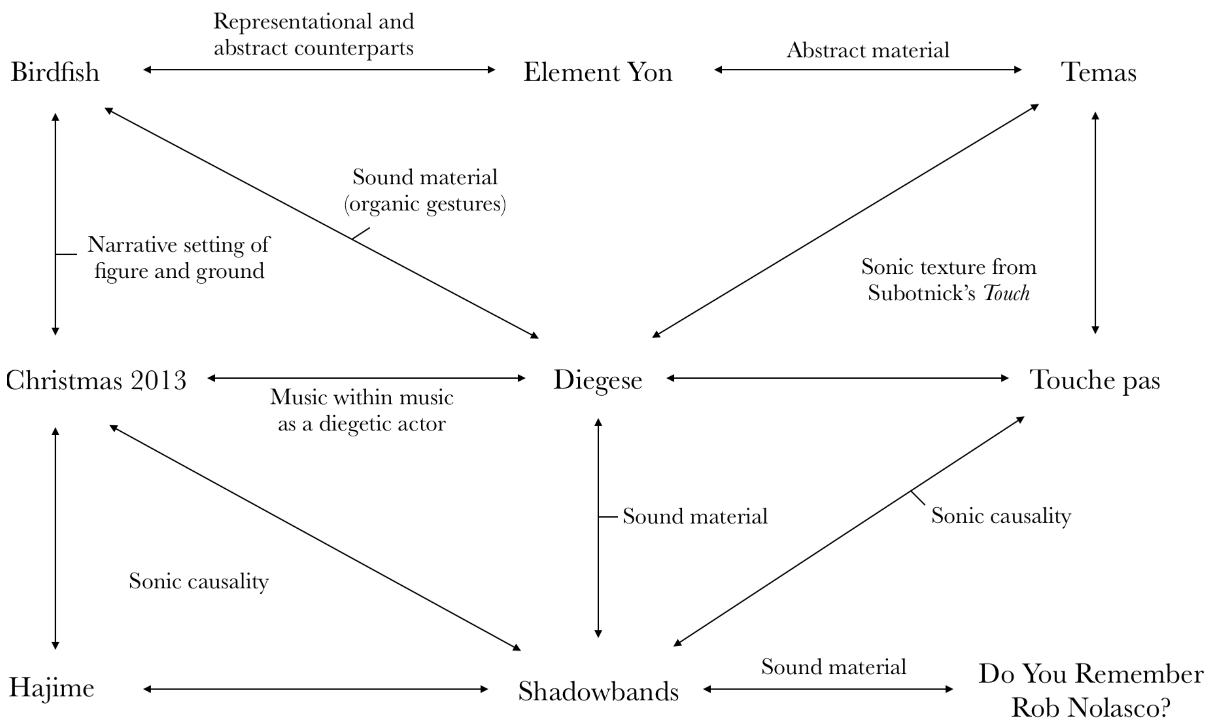


Figure 1.1: A relational map of the pieces

CHAPTER 2

EXPERIMENT DESIGN AND DATA ANALYSIS

EXPERIMENT DESIGN

The "cognitive revolution" of the 1950s brought about new research trends in the fields dealing with the human mind. In psychology, this took the form of a counter movement against behaviorism (Miller 2003: 141). Striving to go beyond the study of observable behavior, cognitive psychologists placed emphasis on brain activities by investigating representations of sensory stimuli and how these representations are processed by various mental faculties. In its rejection of the prevailing divide between mind and matter, a key premise of the cognitive revolution was that "the mental world can be grounded in the physical world by the concepts of information, computation, and feedback" (Pinker 2003: 31). Psychology was not the only field to be greatly influenced by this movement.

> While experimental psychologists were rethinking the definition of psychology, other important developments were occurring elsewhere. Norbert Wiener's cybernetics was gaining popularity, Marvin Minsky and John McCarthy were inventing artificial intelligence, and Alan Newell and Herb Simon were using computers to simulate cognitive processes. Finally, Chomsky was single-handedly redefining linguistics. (Miller 2003: 142)

A main source of momentum for the cognitive revolution was its interdisciplinary relevance. The pioneering cognitive psychologist George Miller lists six disciplines which spearheaded this movement: psychology, linguistics, neuroscience, computer science, anthropology and philosophy (143). Unifying these fields through theoretical models, cognitive science thrives on "the diversity of outlooks and methods that researchers in different fields bring to the study of mind and intelligence" (Thagard 2014).

As the philosopher Paul Thagard puts it, "[a]lthough theory without experiment is empty, experiment without theory is blind" (2014). For the current study, which situates electronic music as an object of cognitive experimentation, I have utilized psychology, linguistics and computer science in the design and the analysis of the experiment, and philosophy to bind theoretical perspectives with experience. By embracing a truly interdisciplinary methodology, this study brings electronic music into a cognitive science framework.

Analytical Approaches to Electronic Music

Such fields as psychoacoustics and music psychology, which have been dealing with sound and music since ancient times not simply as physical but also as *auditory* phenomena, gained a significant prominence in 20th century as a result of the aforementioned shifts in the scientific paradigm. As the cognitive revolution spread to the study of environmental sounds in the latter half of the century (Bartlett 1977; VanDerveer 1979), experiment-based studies on perception and appraisal of music also started to gain prominence. From that period on, countless studies have offered remarkable contributions to our understanding of auditory and musical experiences. The current book will refer to a wealth of modern studies of auditory psychology in the ensuing chapters.

Analytical methods which deal with the experience of electronic music are as old as the genre itself. Pierre Schaeffer demarcated the pioneering style of the French studio, namely musique concrète, by describing theoretical constructs, such as *sound objects*, and listening modes, which in themselves can be considered as proto-analytical devices. Long after their postulation, Schaeffer's theories are still central to many analytical debates on electronic music. However, the *post-Schaefferian era* (Demers 2010: 14) starting in the 1970s has produced its own array of analytical approaches towards electronic music. In novel discussions on the ontological and experiential characteristics of electronic music, many researchers and composers have proposed new perspectives informed by semantics, perception, aesthetics and technology (Emmerson 1986; Bridger 1989; Wishart 1996; Smalley 1997). Furthermore, scholarly work adopting experiential approaches in the analysis of electronic music have gained a significant impetus more recently (Windsor 2000; Field 2000; Simoni 2006).

A common method to gather phenomenological insight on a particular topic is to conduct subject-based studies. But as the composer Leigh Landy states, although listener-based research in electronic music is not unprecedented, it is "the exception rather than the rule" (2007: 39). The amount of such studies focusing exclusively on electronic music is dwarfed by the existing research on the cognition of instrumental music. Below I will discuss a number of studies that enquire into various aspects of electronic music by incorporating listening experiments.

In one of the earliest examples of such studies, the researcher Michael Bridger conducted an analytical investigation of electronic music based on experience reports from listener groups. Using short sections of five electronic music pieces that heavily incorporate the human voice, Bridger administered repeated listening sections to acquaint the participants with the works. This was followed by discussion sessions with each listening group (Bridger 1993: 298), where he annotated the comments on dynamic level traces of the pieces printed on A4 paper (1989: 147). This method, although lacking statistical control as Bridger points out, yielded several interesting insights such as the listeners' attentiveness to the human voice, conventional musical instruments, and spatial movement of sounds (159).

In his studies on listening behaviors in electronic music, the researcher François Delalande was also one of the first scholars to adopt a subject-based experimental model. In a study of "external inquiry" (Delalande 1998: 22), Delalande and the composer Jean-Christophe Thomas requested eight subjects with varying expertise in electronic music to listen to a short movement from Pierre Henry's *Sommeil* (24). Thomas later surveyed the subjects in the form of a "relaxed interview". Delalande describes his research goal as a search for consistencies "not directly in what listeners hear but in (…) their listening behaviours" (23). Accordingly, he concludes that there are coherences within separate listening behaviors which represent analytical points of view and, even with the limited number of participants, there are clear testimonial analogies. Addressing the limitations of his experimental model, Delalande acknowledges the lack of a systematic approach to the analysis and that the number of participants was insufficient to draw statistical conclusions (25). However, in defense of his method, Delalande states that a scientific approach, aimed at collecting simpler responses via such methods as questionnaires, adjective grids or segmentation tasks, would deprive the results of the “richest information which permits a detailed description of listening behaviour” (26). In another comment, Delalande describes verbal testimonies as “more or less a faithful account of what happened during listening” albeit affected by the “self-image of the listener” (25).

During the latter half of the 1990s, the composer Andra McCartney conducted a program of listener-response studies using Hildegard Westerkamp’s works of soundscape music (McCartney 1999). In this research the participants were asked to listen to a soundscape piece and later respond to questions about it in survey format. Although this study offers intriguing insights, its exclusive focus on soundscape music renders the research outcomes highly style-specific. McCartney analyzes the results of the study based on her “open interpretation” of the listener responses; the composer expresses that this decision was influenced by her desire to maintain an interpretational diversity (198).

The Intention Reception Project, conducted by Leigh Landy and Rob Weale, investigates how the intentions of a composer relate to the listening experience in electronic music. The goal of this research is described as gauging accessibility and appreciation in electronic music (Landy 2007: 44). For the experimental component of this study, researchers first directed questionnaires to the composers whose pieces would be used in the listening experiments. The ensuing experiments, which were conducted with listeners, consisted of two questionnaires and three rounds of listening. Before each round, the information provided to the listener regarding the piece was gradually increased. During all three listening sessions, participants reported their immediate responses to the music in the form of thoughts, images and ideas that come to mind, via a real-time written questionnaire. A separate questionnaire with questions on the listening experience was filled exclusively after the first round. The experiments were conducted strictly with fixed stereo pieces that include “real-world sounds that are identifiable” (44). These studies revealed that when inexperienced listeners are provided with dramaturgical information regarding a piece, they are able to use this information to guide themselves through parts of the music that are problematic in terms of access and appreciation (Weale 2006: 196).

With an online survey conducted with 21 participants in November 2010, the composer Adam Basanta examined “the language of listener responses to electroacoustic music” (Basanta 2013). As listening material, short excerpts of music consisting of real-world field recordings and synthetic pitched materials were composed. Each participant was instructed to listen to an excerpt and provide affective, imaginal and other kinds of responses in written format. Responses relating to “positioning of the listening-self”, the “place image” of the piece, and cultural-ecological references were found to be common across all participants with varying experiences with electronic music.

Building upon Landy and Weale’s project discussed earlier, the composer Andrew Hill used “empirical data collection” (2013: 43) to investigate audience reactions to “electroacoustic audiovisual music”. During various phases of this study, audience members were asked to respond to qualitative questionnaires, developed in the light of those from the Intention Reception Project (45). These questionnaires were intended to collect information regarding the material properties of an audiovisual work, semantic and emotional responses of the audience to this work, and whether the audience members wanted to keep experiencing the piece or obtain contextual information about it (45), the latter of which was found to “narrow the interpretative potential of the work” (43).

Experiment Design

The modality of feedback in the current experiment is written language. Usage of verbal feedback is a prevalent method in studies on auditory perception. Furthermore, experimental evidence suggests that there is a substantial overlap between the neural networks dealing with verbal and non-verbal semantic information (Cummings et al. 2006: 92). Another experiment-based study conducted by Orgs et al. also reveals similarities in the conceptual processing of verbal and non-verbal stimuli (2006: 267). Various other studies on environmental sounds have demonstrated the facilitatory effect of such sounds on the retrieval of semantically related words (Ballas 1993; Van Petten and Rheinfelder 1995; Gygi et al. 2007; Guastavino 2007; Özcan 2008), in support of the strong conceptual relationship between sounds and spoken words.

To maintain the richness of a music-listening experience, while at the same time harnessing the statistical potential of a free association task, I designed a two-stage model for the experiment discussed here. Although parts of my design might coincide with those from other studies, the particular combination of its sections amount to a unique methodology which is capable of capturing a comprehensive report of the listening experience. As I will shortly discuss in detail, a general-impressions task allows the participants to listen to a complete piece of electronic music without interruptions or the burden of a task. This is intended to keep the impact of experiment bias on the listening experience to a minimum. Once the listening is completed, the participants report their general impressions in free written form followed by a second listening to the piece, during which they perform a real-time free association task via custom software. While the general-impressions task also yields descriptors pertaining to cognitive processes during listening, the real-time descriptor section mines a more precise and in-the-moment collection of descriptors. To alleviate the effect of self-image described by Delalande, the experiments were conducted with a large group of participants of varying backgrounds in terms of age, nationality and engagement with electronic music.

Working with complete works of electronic music was another decision made to improve the authenticity of the listening experience. Although experimental studies using sound chunks instead of complete pieces are effective for investigating isolated parameters, this approach compromises the natural dynamics of the listening experience. Indeed, my intention with using complete works was to allow the communication between the composer and the listener to transpire at its natural scale.

Another common practice in experimental studies on electronic music is the upfront prescription of a task to be performed either during or immediately after the act of listening. In the former case, where the participants are asked to take notes while a piece of music is being played, the regular music listening experience is clearly altered. Although this method can prove effective with pieces custom-designed to gauge a certain phenomenon, it nevertheless demands that the participant is repeatedly disconnected from the act of listening. In the latter model, in which a task is described prior to hearing the piece for an ensuing survey, the listening experience remains uninterrupted. However, this model too demands that the listener assume a certain stance towards the piece. I should note that such a stance, or bias, can never be fully extracted from experimental studies, owing to the participants' awareness of the simple fact that they are being subjected to an experiment. However, assigning the participant with a distinct task prior to any music playback will inevitably encourage the participant to consciously labor towards fulfilling this task as the piece plays, which again implies a notable alteration of the listening experience. It is possible that the participant might do the same regardless of whether a task is prescribed in advance. To prevent the listeners from speculating on a task and laboring towards it, necessary instructions regarding the nature of the experiment should be given prior to listening.

Dealing with Experiment Bias

The matter of experiment bias can be viewed from two angles based on either the experimenter's or the participant's point of view. From the former perspective, an *experimenter (or observer) expectancy effect* (Zoble and Lehman 1969: 357) requires consideration. This effect occurs when the experimenter unconsciously primes the participant with instructions in a way that will encourage responses that support the hypothesis. A certain degree of expectancy effect is inevitable with verbal instructions, simply because these are intended to communicate a task to be performed by the participant in a specific modality. One way to handle this is to maintain a uniform level of bias across the separate instances of the experiment. It is therefore important that the instructions for the participants remain consistent across different instances of the experiment. To achieve this, the experiment design needs to incorporate an instruction routine and the experimenter must be proficient with the delivery of this routine. Another method to reduce observer-expectancy effect is to abstract the experimenter from the general procedure as much as possible. Since double-blinding was not applicable to the current study (for practical and methodological reasons), I attempted to reduce possible expectancy effects by designing the experiment so that I merely act as an instructor who does not take part in the sections in which the participants actively perform a task.

Another possible bias can be caused by the *demand characteristics* of an experiment (Thomas 2010). For instance, prior knowledge about the experiment might motivate the participant to satisfy (or evade) in their responses a hypothesis which they have elaborated through this prior knowledge. The adoption of a between-subject model, in which the experiment is conducted once with each participant, eliminates this risk for the current study to a certain extent. This however does not imply an inherent flaw in within-subject models, where a participant performs a task multiple times. The choice between these two approaches is determined by the aim of the experiment; the practicalities of each model are factored in accordingly in the analyses. Another measure taken to avoid the effects of demand characteristics in the current study was to request the subjects who had completed their tasks to refrain from discussing the experiment with prospective participants in cases where such an interaction was deemed a possibility (e.g. when the experiment is performed at a school).

Preliminary Study

I started designing the model and the medium of the experiment in February 2010. After an extended period of research and development, I have conducted an initial round of experiments with 12 participants between October 2011 and February 2012. The listening material for these experiments was an early version of my piece *Birdfish*. The preliminary results I obtained from these experiments were published in an article titled *A Cognitive Approach to Electronic Music: Theoretical and Experiment-based Perspectives* (Çamcı 2012). Moreover, these first 12 instances of the experiment helped delineate necessary improvements to the initial experiment design. The modifications I implemented for the next round of experiments ranged from interface refinements to broadening of the collected data.

For instance, a minor interface modification was the removal of the volume adjuster available in the initial design. This user interface element, although intended to recreate the experience of a common audio player, was never used by the participants. Other minor refinements were similarly informed by participant behavior: one of my intentions with the earlier design was to extract general categories for musical backgrounds based on the relevant information written during the general-impressions task and later use these categories in a drop-down menu in the software interface. Even with the relatively small sample group of 12 people, the musical backgrounds, which the participants identified themselves with, varied too greatly to inform a practically viable categorization. Therefore, for the next round of experiments, I added a relevant text field in the participant information form, which gave the participants the freedom to type musical background descriptors.

I also modified to the code which executed the data collection. In the first version, only the descriptor submission times were being recorded. In the final version, I implemented an event-listener which tracked the position in time when a participant started typing a descriptor. This made it possible to observe with higher accuracy the exact time in the piece when a particular descriptor would emerge. More importantly, this implementation provided information regarding the time a participant spent between starting to type a descriptor and submitting it, which allowed for meaningful interpolations in several cases and provided data for typing proficiency analysis.

The methods used to evaluate the results of the preliminary study informed the analysis of the study discussed here. Although the latter benefits from a much more extended analysis, descriptor categories extracted from the preliminary study served as a basis for the categorization of the descriptors from the current study. Furthermore, the data visualization tools I had developed for the preliminary study constituted a substantial framework for the design of the two visualization methods used in the current study.

Experiment Aim

As described earlier, the experiment contains two stages. The first stage, namely the general-impressions task, is aimed at extracting an overall report on the participant's experience of a complete piece of electronic music. This section allows the participants to evaluate the piece holistically and provide their impressions in free form. Having listened to the piece with no prior assignments, the participants are expected to rely on their overall experience in order to complete this task.

The second stage, namely the real-time input task, collects the momentary impressions and mental images that are activated in the listeners' minds as they listen to the piece. This stage is aimed at collecting gesture-level descriptors that pertain to perceptual, cognitive and affective processes. While the first stage allows for an uninterrupted listening experience, the second stage allows for a continuous and immediate reporting of the mental associations evoked by the piece. Furthermore, tracking the momentary impressions of a participant allows me to pinpoint the moments at which the descriptors have been submitted. This way I can later evaluate the gestures and the real-time descriptors that correspond to each other on the timeline of the piece.

It is expected that the two stages of the experiment complement each other with overlaps in a participant's feedback from each stage. The conjunct aim of these two stages is to extract both contextualized and in-the-moment concepts activated in the participant's mind when listening to a certain piece, and to later identify the cognitive characteristics of each piece in the form of mental categories based on the real-time descriptors.

Stimuli

Five complete pieces of electronic music were used in the experiments. Four of these were my works, namely *Birdfish*, *Element Yon*, *Christmas 2013*, and *Diegese*. The fifth piece was Curtis Roads' 2009 piece *Touche pas*. An in-depth report on the materials, tools, and conceptual intents involved in the composition of my works, as well as Roads' program notes for *Touche pas*, were provided in the previous section. The sound files used during the experiments were in 44100 Hz, 16-bit WAV format.

Dealing with both the creation and the analysis of the subject matter is one of the differentiating traits of my approach, and of artistic research in general. The said four works were created during the four years of my research conducted at a doctoral capacity. As outlined in the previous chapter, these works are composed using a variety of materials and techniques afforded by the modern electronic medium. On a conceptual level, these compositions also utilized the underlying theoretical constructs of this research, such as *gesture* and *diegesis*. In that respect, my compositional intents with each piece, as detailed in the first chapter, also suggest an experiential variety. The pieces composed prior to these four works helped me develop my hypotheses on both artistic and scholarly trajectories, which eventually merged.

My authorship of these works grants me advantages in exploring the concept to percept associations, and communicating the results of such investigations to the reader. Using the results of this experiment, I was able to delegate the cognitive evaluation of these works. Based on these external reports, I will reverse engineer my own works in the coming chapters to bind the experiment results with the hypotheses underlying these works. After three years of experimentation, I feel relatively impartial towards the analyses of my works. Furthermore, I believe that the novelty of the insights I am able to draw as the composer of these pieces outweighs the noise my involvement with this material might introduce into the data. Nevertheless, to diminish the impact of a confirmation bias this involvement may impose on the data, the categorization of the descriptors was peer-reviewed.

I used Roads' piece *Touche pas* for two reasons. Firstly, I wanted to include an external work in this study so that I would have a reference when analyzing the data on my own works. In that respect, any piece of electronic music that does not belong to me could serve this function. But secondly, one of my intents with the piece *Diegese* was to explore the concept of "music as a diegetic actor", which I will further explicate in Chapter 5. In this piece, I quote a texture from *Touche pas* by utilizing an algorithmic granulation. Using both pieces in the experiments allowed me to highlight certain cognitive characteristics pertaining to this specific gesture, and granular synthesis in general.

Participants

60 participants from 13 different nationalities took part in the experiment between May 2012 and July 2014. 23 of the participants were female while 37 were male. The average age of the participants was 28.78. Ages ranged from 21 to 61. The pool of participants included professional musicians, music hobbyists, composers, and students of sound engineering, sonic arts and sonology, as well as 22 out of the 60 participants who described themselves as having no musical background. Based on the timing data obtained from the exercise section, all participants proved to be capable of typing 5-letter words in less than 1.5 seconds indicating a typing speed of 40 words-per-minute or faster, which is significantly above the average number of real-time descriptors per piece (as shown in Table 2.1 in the next section),

implying that typing proficiency did not constitute a performance bottleneck for the participants.

Although all participants of the experiment described themselves as English speakers, they were told that they could respond in their native languages whenever they preferred to do so. Two participants used Turkish for both the written and the typed sections of the experiment. Two additional participants typed their real-time descriptors in Turkish despite having written their general impressions in English. A few participants typed occasional descriptors in their native languages but responded in English throughout the rest of the experiment. All of these instances were in Turkish with the exceptions of *kraai*, meaning "crow" in Dutch, and *canicas*, meaning "marbles" in Spanish. Non-English feedback from the participants was translated to English prior to analysis.

Setup

I designed the software components of the experiment in HTML, CSS, Javascript and PHP. The browser-based interface communicates with a local SQL database to store the input from the participants. The choice of the web browser as a platform, and the overall design language of the interface is intended to reduce the amount of experiment mechanics the participants would need to be acquainted with by utilizing familiar interface elements and simple modes of interaction. Labels in the software interface and the text on the participation form were written in English to cater for an international group of participants.

The listening sections were conducted with closed-back (e.g. Beyerdynamic DT-770) or semi closed-back (e.g. AKG K240) stereo headphones that were tested to be capable of reproducing the entire frequency spectrum of the works used in the experiments. To run the browser-based experiment software, either an Apple Macbook Pro laptop computer with a built-in English QWERTY keyboard, or an Apple iMac desktop computer with a peripheral English QWERTY keyboard were used. The keyboard layouts for these two devices were identical. The experiments were conducted in individual units.

Procedure

Each experiment takes 15 to 20 minutes. Experiments are conducted between subjects, meaning that each instance of the experiment is administered with a different participant. The pieces are rotated across participants to achieve a random allocation with an equal number of instances for each piece. Verbal instructions are provided prior each section. The experiment procedure involves an initial listening, a general-impressions task, a real time input exercise and a real-time input task.

Initial Listening

The participants are seated in front of the computer which displays the software interface as seen in Figure 2.1. After a brief description of the interface, the participant is told that once the play button is pressed he or she will listen to an entire piece of music without interruptions. It is explained that what the participant will hear is not a test piece, and that they will not be asked quantitative questions about it afterwards. No information regarding the piece (e.g. title, duration, composer name) is disclosed to the participant. They are asked to simply listen to it, and try to enjoy it as they would with any piece of music. The participant is then provided with stereo headphones to listen, in its complete form, to one of the five pieces of electronic music listed above.

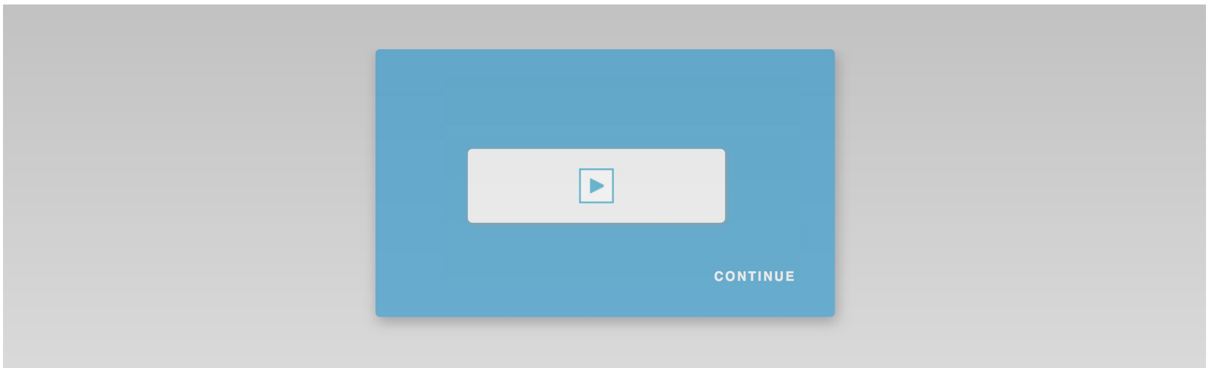


Figure 2.1: Initial-listening section software interface

General-impressions Task

When the initial round of listening is completed, the subject is asked to sign a participation form printed on A4 paper. The participant is then instructed to write, on the remainder of this paper, their general impressions as to anything they might have felt or imagined, or anything that came to their minds as they listened to the piece. This instruction was intended to cover a wide range of mental activations that could represent perceptual, cognitive and affective processes. They are advised to feel relaxed and take their time: it is explained that they could write freely in whatever form to whatever extent they prefer and no time constraints would be imposed for this section.

Once the participant indicates that they have completed the general-impressions task, they are asked to return to the computer and press the continue button on the software interface where they left off. In the following page, they are presented with a digital form, as seen in Figure 2.2, where they can input their personal details. Once this is completed, the participant proceeds to the exercise section for the second part of the experiment.

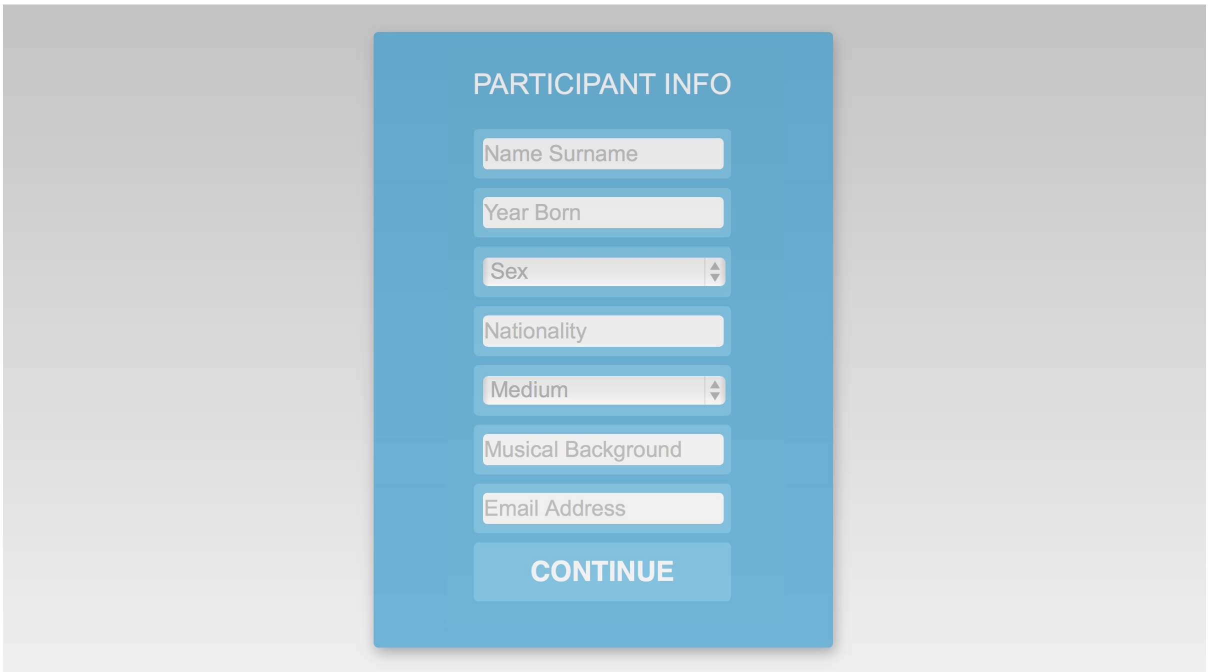


Figure 2.2: Participant information form

Real-time Input Exercise

In the exercise, the participant is greeted with the interface seen in Figure 2.3. It is explained that once the participant hits play, they will hear a voice recording of a text, and they are instructed to pick random words from this text, type them and hit the enter key to submit them one at a time. It is stated that once they press play, the cursor would flash in the text box ready for typing, and once they hit the enter key the field would be emptied and the cursor would go back to its initial position. This design ensures that the participants can secure their hands over the keyboard during the real-time input section of the experiment without having to navigate through the interface.

The main purpose of the exercise is to acquaint the participant with the software and hardware layout of the experiment medium. Both filling out the personal information form and the exercise section familiarize the participant with the input device. Although a standard QWERTY keyboard is used for all instances of the experiment, it is still necessary for the participant to practice typing with the particular keyboard used in the experiments prior to the real-time input task. The exercise section also allows me to monitor whether the experiment software is properly communicating with the SQL database. The recording used in the exercise lasts 30 seconds. However, if the participant experiences a problem during the exercise, it can be repeated. Once the exercise is completed, the participant is asked to press the continue button to proceed.

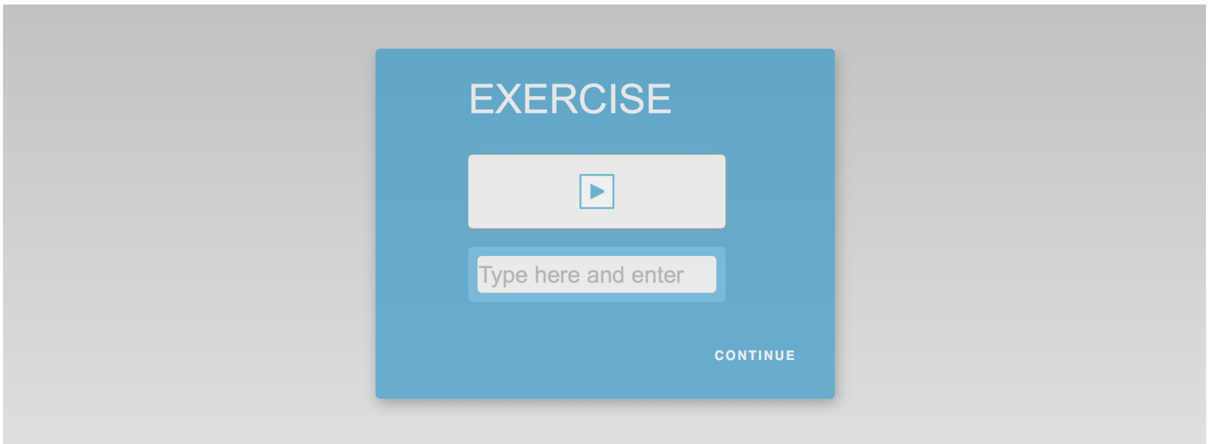


Figure 2.3: Real-time input exercise software interface

Real-time Input Task

In this section, the participants use the interface seen in Figure 2.4, which is almost identical to that from the exercise section, to complete a real-time free association task. Prior to this task, it is described to the participant that once they press the play button, the piece which they previously listened to will play a second time. It is explained that in this section, they are expected to submit descriptors as to what they might feel, imagine or think, the moment such descriptors come to their mind. The participants are advised to be relaxed and spontaneous, and not to contemplate what to type.

The interface seen in Figure 2.4, and the interaction method described in the exercise section are designed to encourage this spontaneity. Although the text box and the corresponding database structure allow for the entry of larger forms, this layout is intended to keep the participants from *disconnecting* from the listening experience for extended periods to type such entries to the detriment of the real-time nature of this section. The participants are also asked to disregard any typing errors and submit their descriptors as soon as they finish typing them.

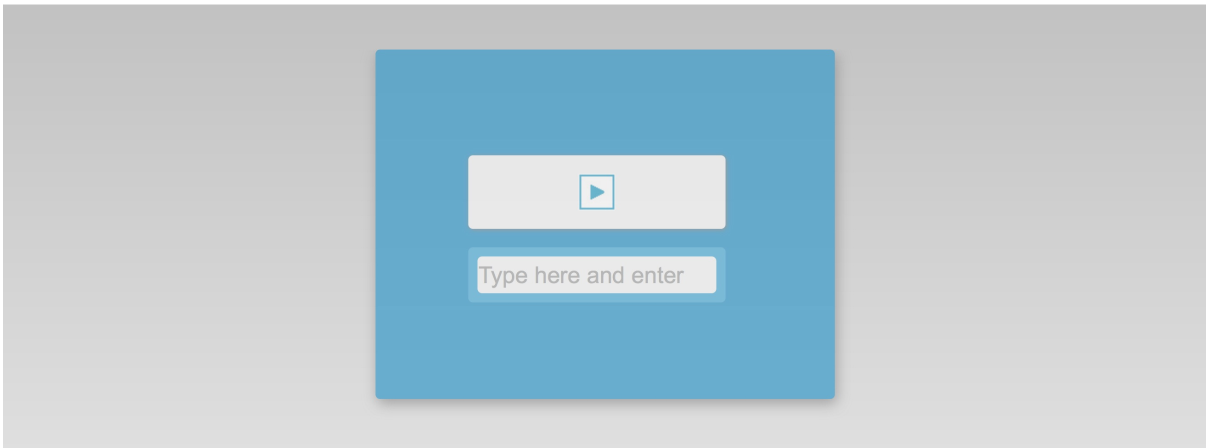


Figure 2.4: Real-time input task software interface

DATA ANALYSIS

Table 2.1 seen below provides an overview of the number of descriptors submitted in total for each piece. Although the vast majority of the descriptors were in the form of single words or two-word noun phrases, there were longer descriptors as well. The longest descriptor submitted was "trying to make the puzzle but can't quite do it" with 10 words.

The general impressions consisted of one or a combination of various forms including list of words, list of sentences, prose and drawing. Although no time constraints were specified for this section, most participants spent between 5 to 10 minutes writing their general impressions.

	Birdfish	Element Yon	Christmas 2013	Diegese	Touche pas
Piece Duration	4'40"	3'45"	2'16"	1'54"	5'30"
Total Number of RTD	334	170	198	161	339
Average Number of RTD per Participant	27.83	14.16	16.5	13.41	28.25
Average Number of RTD per Minute	6.05	3.77	7.27	7.05	5.13

Table 2.1: Total and average numbers of real-time descriptor (RTD) per piece, participant and minute

Data visualization

Experimental studies on auditory perception and cognition largely deal with *sound samples*. The statistical representations of the data in such studies are therefore sufficient to draw conclusions. However, the current experiment is conducted with complete pieces of electronic music. Therefore, the temporality of the listening experience needs to be incorporated into the analysis process. Given the sheer amount of descriptors submitted by the participants, it became apparent early on that custom tools for data visualization would be necessary for a meaningful evaluation of how the descriptors relate to the piece both within and across participants. For the comparative analysis of the real-time descriptors, I have developed two interactive visualization software using the multimedia programming language *Processing*.

Single-timeline Dynamic Visualization

The single-timeline dynamic visualization places the descriptors for one piece from all 12 participants on a musical timeline. This allows for a sequential analysis of the entries and provides a compiled overview of descriptors from multiple participants. However, given the number of real-time descriptors submitted for each piece as seen Table 2.1, it was impossible to make each descriptor readable when placed on a static timeline. To overcome this issue, I have designed a dynamic visualization software which reacts to the passage of time and highlights the relevant descriptors.

In both visualizations, the x-axis represents the timeline of the piece. In this particular visualization, all descriptors pertaining to a piece are placed on this timeline in a vertically cascading pattern as seen in Figure 2.5 with a vertical line drawn from the descriptor to its exact point on the timeline. Pressing the space bar on the keyboard starts the playback of the piece. As playback proceeds, descriptors which were submitted in the vicinity of that specific moment in the piece dynamically expand as seen in Figure 2.5. In order to maintain the temporal relevance between the piece and a given descriptor, the visual placement of each word is based on the time at which the participant started typing the descriptor. An entry begins to expand as the elapsed time approaches its point on the timeline and reaches it most extensive form when the time in the piece at which the typing of the descriptor began is reached. While this expanding behavior makes it possible to view all the descriptors on a single timeline, the fading behavior establishes a sense of context for the expanded descriptors.

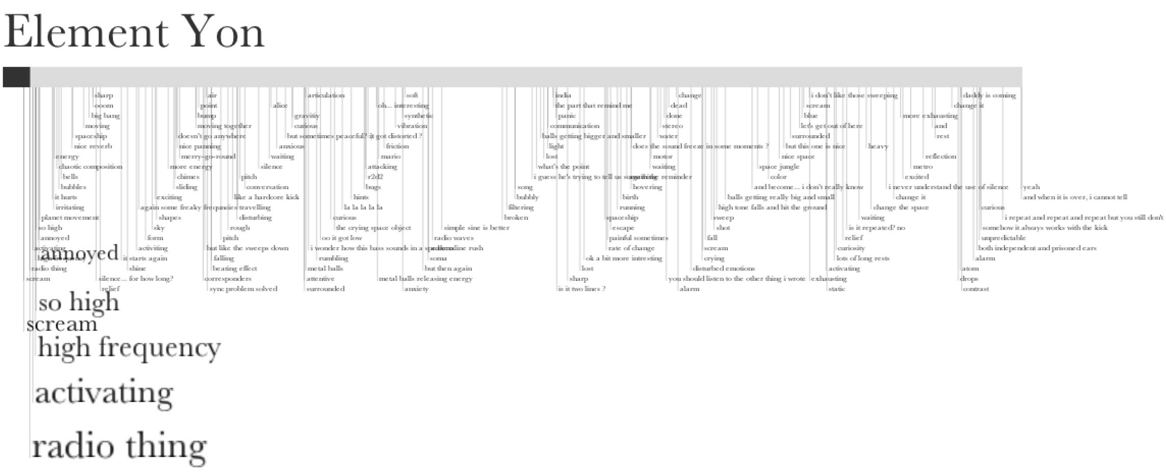


Figure 2.5: Single-timeline dynamic visualization of real-time inputs

The elapsed portion of the piece is displayed in a darker color on the timeline. Clicking on the timeline allows for jumping to different moments in the piece. The dynamic visualization also responds to these jumps by expanding the descriptors at the clicked point. The single-timeline dynamic visualization reveals the relationship between a particular gesture in the piece and the multitude of descriptors submitted by various participants at the moment the said gesture happens.

Multiple-timeline Visualization

To perform contextual analyses within and across participants, the descriptors had to be separated between different timelines. Similar to that of the single-timeline dynamic visualization, the software for multiple-timeline visualization is also capable of playing back the audio file relevant to the data which are being visualized. The visualization is static except for the progress bar as seen in Figure 2.6. It is likewise possible to jump to different points in the piece by clicking on the timeline; in this visualization however, doing so updates the progress bar for all the timelines, effectively highlighting the correspondences across participants. This visualization is also useful when performing per-participant contextual analyses of individual descriptors.

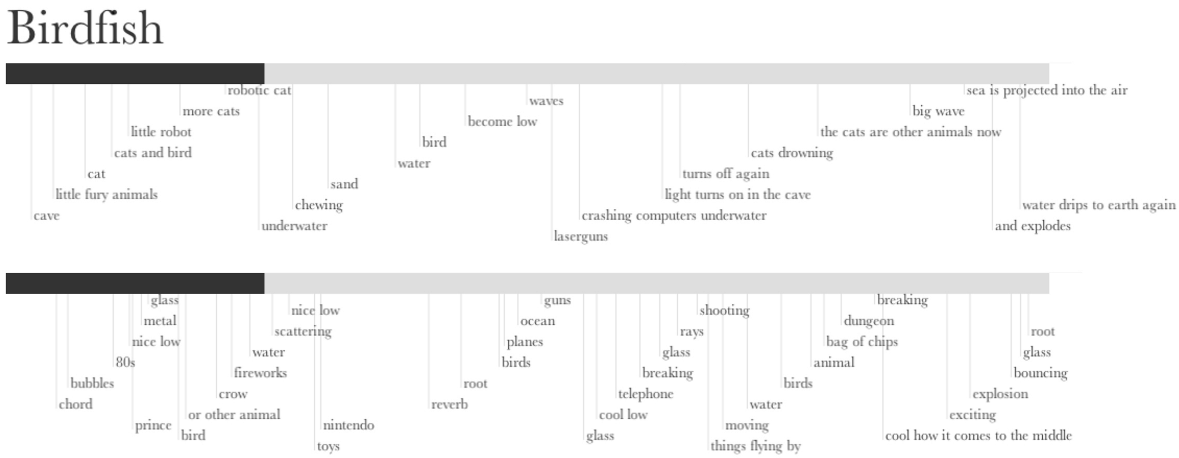


Figure 2.6: Multiple-timeline visualization of real-time inputs by two participants

Analysis Methods

Given the breadth and variety of the data obtained in the experiments, various tools and methods were employed for analysis. These included descriptor categorization, correspondence analysis, discourse analysis, and comparative analysis using the general impressions and the visualizations of the real-time descriptor data. The interpretations of these analyses will be dispersed throughout this book in support of the theoretical discourse.

Categorization of the Descriptors

In order to analyze the descriptors gathered from the real-time free association task, a categorization was imposed upon the data, following the model of many studies dealing with auditory perception (e.g. Ballas 1993; Marcell et al. 2000; Gygi et al. 2007; Guastavino 2007, Özcan 2008). In the preliminary studies an iterative process of thematic analysis was applied to the data to produce a set of descriptor categories. Once the emergent categories were determined, the category membership of each real-time input was assessed through forced-choice categorization. The categories derived from the preliminary study were *source*, *concept*, *scene*, *emotion* and *perceptual descriptors*.

To analyze the data from the current experiment, all of the 1202 real-time inputs were categorized under these five groups in an initial run. If a descriptor consisted of multiple words and noun phrases, it was split up into its constituents that would fall under a category individually (e.g. “computers underwater” broken into “computers” and “underwater”). When categorizing ambiguous descriptors, three cues were utilized: the musical background of the listener, the moment in the piece where the descriptor occurred, and the context of the descriptor (i.e. adjacent descriptors). 5 entries whose categorical correspondence could not be determined either due to obscurity (e.g. “but then again”) or over-generality (e.g. “sound”) have been left out of the categorization. After several iterations of the categorization process, it became apparent that some of these categories were too broad and had to be split up into subcategories. Furthermore, the addition of new categories was also found to be necessary.

Upon further evaluations of the categorical distributions, a list of labels which sufficiently represented the data set was established. This final list of categories addresses the various stages of meaning attribution such as perception, recognition and identification (Özcan 2008: 18), as well as processes of affective appraisal. The said list includes the following descriptor categories: *source descriptors* (SD – subcategorized into object descriptors, action descriptors and musical descriptors); *concept descriptors*; *location descriptors*; *affective descriptors* (AD – subcategorized into emotion descriptors, appraisal descriptors and quality descriptors); *perceptual descriptors* (PD – subcategorized into auditory descriptors and featural descriptors); *meta-descriptors*; *onomatopoeia*. The selection of the categories, and the forced-choice categorization of the descriptors were peer-reviewed by sound design specialist Dr. Elif Özcan Vieira, who is one of the advisors for the current book.

The source descriptor group covers submissions which can broadly be prefixed by the phrase "sound of". The three sub categories refer to *object source descriptors* (e.g. "water", "telephone", "frogs", "wind"), *action source descriptors* (e.g. "breathing", "explosion", "scratching", "bouncing"), and *musical source descriptors* (e.g. "guitar", "lullaby", "rhythm", "pop band"). Objects and actions can refer to both animate and inanimate beings. Musical source descriptors are objects of both animate (e.g. "Mozart) and inanimate (e.g. "percussion") nature. The choice of separating musical source descriptors from object source descriptors originated from both the significant number of relevant entries and my intent to research listener tendencies towards the usage of meta-musical forms as descriptors. This aspect will be further investigated in Chapter 5.

The concept descriptor category includes such descriptors as "waiting", "lights", "transition" and "summer". As seen in these examples, concept descriptors can be objects or actions; however, they do not refer to sounding objects/phenomena in themselves. On the other hand, these descriptors might refer to concepts that *imply* such phenomena, as in "war", "activating", "Chinese" and "science fiction".

Location descriptors refer to imagined spaces other than the one inhabited by the listener (e.g. "jungle", "underwater", "cave", "hallway"). A location descriptor can also indicate imaginary spatial attributes as in "distant", or merely imply an imagined yet unspecified environment as in "space" and "outdoors".

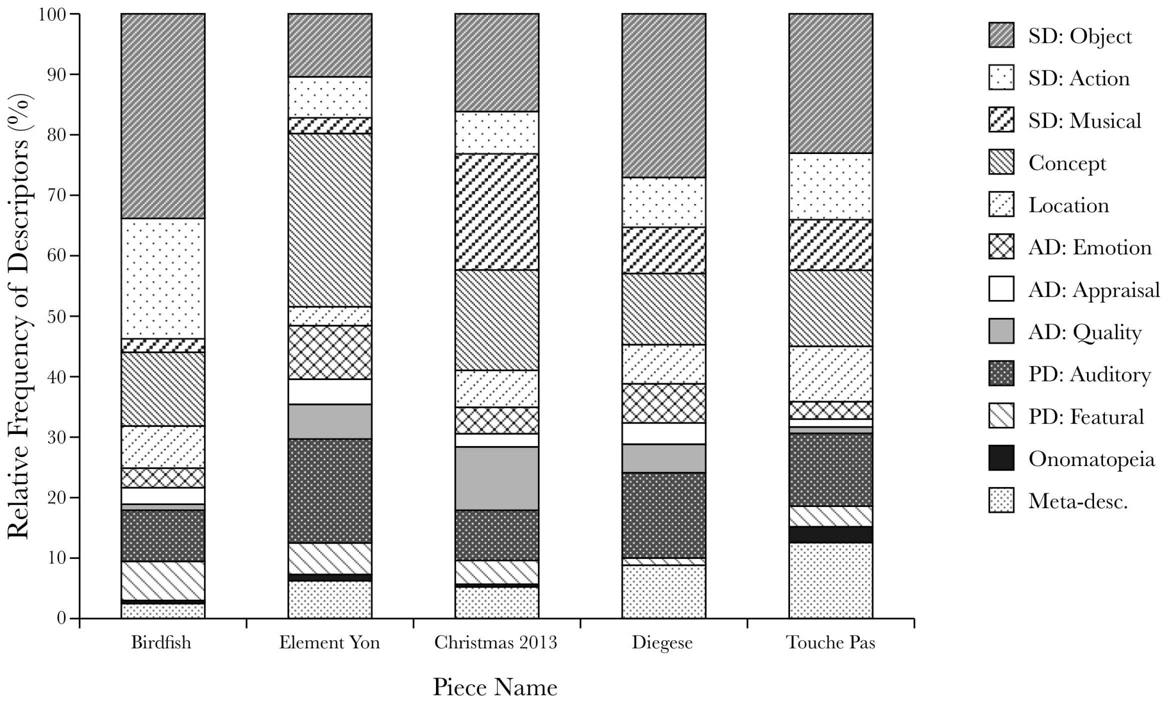
Affective descriptors are grouped into three subcategories. *Emotion descriptors* define feelings that relate to the listener's experience, such as "curious", "stress", "relief" and "fear". *Appraisal descriptors* such as "nice", "cool", "lovely" and "great" are often followed by a source descriptor as in "nice piano" or "cool low". These descriptors denote a listener's basic appraisal of certain components of the piece on a binary basis (i.e. good or bad). *Quality descriptors* such as "weird", "familiar", "exciting" and "mellow" are affective traits which the listener attributes to an external object, as in "relaxing rhythm". Therefore, the difference between emotion and quality descriptor categories is that while the former denotes a feeling of the listener, the latter describes a feeling of an object.

Perceptual descriptors are grouped into two sub categories. *Auditory descriptors* denote perceptual qualities of the sound such as "bass", "silence", "fade in" and "pan". *Featural descriptors* denote non-auditory perceptual qualities of the imagined objects, as in "wide (room)", "small (impacts)", "deep (cave)" and "dark (forest)".

Meta-descriptors refer to the material being of the piece in itself and not the experience of it (e.g. “(great) opening”, “want more bass”, “pause”, “end”). Such descriptors can also refer to form and technique (e.g. “counterpoint”, “granular”, “motif”, “pitch-shifter”).

The onomatopoeia category included a small number of descriptors such as “boooooom”, “ding” and “hummm”.

Graph 2.1 reveals the frequency distribution of each category by piece. The categorical distribution for each piece is already revealing. The reader of this book is invited to listen to these works and compare the results below with their own impressions. I will use these distributions in the coming chapters to draw conclusions both within and across the pieces.



Graph 2.1: Categorical distribution of real-time descriptors by piece

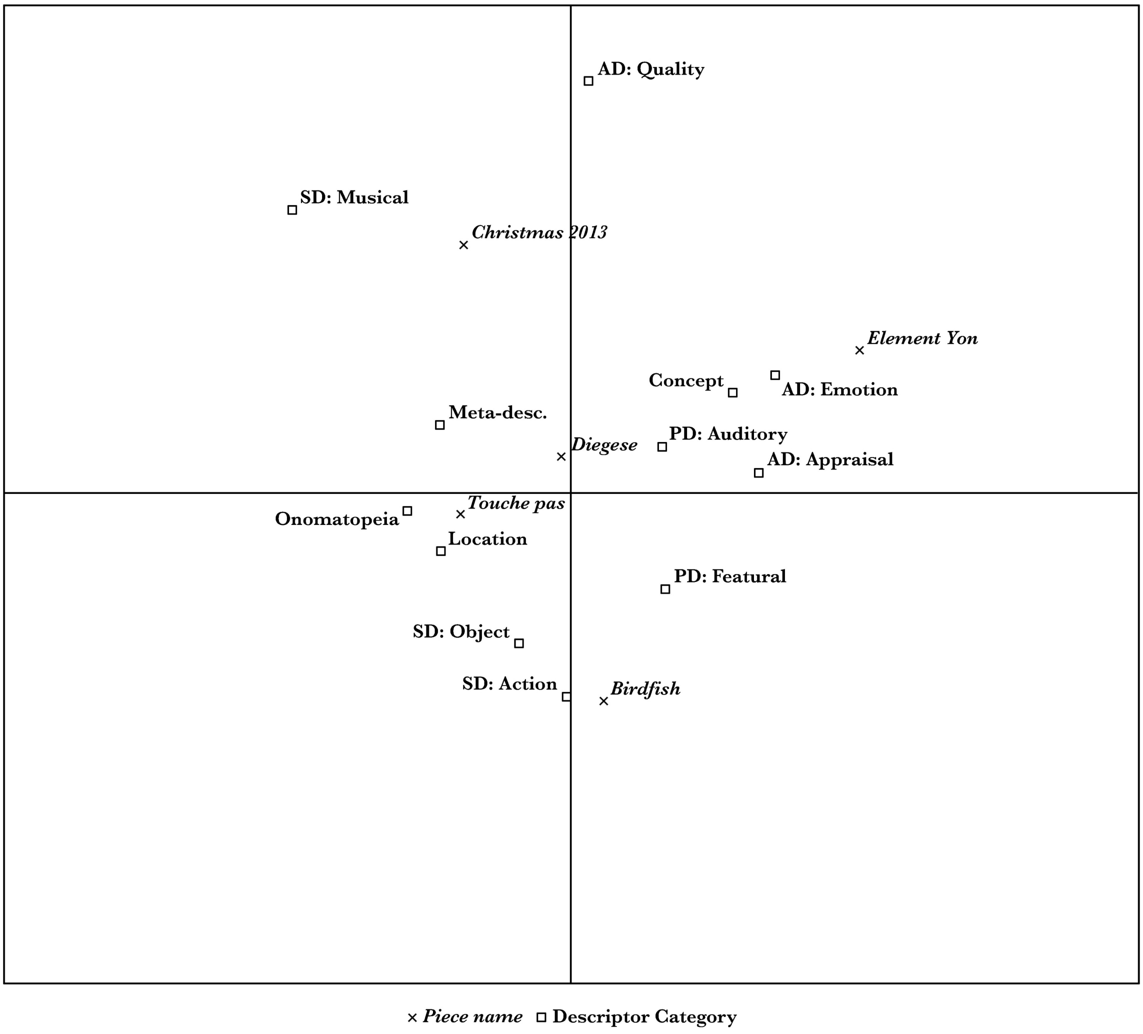
Comparative Analysis

The design of the current experiment allowed for various comparative analyses. Firstly, the general impressions and real-time descriptors were compared within participants to observe the semantic correspondence between the two sections of the experiment. Furthermore, general impressions across participants were also compared during discourse analysis as described below. For the comparative analysis of the real-time descriptors between participants I have used the custom visualization software described earlier.

The data from the two parts of the experiment displayed significant similarities within most participants. The basic themes and objects appearing in the general impressions of a participant were also apparent in his or her real-time descriptors to the most part. Therefore, the comparative analysis allowed me the use the general impressions to contextualize certain real-time descriptors in terms of the narratives and forms perceived by the listener. Conversely, it also allowed me to use the real-time descriptors to locate the parts in the piece to which certain general impressions relate.

Correspondence Analysis

Correspondence analysis is a statistical method for visualizing the relationships between the layers of a frequency distribution matrix. The rows and columns of a two-way contingency table are displayed as points in a low-dimensional space with the aim of maintaining "a global view of the data that is useful for interpretation" (Lee 1996: 65). The analysis is a representation of the categorization data as distributed on a two-dimensional graph in relation to their frequency of occurrence in each piece. The representation contextualizes pieces both within the categories and across other pieces. A correspondence analysis of the data from the current study can be seen in Graph 2.2. The five pieces used in the experiment are marked on the two-dimensional correspondence graph with an "×", while descriptor categories are marked with a "□".



Graph 2.2: Correspondence analysis between pieces and descriptor categories

Discourse Analysis

The content of the general impressions written by the participants was open to various interpretative methods thanks to its free form. One of the methods used for this purpose was discourse analysis. In this analysis, general impressions expressed in a multiplicity of formats (e.g. prose, list, drawing) are split into "meaningful sections" (Özcan 2008). For instance, the sentence "it reminded me of marbles falling" is reduced to the words "marbles" and "falling". This way, a list of keywords that represent a reduction of general impressions are generated. These keywords, in return, are grouped across participants by semantic similarity and evaluated on the bases of their frequencies. The data on the usage of different modalities to express general impressions are also indicated below. Multiple modalities used by a single participant (e.g. both a word list and a drawing), were counted separately. The analysis of an individual general-impressions session conducted with 8 participants who listened to *Christmas 2013* can also be found below.

Real-time inputs were also analyzed for semantic similarities. For a real-time descriptor to be evaluated in the discourse analysis below, it had to be repeated by at least 3 separate participants. The number of occurrence for each word is denoted next to it within parentheses. Certain real-time descriptors displaying semantic proximity were collated under a single descriptor. The collated descriptors are also provided below in a separate list.

Birdfish

<table>
<tr><td colspan="2">General Impressions (word list (5), sentence list (4), prose (3), drawing(1))</td></tr>
<tr><td colspan="2">[water, bubble, splashing, sparkling, fluid, flow, liquid, waves, lake],
[living, creatures, animal, amphibian, bird],
[slimy, worm, snail, squishing, insect, swarm],
[alien, Zerg, Starcraft, sci-fi, star wars],
[high tech, robots, electronic],
[granulating, grinding],
[metallic, blades, gong],
[sense of space, cave, Efteling], bass, dialogue</td></tr>
<tr><td colspan="2">Real-time Descriptors (used by a minimum of 3 participants)</td></tr>
<tr><td>water (12), underwater (3), bubble (3),
bird (7), flying (4),
creature (7), cat (4),
bass (6), big (5),
laser (4), war (3), metal (3),
bug (3),
(sense of) space (3),
mouth (3),
high frequency (3), small (3)</td><td>Collated Descriptors:
water, wet, liquid, fluid, something spilling;
bug, ant, swarm;
animal, creature;
mouth, eating;
bass and low frequency;
high frequency and high pitch.</td></tr>
</table>

Element Yon

<table>
<tr><td colspan="2">General Impressions (prose (6), word list (3), sentence list (3), drawing(1))</td></tr>
<tr><td colspan="2">[wide spectrum, spectral, high frequency, low frequency, contrast],
[electronic, oscillators, synthetic, abstract],
[unpredictable, unstable, unclear, confusing, surprising, exciting],
[dangerous, scary, chaotic, argument],
[painful, irritating, exhausting, annoying], [relief, relieving, calm],
[slow movement, stable, still], silence,
[science fiction, Tron]</td></tr>
<tr><td colspan="2">Real-time Descriptors (used by a minimum of 3 participants)</td></tr>
<tr><td rowspan="2">disturbing (5),
rest (5), relief (4),
sweep (4),
conversation (3)
high (3), frequency (3),
pan (3),
static (3),
repeat (3),
(outer) space (3),
cry (3),
I (3)</td><td>Collated Descriptors:</td></tr>
<tr><td>disturbing, painful, annoyed, irritating, hurt;
rest, freeze, static, wait;
relief, release, peaceful, silence;
conversation, communication, he’s trying to tell us something;
cry, scream;
high, sharp;
frequency, tone, pitch;
sweep, slide, fall;
repeat, again;
space, spaceship;
pan, travel, move.</td></tr>
</table>

Christmas 2013

General Impressions (prose (5), sentence list (5), word list (4), drawing (1))	
[creepy, scary, thriller, paranormal activity], [nervous, stressed, anxiety], [relaxing, happy, calm, relieved, hope, fairy-tale], [melodic, piano, music, song, ballet, cliché, familiar], [space, extraterrestrial, astronomy, science, computer], water	
Real-time Descriptors *(used by a minimum of 3 participants)*	
music (10), piano (9), scary (5), machine (5), (sense of) space (4), suspense (4), storm (4), rumble (3), electronic (3), familiar (3), nice (3), bird (3)	*Collated Descriptors:* music, soundtrack, ballet, a dance, Mozart, jazz, Yes (band), Pink Floyd, Christmas song, cliché; electronic, electricity; scared, scary, Paranormal Activity (film), creepy, death; rumble, low drone; machine, robot, modem, matrix, inhumane; storm, thunder, turbulence; suspense, expectation, anticipation, waiting

Christmas 2013

Individual General-impressions Session (prose (4), sentence list (3), word list (2))
Christmas, [instruments, drums, piano, harmonium], [tonal thread, melody, cadence], [nostalgia, memory, 80s], flying, movement, slow, space

Diegese

<table>
<tr><td colspan="2">General Impressions (sentence list (6), prose (5), drawing (2), words (1))</td></tr>
<tr><td colspan="2">[piano, keyboards, instrumental, song], [comfortable, pleasing, cool, happy],
[ball, ping pong balls, spherical, circular objects], [bouncing, drop, percussive, impulse],
[tiny organisms, insects],
[sands, grains],
[pond, liquid, water, waves, boiling, humid],
[imaginary, mysterious, science fiction, Alice in Wonderland]</td></tr>
<tr><td colspan="2">Real-time Descriptors (used by a minimum of 3 participants)</td></tr>
<tr><td rowspan="2">piano (7),
insect (5),
ball (5),
drop (3),
door (3),
dense (3),
exciting (3),
weird (3),
bass (3),
panorama (3)</td><td>Collated Descriptors:</td></tr>
<tr><td>insect, bug;
pinball, ping pong ball, ball, bubble;
dense, complex;
weird, uncomfortable, creepy</td></tr>
</table>

Touche pas

<table>
<tr><td colspan="2">General Impressions (prose (6), sentence list (4), word list (3), drawing (2))</td></tr>
<tr><td colspan="2">[marble, ball, bowling ball, circular, coin],
[bouncing, dripping, falling, breaking, impact, percussion, door (knocking)],
[granular, pieces, particles],
[convincing physicality, visual],
[calm, relaxing, meditative, relief],
[silence, pauses, ending],
[water, fluid],
[distant, far away, afar], sense of space,
material, panorama, motif, fun</td></tr>
<tr><td colspan="2">Real-time Descriptors (used by a minimum of 3 participants)</td></tr>
<tr><td rowspan="2">ball (6),
again (5), repetition (4),
water (5), drop (3),
percussive (4),
(sense of) space (4),
bells (4)
reverse (4),
grain (3),</td><td>Collated Descriptors:</td></tr>
<tr><td>ball, marbles;
grain, granular;
percussive, gong, xylophone, woodblock;
reverse, rewind</td></tr>
</table>

CHAPTER 3

COGNITIVE FOUNDATIONS OF ELECTRONIC MUSIC

COGNITION OF MUSIC

Before going into a discussion of the experiential characteristics of electronic music, I will provide an analysis of music cognition in general. A significant amount of research into this matter has been conducted over the past decades. Furthermore, musicologists, music theorists and philosophers have been placing immense scrutiny on the mechanisms underlying music appreciation for as long as their fields have existed. We therefore have a relatively large body of knowledge on the cognition of music. The overview below will function as a frame of reference for when I describe the cognitive idiosyncrasies of electronic music in the following section.

An overwhelming majority of research on music cognition focuses on Western musical practices (Cross 2010: 4). While this causes my frame of reference to be skewed towards Western music, the discourse on music cognition nevertheless takes cultural orientations into account. I should also note that my focus throughout this section will be on instrumental music. Text-driven vocal music, although utilizing similar devices as instrumental music, communicates meaning through spoken language. Since such a language is a communication system that relies on its own semantic conventions, a study of verbally communicated meaning falls outside the scope of the current discussion.

Development of Musical Behavior

A complex web of perceptual and cognitive processes determines the nature of a musical experience. The gestalt of this experience is a mysterious transduction of changes in air pressure into affective appraisal. I will now go over some of the facts and hypotheses which address this mystery.

Since music predates recorded history, we only have theories regarding its origin. Throughout its existence, music has been associated with various functions ranging from communication to ritual. It is therefore impossible to delineate a single instigator for musical activity in humans. The author and soundscape artist Bernard Krause, for example, breaks the history of musical sound into several evolutionary stages (2012). In his taxonomy, *geophony* represents sounds produced by the earth: wind, thunder and earthquakes are examples of geophonic sound sources. On the other hand, *biophonic* sounds are produced by living organisms, particularly by animal species which predate the evolution of humans. Krause suggests that biophony has its roots in geophony, because animals might have initially imitated the sounds of the earth. Going further ahead in the evolutionary chain, Krause describe *anthrophony* as sounds produced by humans. He hypothesizes that humans were originally inspired by geophonic and biophonic sounds when establishing a vocabulary of vocalizations. In his book *The Great Animal Orchestra* (2012), Krause provides several examples of biophonic sounds which made their way from biophony to the musical vocabulary of humans. However, even research in the relatively modern field of biomusicology would admit, for instance, that the connection between music and animal song is ambivalent (Brown et al. 2001: 8). Several other theories indicate that music could have originated from, or at least co-evolved with speech and language (Richman 2001: 301; Marler 2001: 45; Mithens 2005: 6).

The ongoing discussion on the evolutionary origins of music is extensive. A different point of focus in this area is the development of musical behavior in humans from birth. Since the sense of hearing is primarily a survival tool for human beings, the auditory system functions in a multi-sensory context. There are many studies on the perception and semiotics of sounds which focus on the correlations between auditory and other sensory information (e.g. visual and kinetic stimuli) (Warren et al. 1987; Merer et al. 2007; Özcan and van Egmond 2009; Vines et al. 2011). Music as an auditory phenomenon inevitably inherits multimodal characteristics. In relation to this biological disposition, several studies indicate that certain features of music and the affective appraisal of musical experience have evolved similarly across cultures. In their experiment-based investigation of the correlations between the dynamic structures of music and movement, Sievers et al. (2013) found that certain structural features like rate, direction and dissonance prompted similar emotions when evaluated separately within music and animations. Furthermore, the reactions to structural similarities across music and movement were consistent amongst participants from the US and Cambodia, implying cross-cultural roots to this behavior.

In another study on how low-level variables in music, such as changes in pitch, dynamics and rhythm are mapped in the non-auditory domains of space and motion, Eitan and Granot collected data that corroborate certain widely shared assumptions on the matter (e.g. a decrease in pitch corresponding to a downward motion). However, they also found that these cognitive mappings were multifaceted and much more complex than previously assumed: "[m]usical space seems to be skewed in many different ways, rather than composed of neatly arranged, symmetrical parametric scales and intervals" (2006, p, 242).

While music shares similarities with speech in terms of communication of emotions, the evolutionary origins of the associations between pitch patterns and emotional states are not clear: these associations may have arbitrarily emerged and evolved over time into a "formal communicative code", or they might have formed based on the physiological characteristics of the human auditory system (Curtis 2010: 12). Accordingly, Brown et al. underline a middle ground for the discussions on the origins of music perception mechanisms: while ethnomusicologists are mostly skeptical towards *musical universals*, which imply biological determinism, modern biocultural studies on social behavior motivates "a balance between genetic constraints on the one hand, and historical contingencies on the other" (Brown et al. 2001: 13). Evidence suggested as a preview to a universal music theory addresses several aspects of a musical structure:

> [O]ctaves are perceived as equivalent in almost all cultures, that virtually all scales of the world consist of seven or fewer pitches (per octave), that most of the world's rhythmic patterns are based on divisive patterns of twos and threes, and that emotional excitement in music is universally expressed through loud, fast, accelerating, and high-registered sound patterns. (14)

Trehub corroborates this view by enumerating other universals such as the prevalent emphasis on global structure in music, preference of small-integer frequency ratios between pitches and the ubiquity of unequal steps in scales (Trehub 2001: 427). The universality of these characteristics implies biological roots to music. Yet "most of these features are low-level structural properties" (Sievers 2012: 1).

From Biology to Culture

When we look at Western music history, we can observe that music has evolved into a much more complex artifact than individual variations in low level properties such as pitch, timbre and rhythm. Furthermore, certain seemingly instinctual behaviors that are genetically transferred may be rooted in a naturally selected ability to learn. This theory, called *The Baldwin Effect*, points to a cultural inheritance of learned behavior across generations (Depew 2003: 3). In his book *How Musical is Man?*, the ethnomusicologist John Blacking describes a common understanding of music as "a system of ordering sound in which a cumulative set of rules and an increasing range of permissible sound patterns" (1973: x). He later explains that while biology does have an impact on musical abilities, social factors play a much more important role in their development (46).

In short, there are qualities of music we enjoy due to our physiological disposition, but beyond that is an experiential complexity that originates in culture. A multi-disciplinary investigation of this complexity is necessary in order to form a comprehensive understanding of how and why we engage in musical activities. For instance, in a perception study conducted with infants, researchers observed a preference for consonant intervals between pitches (Trainor et al.: 187). While this implies a physiological origin for musical consonance, it also reveals that the aesthetic appeal of the so-called dissonant intervals is a cultural phenomenon (Curtis 2010: 346). Several other studies conducted with young children highlight a corroborating idea that musical expectancy depends heavily on cultural learning (Juslin and Västfjäll 2008: 568) and does not develop fully until sometime between the ages 5 and 11 (569). In other words, we learn to appreciate many characteristics of music. From a different research perspective, neuroscientific evidence supports that music is an acquired taste. In a recent fMRI-based experiment conducted to investigate the neural processes related to reward in previously unheard music, Salimpoor et al. observed significant effects of sociocultural factors, experience and memory:

> [O]ur appreciation of new music is likely related to (i) highly individualized accumulation of auditory cortical stores based on previous listening experiences, (ii) the corresponding temporal expectations that stem from implicit understanding of the rules of music structure and probabilities of the occurrence of temporal and tonal events, and (iii) the positive prediction errors that result from these expectations. (2013: 218)

These findings suggest that musical taste is based on the accumulation of our listening experiences. Whatever music we have heard thus far will contribute to our appreciation of the music we will listen to in the future.

Music and Emotion

Music, despite lacking immediate survival value, activates brain mechanisms associated with pleasure and reward. The neurobiology of music may be "incompletely understood" but there is scientific evidence that listening to music activates "brain areas involved in the formation of learned associations and representation of value in stimuli" (Omar et al. 2011:

1814). Correspondingly, experienced listeners have been observed to exhibit increased neural responses related to emotion when compared to inexperienced listeners (Chapin et al. 2010: 8).

> The journey from listening to feeling involves a dynamic interplay between several neural systems (…) It is from this complex interaction of auditory, attentional, motor, emotion, and cognitive networks that feeling takes form and sound becomes music. (11, 13)

The combined sensory and cognitive experience of a musical piece influences the listener's affective state (Salimpoor et al. 2013: 218). In a study on the induction of emotions in music, the psychologists Juslin and Västfjäll refer to existing research which indicate that "people value music primarily because of the emotions it evokes" (2008: 559) and emphasize a need to investigate the mechanisms underlying the affective appraisal of music. They argue that evocation of emotions in music is based on processes that are not exclusive to music. As a result, they enumerate six mechanisms which they have observed to contribute to this phenomenon: *brain stem reflexes*, *evaluative conditioning*, *emotional contagion*, *visual imagery*, *episodic memory*, and *musical expectancy*. These mechanisms do not function in a mutually exclusive manner but rather assume complementary roles when processing emotions. Our emotional experience of music is the outcome of complex interactions across these mechanisms (572). Below are several of the said mechanisms that pertain to the current discussion:

Brain stem reflex deals with the previously described low-level structural and cross-cultural characteristics of the musical experience. Brain stem reflexes are hard-wired and are connected with the early stages of auditory processing. Sounds that are "sudden, loud, dissonant, or feature fast temporal patterns" signal the brain stem about potentially important events and induce arousal. According to Juslin and Västfjäll, this arousal reflects the impact of auditory sensations, "music as *sound* in the most basic sense" (564).

Visual imagery is a mental process which resembles perceptual experience but occurs in the absence of relevant stimuli. Several studies have shown that music is highly capable of stimulating such processes. Whether visual imagery involves "pictorial" representations or it reflects "propositional" representations of events in mind is an ongoing ontological debate. However:

> [L]isteners seem to conceptualize the musical structure through a metaphorical nonverbal mapping between the music and so-called image-schemata grounded in bodily experience. (566).

Musics which accompany certain life events are stored in e*pisodic memory* and represent a point of reference for pleasantness of a musical experience. Episodic memory is therefore a "subjectively important source of emotion in music" (567).

Musical expectancy pertains to the induction of emotions through the violation of a listener's expectations. This, however, should not be confused with simple forms of unexpectedness, such as the sudden onset of a loud tone, which would instead trigger a brain stem reflex. the development of musical expectancy involves the cultural learning of syntactical relationships across the components of a musical structure (568).

In their open peer commentary on Juslin and Västfjäll's theories, Fritz and Koelsch suggest the addition of *semantic association* to the mechanisms that underlie music perception (2008: 580). They give the examples of drum figures in the musics of African cultures and national anthems as musical forms which could evoke semantic associations. Since the semantic concepts attached to these musics exhibit emotional connotations, decoding of these associations can induce emotional responses (580). The composer and philosopher Leonard B. Meyer refers to musical structures which elicit semantic associations as *connotative symbols*. A connotative symbol can designate a specific emotional state and be indicative of "a specific idea, concept, or individual" (Meyer 1956: 260).

Leonard B. Meyer's comprehensive analysis of meaning in music constructs and consecutively deconstructs a dichotomy between absolute and referential meanings in music. The absolutist approach claims that music communicates only musical meaning, which is *abstract* and *intellectual*, and musical material refers to nothing but itself. Conversely the referentialists contend that music is capable of communicating meanings that refer to the "extramusical world of concepts, actions, emotional states, and character" (1). Meyer's position on this matter is that music can indeed convey referential meanings but the two camps are not mutually exclusive: these two types of meaning "can and do coexist in one and the same piece of music, just as they do in a poem or a painting". More importantly, both types of meaning "depend upon learning" (2). The communicated meaning of either flavor can be both intellectual and emotional at the same time (39). Meyer's opinion as a music philosopher is in agreement with the scientific studies on emotion in music as discussed above.

Material and Language of Instrumental Music

The material of music is fabricated. The musical instrument is a sound source manufactured to produce *pure sounds*: most instrumental sounds are harmonic and display a smooth temporal evolution when compared to the sounds of daily life (Gaver 1993a: 2). Although modern performance practices explore further timbral possibilities of acoustic instruments, the instruments were originally designed to articulate proportional tonal relationships. The language through which an instrument speaks is therefore fabricated in a similar fashion. A musical language is based on "codes of a convention consolidated over the centuries" (Boulez 1986: 4).

> [T]he listener qualifies sounds as musical, because s/he hears certain characteristics that lead him/her to believe that s/he is hearing music. These sounds more or less comply with the musical precedents s/he is familiar with, and therefore s/he calls these musical sounds. This results in the listener assuming a listening stance that differs from everyday listening. As soon as s/he has decided to regard a series of sounds as music, other conventions, criteria, and precedents are used while listening to it. (Meelberg 2006: 15)

The constituent structures of a musical language, such as melodies and harmonies, are abstract concepts that have been gradually established and acknowledged over time. In that sense, music had managed to reverse the traditional development of semiosis, as the sign (i.e. the abstract components of a musical language) has come to synthesize the referent (i.e. affective appraisal). We have constructed a plethora of clichés to facilitate musical communication (Huron 2006: 2) and the fabricated structures of music have been engraved in our deep-seated mechanisms of music perception. The sociocultural environments we are born into provide us with an initial context of conventions, and as we become exposed to new music, our musical vocabularies expand. Although certain musical affects such as frisson, have their roots in biology (34), we primarily *learn* how to feel about music. Our culturally-idiosyncratic musical languages mediate our appreciation of music.

While, from various ontological perspectives, music can be described to serve other goals, I will align myself with the scientific evidence above and contend that musical experience is ultimately one of emotions. This emotion can be the satisfaction gained from the systematic resolution of a purely formalist program, or it could be the overtly clichéd sadness of a minor chord. By arguing thus, I do not intend to motivate an opposition against divergent views on what is to be experienced in music but rather to situate emotion, of various kinds and degrees, as the inevitable outcome of musical experience. The language of instrumental music can therefore be considered to translate musical material into human emotions.

Affect in Music

This translation of material into emotion is a multifaceted process which involves a host of mechanisms. Therefore the affective appraisal of music comprises successive stages which utilize different but interconnected perceptual resources. A particular component of this spectrum, which will contribute to further discussion in the next chapters, is the experience of affect. The previous references to affective appraisal in this section pertained to the use of the term in psychology. But the concept of affect has been applied to many studies of experience in a variety of domains ranging from virtual reality (Bertelsen and Murphie 2010) and painting (Deleuze 2003) to politics (Massumi 2010) and sports (Ekkekakis 2012). This concept is not only adopted by a large array of disciplines but it is also subjected to a miscellany of interpretations. On the far end of the spectrum, Lim et al. (2008: 118) and Shouse (2005) point to uses of affect as a synonym for emotion. While this approach begs the question of why affect would need to be demarcated as a separate concept, it nevertheless provides an insight regarding the context within which the concept is situated. The particular interpretation of affect that I find constructive for the current discussion is offered by the philosophers Deleuze and Guattari:

> We paint, sculpt, compose, and write with sensations. We paint, sculpt, compose, and write sensations. As percepts, sensations are not perceptions referring to an object (reference): if they resemble something it is with a resemblance produced with their own methods; and the smile on the canvas is made solely with colors, lines, shadow, and light. If resemblance haunts the work of art, it is because sensation refers only to its material: it is the percept or affect of the material itself, the smile of oil, the gesture of fired clay, the thrust of metal, the crouch of Romanesque stone, and the ascent of Gothic stone. The material is so varied in each case (canvas support, paintbrush or equivalent agent, color in the tube) that it is difficult to say where in fact the material ends and sensation begins; preparation of the canvas, the track of the brush's hair, and many other things besides are obviously part of the sensation. How could the sensation be preserved without a material capable of lasting? And however short the time it lasts, this time is considered as a duration. We will see how the plane of the material ascends irresistibly and invades the plane of composition of the sensations themselves to the point of being part of them or indiscernible from them. (2000: 466)

The use of affect in philosophy dates back to Spinoza's *Ethics.* Spinoza identifies affect as an affection of the body by which "the body's power of acting is increased or diminished" (1994: 154). In his introduction to Deleuze and Guattari's *A Thousand Plateaus*, the philosopher Brian Massumi offers a related description of affect as a "prepersonal intensity corresponding to the passage from one experiential state of the body to another" (in Deleuze and Guattari 1987: xvi). Emotion on the other hand is personal according to Massumi:

> Emotion is qualified intensity, the conventional, consensual point of insertion of intensity into semantically and semiotically formed progressions, into narrativizable action-reaction circuits, into function and meaning. (2002: 28)

The music philosopher Vincent Meelberg, offers a comparatively demystified interpretation of affect based on Massumi's definition. In his analysis of expressive qualities in music, Meelberg proposes a differentiation between musical gestures and *sonic strokes*. A sonic stroke is an acoustic phenomenon that induces musical affect upon impacting the listener's body (Meelberg 2009: 325). A consequence of this impact is emotion, which emerges once the affect is reflected upon (i.e. a sonic stroke is registered as a musical gesture).

Connecting this philosophical approach with the scientific studies discussed earlier, affect can be considered to engage with brain stem reflex. Due to its attachment to the early stages of auditory processing, brain stem reflex is highly correlated with physiology and the so-called universals (i.e. the low-level structural properties) of musical experience. A functional coherence between affect and the brain stem reflex is highlighted by their intrinsic reliance on the spectrotemporal and dynamic properties of musical sound. While affect represents the corporeal segment of the affective appraisal of music, it cannot be dissociated from an ensuing emotion. This is mainly due to the aforementioned interplay between the mechanisms underlying music cognition. The musicologist Marc Leman points to seminal neuroscientific studies, such as those by Antonio Damasio, Marc Jeannerod and Wolf Singer, that motivate a departure from the Cartesian view of mind and matter as separate entities; it is understood that the so-called subjective world of mental representations stems from our embodied interactions with the physical environment (Leman 2008: 13).

> [T]he conceptual system is grounded in sensorimotor simulation. It is becoming increasingly difficult to argue that the conceptual system is completely modular and amodal. To the contrary, the conceptual system appears to share many mechanisms with perception and action, thereby making it non-modular and modal. (Pecher et al. 2003: 129)

This view brings us back to the understanding of music cognition grounded in the indivisible union of body and mind; biology and culture. From a phenomenological perspective, the mechanism of anticipation can be considered to mediate our everyday experiences (Schutz 1967:58), musical or not. *It is no surprise*, then, when the music cognition researcher David Huron congruently characterizes musical expectancy as being interwoven with both biology and culture (2005: 3).

COGNITIVE IDIOSYNCRASIES OF ELECTRONIC MUSIC

Now let us look at how electronic music differs from instrumental music in terms of the listening experience. There are two standpoints to be noted here that are fundamental to the research discussed here and my practice in general: Firstly, when I refer to *listening*, I do not seek a separation between the composer and the listener. As briefly touched upon in Chapter 1, listening will be considered the primal activity of electronic music composition with regards to the particular characteristics of cognition that are being scrutinized in this book. Secondly, although it may initially appear that I intend to impose a dichotomy between instrumental and electronic musics, this is in fact not so. The following comparison between the two will act as a gateway to a discussion of the cognitive idiosyncrasies of electronic music. Eventually, I will argue that the experiential differences between the two, merely represent poles in a continuum; their juxtaposition reveals more of an *amalgamation* than a *shift* in languages.

The electronic medium affords myriads of techniques to compose music. I have described a number of these in Chapter 1 when I also stated that, from a listener's perspective, pieces created with drastically different techniques could be experienced similarly. This also implies that the actions through which a composer materializes an idea may be perceived by the listener differently. For instance, a participant of my experiment expressed in his general impressions that *Element Yon* might be a generative piece although the piece was composed almost entirely by performing with various devices and later montaging the results. Conversely, some participants have associated the algorithmically generated sections of *Diegese* with choreographed narratives. Later in the chapter, I will adopt a semiological model to overcome a communicational hierarchy between the composer and the listener and to put the emphasis on the complexity of listening instead.

The composer who is also a listener

> The composer as a listener is the correlate of the composer as a producer: in order to produce music, an act of hearing is necessary, whether it be the "inner hearing" (the silent writing situation) of pure instrumental music composition, or the "concrete hearing" of electroacoustic music composition. These situations involve variants (there are many others) of an "action/perception feedback loop" which can be defined as an instance of validation proper to musical processes. (Vaggione 2001: 60)

The composer Horacio Vaggione's distinction between modes of hearing articulates some essential characteristics of electronic music composition. For the composer working in the electronic medium, both inner and concrete modes of hearing become vital activities. While the interplay between these actions will be unique to each instance of composition, they will nevertheless coexist.

Undoubtedly, the gamut of compositional strategies in electronic music is extremely wide but a common scenario for me, and perhaps other artists, is as follows: I *imagine* or *recall* a sound. This sound may have been conjured up as a component of a premeditated structure, or it might act as a starting point at a more exploratory stage of composition. I might have *listened* to this sound previously or I might be making this sound up from scratch, but a pool of possibilities had already been defined through what I am physiologically capable of hearing and what I had previously heard. On certain occasions, I prefer to draw this sound on paper[8]. This drawing might represent the temporal unfolding of an envelope (i.e. a waveform) or the spatial movement of a sound object. Such drawings display similarities to how I would animate sound events with hand gestures if I were to talk about my music. So far no sound has been produced in the physical domain. The sound has been imagined and may have been represented in different modalities. All these actions are guided only by my inner hearing.

The process up until this point is not intrinsically different for a composer of instrumental music. The possible pool of sounds is defined by the *material* of instrumental music, as discussed in the previous section, and what is recalled would be expressed in the *language* which the instruments are designed to speak. In the case of instrumental music, the act of creating visual representations of musical ideas would correspond to the writing of the score. The difference for the instrumental music composer is that this process remains the sole activity until the work is interpreted by a performer. The back and forth between creating and evaluating the work transpires within a loop between the composer's inner hearing and the score on paper. The composer is capable of auditioning chunks of music by playing it with an instrument or via software, the latter being a fairly modern artifact, but the results would still be mere representations of the actual work. Of course, a work can be a solo piece which the composer herself can perfectly imagine and recreate on an instrument, but in this case either the inner hearing lends itself to concrete hearing where the writing becomes no longer silent in an improvisational manner, or the composer assumes consecutive identities, writing music through inner hearing as a composer and later interpreting as a performer.

Electronic music blurs this distinction by affording the coexistence of hearing modes. To illustrate this, let me continue describing my experience as an electronic music composer from where I left off: the sound has been imagined through inner hearing, yet no sound has been produced. At this point, I proceed actually to design this sound. There are several strategies to achieve this: If the sound in mind is referential (e.g. the sound of a wind blowing, the sound of shattering glass), I might (a) record this sound from an actual source, (b) record sounds that create an illusion of the reference (similar to foley in filmmaking) or, (c) generate sounds that create an illusion of the reference. In the latter method, I would investigate the physical characteristics of the sound in mind: What are the temporal and spectral constituents of this sound? How does it resonate and become attenuated in a space? Which synthesis method would work best to recreate the sonic characteristics of this sound? If recordings of this sound were available, I would go through them and analyze their physical invariants. Based on such inspections, I might use various oscillators, noise generators and filters to *sculpt* the sound in a similar fashion to *subtractive synthesis*, or if the sound is a product of complex processes, I might build software that can recreate the unfolding of the sound.

[8] Research findings show that when we imagine a sound, the process is a multimodal experience during which our faculties of visual perception are also activated (Bradley 2000: 213). Gygi et al., in an attempt to explain the strong correlation between the perceptual spaces of sounds and multimodal events, hypothesize that listeners may be unable to judge sounds and events independently (2007: 853). Research on embodied music cognition similarly emphasize the multimodal nature of musical experience (Godøy 2006: 149).

On the other hand, if the sound in mind is purely speculative without a clear reference (as in Schaeffer's *sound objects*), I would first evaluate the complexity of the sound. Would it be easier to generate this sound, or should I micromontage it into existence from chunks of recordings? Although the sound itself is not referential, what could be a reference *to* this sound? What is the sound of that reference, and how does it relate to my speculative imagination? Then the strategies listed above come into play: I would record or generate sounds, either manually or via algorithms, and try to materialize the sound in mind.

The above steps taken as a result of my inner hearing will have immediate sonic consequences which will instigate my concrete hearing. The results of these actions will not be representations of the musical material but will make up the actual work itself, without a need for a mediating performance. I can therefore imagine the work and experience it at the same time. Morton Subotnick describes this idiosyncrasy of electronic music as his primary reason for deciding to compose for the electronic medium in the 1960s:

> I thought what I saw was the possibility one day of having a studio in your home and to create a whole new music, where you would be where music could become a sound. A studio art, where I could have an idea and try it out. Instead of putting it on paper and having musicians play it, I could actually try it out directly, listen to it and redo it, just like a painter would (…) I would be the composer and the performer and the listener, then send it off, and other people could listen to it. (quoted in Rosenbloom 2011)

The painting analogy expressed here is particularly effective in delineating the concurrency of imagining to the formation of the work. The electronic music composition emerges from an immediate interplay between the composer's actions and their audible outcomes. Vaggione describes this phenomenon as an "action/perception feedback loop" (2001: 60). To obtain a better understanding of this concept let's imagine a scenario in which I am designing a sound which does not have a clear reference. Upon the first step I take to produce this sound, my inner hearing is instantaneously supplemented by my concrete hearing. As I proceed to develop this sound, my initial imagination begins to evolve. This is the result of a complex negotiation which will be unique to every sound I design for every piece that I compose. The imagined sound of my inner hearing can take total precedence and steer the design process. Conversely, the sound that I bring into physicality through various methods can begin to overpower the imagined sound by offering new possibilities previously unimagined. I, as the listening composer, discover the physical characteristics of my quiet speculation. Every action I take will trigger new perceptions, which, in return, will *immediately* influence my next step.

> In a manner similar to a child's cognitive development, active manipulation of the "object" leads to its functional and conceptual understanding, and therefore, similar to its role in childhood, play is an important activity to stimulate that learning. Playing with a sound involves both memory and imagination, the "what if" question, and the sense of discovery. (Truax 1996: 60)

Parameters to Instincts: A Priori to Experiential

A particular competence granted by the electronic medium is the ability to achieve a superhuman degree of accuracy. With modern computers, the level of time-domain precision is unrestrained within the limits of human perception. Many digital processes which would be deemed ordinary by the contemporary electronic music composer, such as zooming in, stretching, duplicating and reversing an audio file, are relatively recent implementations. Yet these processes are now inextricable from modern composition routines, and they bring an unprecedented level of elasticity to the sonic material.

Such elasticity was not at the artist's disposal up until the late 1980s when the first digital audio workstations were introduced. Even then, hardware constraints significantly hindered the capabilities of audio applications. As someone who was born into the age of personal computers, even I am able to retrospectively discern remarkable leaps in efficiency of my compositional workflow within time spans as brief as a couple of years. These leaps have especially become apparent in the quality of resource-demanding processes such as reverberation and frequency-domain transformations. The number of such processes that can be applied to an audio track, and the number of effect-laden audio tracks which can be played back in real-time without disruptive CPU overloading have considerably increased. Audio programmers today are supplied with a surplus of hardware capacity. The implications of such processing power go beyond a feat of numbers. The technical gap between a composer's concept and its perceivable outcome is continuously shrinking: the ever-expanding arsenal of audio processing tools makes it progressively easier for a composer to materialize sounds faithful to the fantasies of inner hearing. This is the reason why the electronic music composer Curtis Roads refers to the present day as "the golden age of electronic music" (quoted in Robindoré 2005: 11).

A historical overview of such interplay between technology and the composer paints a clear picture of certain emergent characteristics of electronic music. The promise of the electronic medium was not entirely decoupled from preceding views on what should be deemed musical material. But it did nevertheless bring about a musical paradigm shift:

> The new sound material has come upon unsuspected possibilities, by no means purely by chance but at least by guided extrapolation, and has tended to proliferate on its own; so rich in possibilities is it that sometimes mental categories have yet to be created in order to use them. (Boulez 1986: 9)

As briefly touched upon in Section 1 of Chapter 1, the early theoretical perspectives towards electronic music guided the composers through their initial encounters with the electronic medium in the 1950s. One of the most significant examples of this was the adoption of *serialism* from the *Second Viennese School* as a philosophical direction for the electronic music studio at the Westdeutscher Rundfunk in Cologne. One of the founders of this studio, Herbert Eimert wrote: "It is certain that no means of musical control could have been established over electronic material had it not been for the revolutionary thought of Anton Webern" (Chadabe 1997: 37). Webern was the most influential exponent of serialism in the domain of instrumental music. *Total serialism*, which extends the application of serial techniques beyond pitch configurations to further compositional parameters such as duration and dynamics, was exercised by the composers of the Cologne studio such as Boulez and Stockhausen.

There was indeed a natural marriage between total serialism and the electronic medium. On the one hand it was a composition technique which demanded meticulous control over each parameter of music including pitch, rhythm, dynamics and timbre. An ideal exhibition of the finely pointillistic essence of this style required super-human performance. On the other hand it constituted a brand-new compositional paradigm which afforded an unprecedented mathematical precision in the control over sonic parameters via industrial-grade electronic devices. Most composers, however, did not possess preconceived ideas as to how these devices could be utilized within the context of music. The studio technician had a primary role in bridging the gap between the artist and the medium. Most composers, therefore, were not in absolute control of the creative process. Furthermore, technical challenges were coupled with a lack of aesthetic precedent. An "irrational necessity" to overcome the stagnation in the world of musical instruments came before aesthetic reflection, which was all but relinquished in favor of free development (Boulez 1986: 9):

> To musicians accustomed to a precise demarcation, a controlled hierarchy and the codes of a convention consolidated over the centuries, the new material has proposed a mass of unclassified solutions, and offered us every kind of structure without any perspective, so affording us a glimpse of its immense potential without guidance as to which methods we should follow. (4)

The inherent compatibility of the electronic medium with the parametric nature of serialism, and the existing affiliation of the Cologne composers with this style in the instrumental domain represented natural gateways to electronic music. When we view Eimert's earlier statement in this context, it could be argued that serialism functioned as an initial comfort zone for the composers facing the unknowns of the electronic medium for the first time.

The strictly deterministic reliance on serial permutations exercised during the early years of the Cologne studio was criticized by the members of the Paris studio. Conversely, the stylistic direction of the Paris studio, which relied heavily on exploration and play, was condemned by the adamant practitioners of serialism for not having any deterministic basis. A few years later, Luciano Berio and Bruno Maderna established the *Studio di Fonologia Musicale* in Milan and instated a mix between serialism and musique concrète as the studio's stylistic orientation. They referred to their output as *radiophonic art*, which relied on the said styles only to the extents deemed necessary by the artist.

The composer Luigi Nono, who succeeded Berio as the head of the studio, criticized any artistic dependence on mathematical relationships without interrogative contemplation as a "tendency to seek refuge" (1960: 1). He also described the delegation of artistic determinism to randomness at the opposite end, as a sign of inability on the composer's part to make decisions. Nono's arguments emphasize the significance of artistic initiative and the conscious translation from artistic instincts to actions. To Nono, neither pure determinism nor pure randomness should overpower intuition and logic (3). It should be noted that deterministic procedures governed a significant portion of Nono's early work; the artist merely opposed lending too much authority to such methods[9]. Pierre Boulez, who was a prominent practitioner of serialism in the early 1950s, similarly emphasized a need for a middle ground:

> [M]usical invention must bring about the creation of the musical material it needs; by its efforts, it will provide the necessary impulse for technology to respond functionally to its desires and imagination. This process will need to be flexible enough to avoid the extreme rigidity and impoverishment of an excessive determinism and to encompass the accidental or unforeseen,

[9] Nono's *Liebeslied*, for chorus and instruments, utilizes a revised serial method which incorporates "less automatic procedures" (Zampronha 2005: 3).

> which it must be ready later to integrate into a larger and richer conception. (Boulez 1986: 11)

The ability to think through the electronic medium developed in parallel with the artist's comprehension of technology. The composer's concept at some point needs to converge with the medium because "when either the material or the idea develops independently, unconcerned whether or not they coincide, a serious imbalance develops, to the detriment of the work" (Boulez 1986: 6). Karlheinz Stockhausen has produced arguably the most prominent works of electronic music to come out of the Cologne studio. In 1963, Stockhausen succeeded Eimert as the artistic director of the studio and remained at the helm until 1977[10]. Stockhausen's oeuvre of electronic music constitutes an illuminating timeline of both the stylistic evolutions in early electronic music and the artists' internalization of the electronic medium.

Stockhausen's early electronic works at the WDR were serial studies in accordance with the artistic direction of the studio. In 1956, four years after the studio was established, Stockhausen completed *Gesang der Jünglinge*. This seminal work marked a departure from a strict adherence to the technique (Holmes 2008: 66). His electronic epic from another three years later, *Kontakte*, is described to rely on serial proportions only at a "broad formal level" (Toop 1981: 189). While the realization of this piece employed serial methods to a certain degree, Stockhausen had gained enough artistic liberty over the electronic medium to override them when he felt it necessary. As the researcher John Dack expressed in his 1999 article, *Karlheinz Stockhausen's Kontakte and Narrativity*, the composer did not allow "any rationalistic method to take precedence over musical instinct". In a 1997 interview, Stockhausen recounts an instance where he ended up recomposing an entire section of *Kontakte*:

> [If] one has a construction planned [for the piece], if it is based on relationships between the individual durations–and in my music that has always been the case–then you go on and trust that it will sound organic. But then when you splice all the parts together in the end, all the different sections, then you hear for the first time how it sounds in a run, in continuity. (Stockhausen quoted in Paul 1997)

Stockhausen's theoretical work accompanying his artistic output reinforces his role as a pioneering figure. His concept of *Unity in Electronic Music*[11] relies heavily on the physics of sound and the characteristics of auditory perception. In order to implement the requirements of this concept, Stockhausen amassed a significant amount of research rooted in scientific principles. The outcome of these endeavors in the form of artistic works represents an evolution in the relationship between the electronic medium and the composer.

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[10] Stockhausen continued to act as the permanent artistic advisor of the electronic music studio at the Westdeutscher Rundfunk from 1977 until 1990. The studio was decommissioned by the radio in 2000. In later interviews, Stockhausen expressed his hopes to procure the equipment for a new establishment. Unfortunately, this plan never materialized.

[11] *The Concept of Unity in Electronic Music* is a proposal "to bring all the spheres of electronic music under a unified musical time, and to find one general set of laws to govern every sphere of musical time itself" (Stockhausen 1962: 48). The main premise of this approach is that every structure in electronic music, from a pulse to a composition, is a result of the temporal orderings in continuous time-spheres (e.g. frequency duration, rhythm duration and form duration).

Complexity of Listening

As composers tightened their grasp on the new medium, what is *heard* in electronic music started to take precedence over what had been *parametrized*. By the early 1960s, composers began to acknowledge that a listener would "perceive a sound-event as a homogeneous phenomenon" (Stockhausen 1962: 40) rather than a manipulation of individual properties. During the ensuing decades, the mutual influence between parameters and the "complexity of listening" (Zampronha 2005) gained even further prominence in electronic music practices. The musicologist Joanna Demers refers to this period as the *post-Schaefferian era* (2010: 14) mainly because of declining interest at the time in practicing Schaeffer's *reduced listening*[12]. Working with external associations, a practice which goes against the mandates of this mode of listening, progressively became an integral aspect of electronic music (14). The composer Ambrose Field asserts that, today, neither composers nor listeners foster a need to disregard the extramusical connotations in electronic music (2000: 37). Demers states that this evolution is, above all, practical, since both empirical evidence and common sense affirm recognition as an intrinsic aspect of listening (2010: 84).

The composer Trevor Wishart, while on the one hand denying the premise of reduced listening, agrees with Schaeffer on the possibility of maintaining control over the listening experience (Demers 2010: 30). Wishart contends that a set of *metaphoric primitives* would be necessary to establish a complex metaphoric network between the composer and the listener. Metaphoric primitives are "symbols which are reasonably unambiguous to a large number of people" (Wishart 1986: 55). This definition reminds the concept of *connotations* described by Meyer as conscious image processes common to individuals within a culture (1956: 257). Image processes, as referred to here, are memory functions triggered by musical stimuli, and act as mediators through which music arouses affect. Connotations are based upon similarities between our experience of musical material and the "non-musical world of concepts, images, objects, qualities, and states of mind" (260). The recognition of such connotations necessitates habituation and automatism, which are established over time and after "repeated encounters with a given association" (260). It should be noted that Meyer proposes this concept within the paradigm of instrumental music and points to the difficulty of particularizing connotations aroused by musical material. According to Meyer, connotative meaning in instrumental music is therefore a problematic topic to theorize upon (264). This is why Meyer views extrinsic (or designative) meaning in instrumental music of lesser prominence when compared to embodied meaning in which music refers to *itself* (35).

However, connotations, and more generally processes of meaning attribution, gain new facets when viewed in light of the material of electronic music. What is *itself* to electronic music (i.e. its material and therefore its language) is redefined. Technologies of sound generation and reproduction unlock for the artist an entirely new and virtually unlimited vocabulary of sounds. Unsurprisingly, the extent of this sonic material far exceeds the vocabulary of a traditional musical language and "pitches music into a no-man's-land" (Demers 2010: 13). Electronic music is therefore characterized as "the first musical genre ever to place under the composer's control an acoustic palette as wide as that of the environment itself" (Emmerson 1986: 18). Metaphorical systems which play "a central role in defining our everyday realities" (Lakoff and Johnson 2003: 3) extend into the communication of meaning in electronic music.

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[12] Reduced listening is a listening mode that "focuses on the traits of the sound itself, independent of its cause and of its meaning" (Chion 1994: 29).

The medium through which musical material comes into being also has implications in terms of semantics. In a study of the communication of expression in instrumental music, Vines et al. found that being able to see the performer has an impact upon our emotional experience (2010: 157). Even in the absence of a performer, we mentally simulate physical gestures: the perception of instrumental music incorporates what the musicologist Rolf Inge Godøy refers to as a *motormimetic component*, in which the listener mentally re-enacts the articulatory gestures of a performer (2006: 155). This motormimetic component relies on the listener's mental repertoire of action/gesture consequences (Leman 2012: 5). The physical activities relating to sound making in instrumental music is therefore interwoven with how the resulting sounds would be perceived. This relationship, however, disappears in electronic music since the immediate corporeal link between the performer (i.e. the composer) and the material is broken. Producing a sound in the electronic medium is "rarely the result of a single, quasi-instrumental, real-time, physical gesture" (Smalley 1997: 109). A single gesture in electronic music can encompass many gestures performed at different times and layered together in a way that obscures the perception of the individual gestures.

The new material, brought into the composer's vocabulary by the electronic medium, necessitates a new language. The culturally embedded language of instrumental music is unidiomatic and insufficient to address the structural complexity this new material makes available for artistic expression. When music is opened up to all sounds, discovering a path through the "bewildering sonic array" of electronic music becomes a challenge both for the listener and the composer (107). As Smalley denotes, the electronic music listener rarely has preconceived notions as to what to expect from a new piece as "everything remains to be revealed by the composer and discovered by the listener" (1996: 101). If anticipation underlies our appraisal mechanisms (Huron 2006: 7), musical expectancy plays a significant role in how we experience a particular piece. But if any sound within the threshold of our hearing is to be expected in electronic music, how can the composer construct the unexpected?

> [S]urprise requires an expected outcome; and an expected outcome requires an internalized norm. Composers must activate either normative schemas (such as styles) or commonplace clichés in their listeners if their violations of expectation are to have the desired effect. (36)

As Field states, a common ground is necessary for the composer and the listener to communicate (2000: 40). This sentiment aligns with the conceptualizations of metaphoric primitives and connotations. Establishing a framework of anticipation for the experience of electronic music necessitates a shared point of reference across the agents of this experience. Such a normative function exists in our survival instincts and the formation of our sensory mechanisms. We are hardwired to perform what the composer Michel Chion refers to as "causal listening" (1994: 26), during which one can identify a precise cause or recognize a category upon hearing a sound. This is because the act of listening in humans has evolved to locate and identify events (Gibson 1966: 96). From this evolutionary perspective, all sounds can be considered signs: the perception of a sound indicates something beyond the sound itself and a sound can never exist as a pure abstraction (Demers 2010: 37) since a sign is "in a conjoint relation to the thing denoted and to the mind" (Peirce 1885: 180). Accordingly, the sound world of electronic music encourages the imagination of extrinsic connections (Smalley 1997: 110). Even in the absence of adequate information, "the perceptual system hunts" and "tries to find meaning to make sense from what little information it can get" (Gibson 1966: 303). This has various implications in terms of the listening experience of electronic music on both ends of the communication.

Esthesis-Poiesis Model of Semiology

To delineate these implications, I will split the discussion into two threads of listening imagination. Instead of merely contrasting the composer with the listener, I will adopt Jean-Jacques Nattiez's theory of musical semiology and describe these two threads through *poiesis* and *esthesis*. Nattiez characterizes the three dimensions of symbolic phenomenon as:

1. *The poietic dimension* is the *sender*'s *process of creation*,
2. *The esthesic dimension* is the *receiver*'s *construction* of a meaning from the poietic,
3. *The trace* is the physical and material embodiment of the symbolic form, accessible to senses. (Nattiez 1990: 12)

This model is based on the semiologist Jean Molino's theory which restructures the classic schema of communication from "Producer –> Message –> Receiver" into "Producer –> Trace <– Receiver", implying, in effect, that:

(a) a symbolic form (a poem, a film, a symphony) is not some "intermediary" in a process of communication that transmits the meaning intended by the author to an audience;

(b) it is instead the result of a complex *process* of creation (the poietic process) that has to do with the forms as well as the content of the work;

(c) it is also the point of departure for a complex process of reception (the esthesic process) that *reconstructs* a "message" (Nattiez: 17).

In other words, poiesis is the transduction of meaning (or concept) into material, while esthesis is the construction of meaning (or percept) from the material (the trace). But *meaning as concept* and *meaning as percept*, attached to the same material, are not preordained to match. There are several reasons for me to adopt Nattiez's approach instead of a simple collation of the composer and the listener. Firstly, I find a semiological perspective to be appropriate for discussing the communication of meaning in electronic music. More importantly, Nattiez's ternary model bears a distinct compatibility with the unique form of action/perception feedback loops inherent to electronic music composition as discussed above. Poiesis and esthesis can easily, and to the most part accurately, be regarded as acts of the composer and the listener respectively. However, since electronic music composition enables the coexistence of inner hearing and concrete hearing, it can be formulated as a complex interplay between poiesis and esthesis. This approach resonates with the previously highlighted understanding of *the composer as a listener*. The momentary acts of composition can therefore be schematized as:

Action —>	Trace	<— Perception
Poiesis		Esthesis

The idea of trace not only contributes to a unified understanding of listening but at the same time liberates the percept from the concept. This liberation can manifest itself during the composition process as illustrated in the above schema, or it can transpire between composer and listener. For the composer, a concept to be materialized and the perception of the resulting material can contradict each other. This is an internal conflict between poiesis and esthesis. Conscious or unconscious resolutions of such conflicts guide the nonlinear progression of a composition at various scales ranging from gesture to form. Communication of meaning between the composer and the listener is also fertile with such conflicts. I will further analyze these conflicts in the next chapter under a discussion of gestural intentionality.

The Esthesic Thread

The human mind processes sensory input on the basis of what has already been experienced (Demers 2010: 50). The auditory system is "constantly ready for new information about the environment and compares it to stored experience" (Truax 1984: 26). Our knowledge of likely sequences of sounds significantly aids auditory recognition (Gygi 2004: 1262) since the memory of a sound shares a highly correlated perceptual space with the actual experience of this sound (Gygi et al. 2007: 853). The structured environments which we co-evolve with establishes a context for our auditory experiences (Windsor 2000: 20) and our past experiences impact our appraisal of future encounters (Tajadura-Jiménez and Västfjäll 2008: 68).

We develop cognitive representations of acoustic phenomena as part of meaningful events occurring in our daily environments; these representations are collective in terms of their relevance to the observer's membership to a community of experiences (Dubois et al. 2006: 869). This aspect of cognitive representations has a similarity to the connotations described by Meyer, and offers an insight into how connotations can be easier to particularize in the context of electronic music. When listeners are enculturated into a particular auditory environment, learned schemas establish the ground for prediction and *surprise* (Huron 2006: 36). When our mental catalogue of musical experiences fails to guide us through a piece of electronic music, the mind resorts to a more general catalogue of experiences: a lack of musical reference conjures up a profusion of other kinds of references. The esthesic complexity of electronic music matches that of environmental sounds, which "can hardly be reduced to a set of physical parameters" (Dubois 2000: 49). The experience of meaning in electronic music "is in essential harmony with that in everyday life" (Kendall 2010: 73).

Even the synthesized sounds of electronic music can trigger references in the listener's mind (Emmerson 1986, p. 26; Windsor 2000: 17) since synthesized sound events too convey environmental information (Gaver 1993b: 290). A real source is not necessary for the listener to speculate a physical cause (Windsor 2000: 15). The tendency of a listener to make sense of a sound in relation to the environment (21) expands beyond the recognition of featural similarities between sounds inside and outside electronic music, and facilitate the attribution of contextual meaning to stimuli. The disposition of a sound objects can maintain a sense of reality contextually (Wishart 1996: 146). The mind is capable of situating abstract sound sources within a "real-space" (146) and retaining associations to past experiences.

Smalley refers to this reflex of the human mind as *source bonding*, which "can occur in what might be considered the most abstract of works" since bonding play "is an inherent perceptual activity" (Smalley 1997: 110). He further describes this phenomenon as "the natural tendency to relate sounds to supposed sources and causes, and to relate sounds to each other because they appear to have shared or associated origins" (110). Smalley utilizes this concept to discuss the links between the intrinsic (the musical work) and the extrinsic (the sounding world outside)[13].

The Poietic Thread

In his *Aesthetic Theory*, Theodor Adorno describes art as the language of wanting the other: "The elements of this other are present in reality and they require only the most minute displacement into a new constellation to find their right position" (Adorno 1997, 132). An artwork is a demonstration of this displacement in reality. In Demers' interpretation of Adorno, it is impossible to create an entirely new type of material from nothing, so artistic material can either imitate empirical reality or mediate it by alienating the familiar through technology (Demers 2010: 50).

Our encounters with environmental phenomena establish a frame of reference for our esthesic activities. This has self-evident implications for the poietic acts of the composer who is also a listener. My knowledge of sounds come from my daily environments. When I design a sound, the possible outcome is above all bounded by the physiological constraints of my auditory mechanisms. Once the physical characteristics of the changes in air pressure fall within the thresholds of my perception, my cognitive faculties come into play. My ideas as to how to design a sound will be shaped by how the sounds I have encountered thus far have come to pass, since actual sounds and imagined sounds occupy highly correlated perceptual spaces (Gygi et al. 2007: 853). This does not necessarily point to a normalizing function of my mental catalogue of sounds. But I can design the abstract only in reference to the concrete; the unreal *becomes* through the real. In this vein, Adorno describes the role of material in going beyond the material itself:

> The choice of the material, its use, and the limitations of that use, are an essential element of production. Even innovative expansion of the material into the unknown, going beyond the material's given condition, is to a large extent a function of the material and its critique, which is defined by the material itself (…) If [the composer] turns critically against tradition through the use of an autonomous material, one completely purged of concepts such as consonance, dissonance, triad, and diatonicism, the negated is nevertheless retained in the negation. Such works speak by virtue of the taboos they radiate. (Adorno 1997: 148)

While this statement can be viewed as a conceptualization of breaking away from musical (and otherwise artistic) tradition, it can also be applied to the relation between abstractness and representationality in artistic material. In an abstract work, physical reality becomes the negated; the negation commissions the negated in both poiesis and esthesis. This principle applies to representations of reality (or the lack thereof) in electronic music as well. For instance, acousmatic music, in similar fashion to Meyer's prioritization of embodied meaning in instrumental music, focuses on the qualities of sounds in themselves. Even in the early years of the Paris studio where this style originated, a common technique for producing abstract sounds was the exhaustive investigation of sound recordings which were clearly indicative of their sources. By studying those attributes of a sound that attach it to its source event, composers discovered what exactly they had to deform to sever this tie. Such practices

[13] This binary approach to signification is apparent in numerous studies on meaning in instrumental music as well (Meyer 1969, Jakobson 1970, Coker 1972, Nattiez 1990).

demonstrate that an extensive understanding of reality facilitates its abstraction. In electronic music, the reality to be embraced or negated is the entirety of our auditory vocabulary.

But how does one meaningfully deal with such a large corpus? Exploration and experimentation are undoubtedly inextricable components of electronic music composition at any level of artistic expertise. However, as one furthers his or her involvement with the electronic medium, methods to materialize a sonic imagination become increasingly more innate for the composer. As a teacher of electronic music composition, I find that the novice composer is often inclined to *play* with sounds or sound generating devices until they arrive at a base material which they find interesting or pleasing. This process, at times, deviates from the "guided extrapolation" Boulez describes, and suffers an absence of artistic initiative. When I described a composition scenario earlier in this section, I stressed the prominence of the unimagined in the action/perception feedback loops. Exploring a sound material for poietic leads is an unquestionably valid form of composition. However, the composer should not easily surrender to the immediate *artifacts*[14] *of the medium*.

> [Material] is the sum of all that is available to [the artists], including words, colors, sounds, associations of every sort and every technique ever developed. To this extent, forms too can become material; it is everything that artists encounter about which they must make a decision. The idea, widespread among unreflective artists, of the open eligibility of any and all material is problematic in that it ignores the constraint inherent in technical procedures and the progress of material, which is imposed by various materials as well as by the necessity to employ specific materials. (Adorno 1997: 148)

In my opinion, this correlates to the confusion of non-motivated openness with artistic initiative. In the former, one loses track of artistic inclination and obliviously gives in to the constraints or the self-assertions of the medium. Falling into this poietic trap engenders an artistic inertia disguised in unrestricted exploration. On the other hand, constraints, different from rules, "act as "reflecting walls" inside which a tissue of specific relationships is spun" (Vaggione 2001: 57). The articulation of artistic initiative through constraints becomes of particular importance in the open sound world of electronic music.

Amalgamation of Musical Languages

The material of electronic music, and the language this material motivates, undoubtedly set the genre apart from its predecessors. The cognitive Psychologist William W. Gaver's distinction between everyday listening and musical listening is naively insulated from the immutable debate on what music is. For Gaver, in everyday listening we would hear "a single-engine propeller plane flying past"; musical listening on the other hand involves an experiencing of the sound itself (Gaver 1993b: 286). This, to say the least, would be a crude segregation in the context of the current discussion. However, it also affords an external perspective that reveals two poles of the semantic play in electronic music. The language of instrumental music is not discarded but augmented by that of electronic music. The cognitive continuum from abstract to representational becomes an instrument for the electronic music composer. All of the pieces associated with the current study makes use of this continuum to

[14] "Something observed in a scientific investigation or experiment that is not naturally present but occurs as a result of the preparative or investigative procedure" (Oxford Dictionary of English).

varying degrees. The amalgamation, for instance, can serve a formal function: in my piece *Do You Remember Rob Nolasco?,* two movements imitate each other's narrative arcs by making use of separate musical languages[15]. In *Christmas 2013*, one musical language is situated within the other in the form of a diegetic actor at a gesture level. In *Birdfish,* adhering to the work's evolutionary theme, the amalgamation is transformative as an amphibian mutates into a bird, which mutates into a leitmotif.

The culturally encoded "material-to-emotion" pathway relevant to the appraisal of instrumental music is intercepted in electronic music by acts of meaning attribution instigated by the musical material. This, however, does not invalidate the affective outcome of music which was described earlier as an ultimate goal for artistic experience. In their experimental study on auditory-induced emotion, Tajadura-Jiménez and Västfjäll concluded that the meaning attributed to a sound by the listener is as important as the physical properties of the sound in inducing affective response (2008: 63).

Amorphous sequences, in the cognitive scientist Danièle Dubois' terminology, yield a categorization on the basis of acoustic parameters such as intensity or pitch. An example of these are background noises "in which no specific event could be isolated" (Dubois 2000: 48). In other words, when the listener fails to identify a source for it, the auditory stimulus is processed as an abstract phenomenon rather than a part of a meaningful event (49). This finding is in agreement with the results of the experiments conducted by Guastavino et al. which revealed that in describing *ambient noises* participants commonly used simple adjectives relating to physical attributes of the acoustic signal instead of source descriptors, "suggesting a more abstracted conceptualization of a sound in itself" (2007: 55). Similarly, Özcan and van Egmond state that in the absence of identification during a sound recognition process, featural aspects of the sound are analyzed (2007: 199). In summation, upon hearing a sound, a series of perceptual mechanisms are activated. If the heard sound is abstract, we focus on its featural aspects (i.e. we evaluate it in itself). If, on the other hand, the heard sound is representational, we focus on its semantic associations.

However, these two processes are not necessarily mutually exclusive. The acoustic engineer Pedro Novo describes three models for the design of acoustic virtual environments, namely authentic, plausible and creational approaches (2005: 278). The plausible approach evokes auditory events which will be perceived as having happened in a real environment. The authentic approach aims at reproducing existing real environments, while the creational approach attempts to evoke neither authentic, nor plausible auditory events. This mainly self-evident tripartite taxonomy is reminiscent of Wishart's couplings of objects and spaces that are real and unreal. Interestingly, although such actor and setting pairs would amount to four combinations, Wishart's *landscape* model is also three-part: (1) unreal-objects/real-space, (2) real-objects/unreal-space, (3) real-objects/real-spaces (1996: 146-147). Simon Emmerson, the editor of Wishart's *On Sonic Art*, points to this reduction in footnotes and offers the possibility of an unreal-object/unreal-space scenario (147). However, Wishart's omission of this option could be due to the listener's instinctive imposition of reality on the auditory experience.

Wishart's dichotomy of *real* versus *unreal* on an object-space plane is comparable to Emmerson's language grid as seen in Table 3.1. Between a mimetic discourse, which evokes images external to the musical material, and an aural discourse based on sound objects which are free of such associations, Emmerson sees a "continuum of possibilities" (19). In pieces where a balance of both is found, although the sound sources are recognizable, "the

[15] For a more detailed compositional report, please refer to Section 2 of Chapter 1.

impressions are welded together in other ways than those based on associative image" (Emmerson 1986: 20). The axes of the grid are discourse (representing the degree to which mimetic references are used) and syntax (either abstracted from the material or constructed independently from it). In devising this grid, Emmerson's actual goal is to address the divide between *elektronische Musik* and *musique concrète*, with the former relying upon an abstract syntax while the latter focuses on abstracting syntax from material. Each number in the language grid corresponds to a combination of discourse and syntax, which Emmerson exemplifies with various pieces of electronic music. Having constructed the language grid, Emmerson notes that the outermost boundaries of the discourse-syntax plane are "ideal states which are probably unobtainable" (25). I wish to interpret this distinction as Emmerson's pre-emptive affirmation of the lack of an unreal-object/unreal-space scenario in Wishart's model.

Abstract syntax	1	4	7
Combination of abstract and abstracted syntax	2	5	8
Abstracted syntax	3	6	9
	I: Aural discourse dominant	II: Combination of aural and mimetic discourse	III: Mimetic discourse dominant
		MUSICAL DISCOURSE	

Table 3.1: Language Grid (Emmerson 1986: 24)

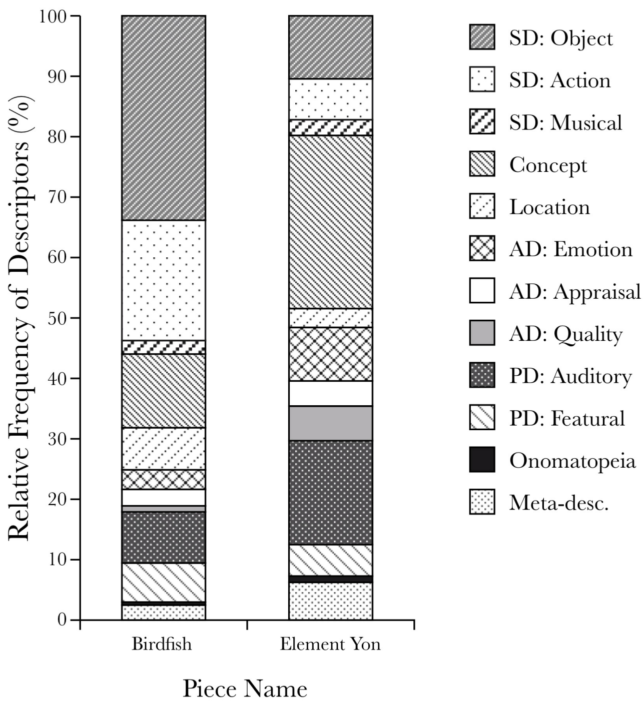
The current discussion focuses on language as a whole rather than as a construct of discourse and syntax. I have regarded musical language as being in a constant and causal duality with material in both instrumental and electronic domains. The conventions as to the organization of the material (i.e. the language) emerges from the material. From an esthesic perspective material and language are symbiotic. Therefore, the aforementioned cognitive continuum crosses the language grid diagonally from *abstract* at *field 1* (exemplified by Emmerson with serialist *elektronische Musik*), to *representational* at *field 9* (exemplified with Ferrari's *Presque Rien*).

As a display of the poles of the cognitive continuum, the data from the listening experiments conducted with *Birdfish* and *Element Yon* reveal a stark contrast between listener responses. In Chapter 1, I described these two pieces as having been composed concurrently using similar structural and gestural formations, but with synthesized materials which diverge significantly in terms of representational intentions. Revisiting the data presented earlier, Table 3.2 shows the significant difference in the number of descriptors per piece.

	Birdfish	Element Yon
Piece Duration	4'40"	3'45"
Total Number of RTD	334	170
Average Number of RTD per Minute	6.05	3.77

Table 3.2: Real-time descriptor (RTD) numbers for Birdfish *and* Element Yon

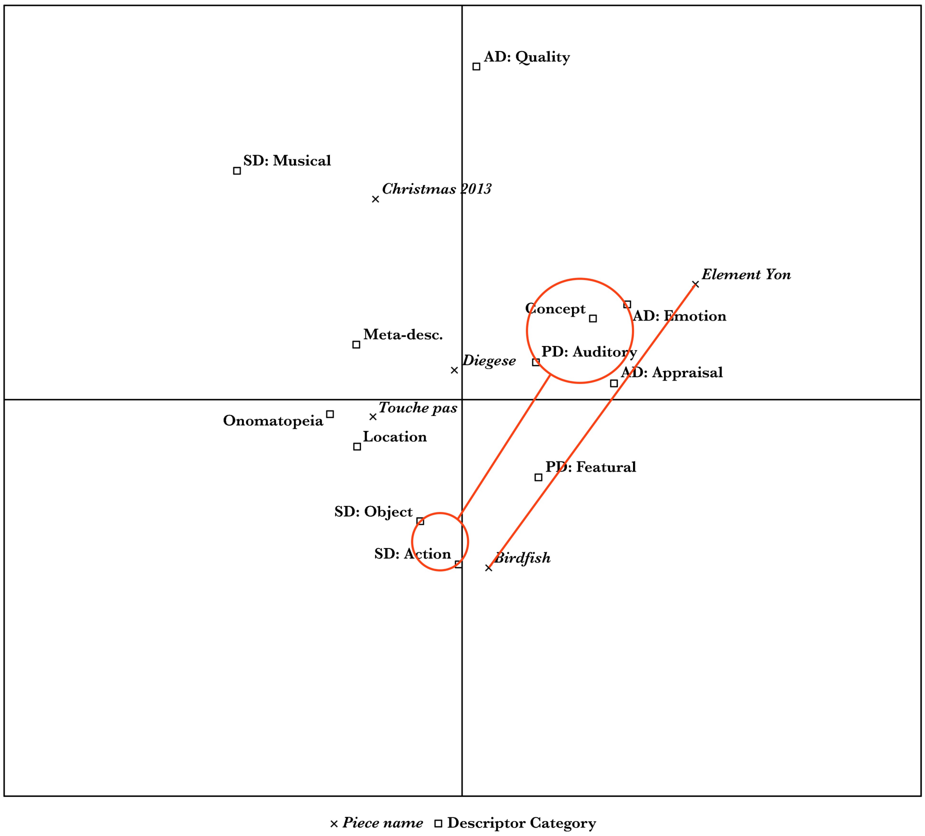
Looking at Graph 3.1, the most salient descriptor category for *Birdfish* is observed to be *object source descriptors* (SD: Object), covering 33.83% of all submissions. When weighted with *action* and *musical source descriptors*, the representational sound world of *Birdfish* appears to have instigated a dominance of source descriptors accounting for 55.96% of all descriptors. For *Element Yon*, *concept descriptors*, which represent 28.64% of all entries submitted for this piece, were the most common. Given the abstract content of this piece, this result conforms to prior expectations. Graph 3.2 revisits the correspondence analysis from the previous chapter with the regions relevant to these two pieces highlighted.



Graph 3.1: Categorical Distributions for Birdfish *and* Element Yon

Another significant difference between the two is observable in the *auditory descriptors* category (8.45% for *Birdfish* versus 17.18% for *Element Yon*). With *Element Yon,* listeners were much more inclined to describe those perceptual characteristics of sound which pertain to frequency spectrum and dynamics. This is in agreement with the results of previous experimental studies which described that in the absence of source identification more abstract conceptualizations of sounds grounded in physical attributes emerge.

Categories of lesser salience also reveal insights when reviewed comparatively. Given that the two pieces were designed with similar spatial characteristics, the relative difference in the percentages of location descriptors, (6.96% for *Birdfish* and 3.12% for *Element Yon*) can be explained by contextual evaluation of spatial cues. While spatial components in *Birdfish* were marked with *location* and *action descriptors* such as “cave”, “dungeon”, “underwater”, “flying” and “running”, such components in *Element Yon* were referred to with *concept*, *auditory* and *meta-descriptors* such as “surrounded”, “panning”, “stereo” and “reverb”.



Graph 3.2: Correspondence analysis highlighting Birdfish *and* Element Yon

Furthermore, *Element Yon* produced a notably higher percentage of *affective descriptors* (AD) with *emotion descriptors* as the most salient subcategory (18.75% for *Element Yon* and 6.95% for *Birdfish*). This can be explained by the dominance of representational imagery in *Birdfish*, so that the spontaneous responses related more to the descriptions of objects and actions. With *Element Yon* on the other hand, the participants, besides having *less* to say as evidenced in Table 3.2, were more inclined to reflect about their affective experience. These results suggest that, despite the syntactical congruences across these pieces, the sheer difference in how the source materials were perceived mediated the appraisal of the works.

General impressions submitted by the participants who listened to *Element Yon* were mostly concerned with the physical characteristics of sounds such as spectral characteristics, concepts such as "flow", "hollowness", "contrast" and "heaviness", and affective appraisals such as "exciting", "curious", "calm" and "annoyed". Impressions relating to objects or environments were also highly conceptual, such as "big magnets", "gravity", "circus-like", "a dark metro station". One participant expressed that "no images came to [her] mind". In Chapter 5, I will further interpret such general impressions in relation to the *awareness of the physical self*. The general impressions of *Birdfish* were either in the form of word or sentence lists enumerating imagined sound sources, or visually-oriented narratives that recounted a story involving sound sources. One participant sketched the drawing seen in Figure 3.1 as his general impression of this piece.

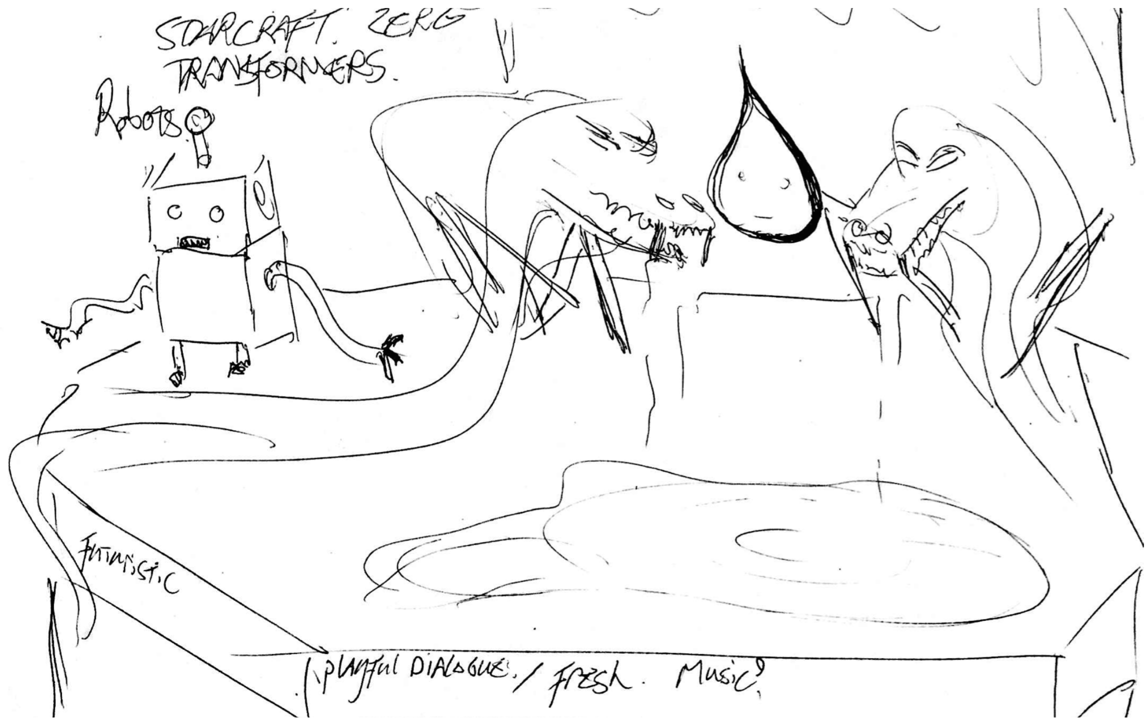


Figure 3.1: A participant's general impression of Birdfish *in the form of a drawing*

As may be observed from the data collected with only these two works, electronic music can induce a variety of experiences from representational to abstract, conceptual to perceptual and semantic to affective. In the beginning of this section, I noted that although the current discourse might appear to impose a dichotomy between instrumental and electronic musics, the ultimate point to be made would be that the language of electronic music does not replace that of instrumental music, but rather expands it. This sentiment, which I have characterized above as an amalgamation of musical languages, is probably best expressed by the pioneering composer of electronic music Edgard Varèse:

> My fight for the liberation of sound and for my right to make music with any sound and all sounds has sometimes been construed as a desire to disparage and even to discard the great music of the past. But that is where my roots are. No matter how original, how different a composer may seem, he has only grafted a little bit of himself on the old plant. But this should be allowed to do without being accused of wanting to kill the plant. He only wants to produce a new flower. It does not matter if at first it seems to some people more like a cactus than a rose. (Varèse and Wen-chung 1966: 14)

CHAPTER 4

GESTURE/EVENT MODEL

EVENTS IN THE ENVIRONMENT

In the previous chapter, I have discussed *why* meaning is communicated in electronic music. In this chapter, I will investigate *how* it is communicated and will do so by describing a model which unites several of the concepts discussed so far. The emergence of this model will be grounded in human cognition, and supported by experimental data. The model will delineate the parallels between how we experience electronic music and how we make sense of environmental sounds.

Also in the previous chapter, I have identified "survival" as the first and foremost function of the human auditory system. This had significant implications in terms of how audiences deal with the material introduced into music via the electronic medium. I have described that our everyday auditory experiences constitute a frame of reference for our future encounters with not only environmental sounds but also electronic music. I will now offer a closer look at the characteristics of the mechanisms underlying our everyday hearing.

Environmental Sounds

First, I will cite a seminal description of environmental sounds by Nancy J. VanDerveer: An environmental sound (a) is produced by real events, (b) has meaning by virtue of causal events, (c) is more complicated than laboratory-generated sounds such as pure tones and (d) is not part of a communication system such as speech (paraphrased in Ballas and Howard 1987: 97).

This comprehensive definition offers points of varying significance for the current discussion. The first two items, which I will further elaborate on shortly, are particularly central to the model described in this chapter. The structural complexity of environmental sounds, mentioned in the third item, is paralleled by the sounds in electronic music. This has been acknowledged in the previous chapter when I emphasized the *complexity of listening* pertinent to the electronic music experience. Furthermore, the shift in interest from perceptual studies relying on elementary sounds towards cognitive studies on complex everyday sounds have only progressed since VanDerveer proposed this definition in 1979. The last item in this definition serves not to strip environmental sounds of their communicative capacities, but to abstract sounds that are in physical and causal relationship with environmental events from sounds that are intentionally produced for purposes of communication. While Ballas and Howard's prime example for this abstraction appears to be "speech", this very item also separates music from environmental sounds.

I corroborate VanDerveer's definition on all accounts. However, certain aspects of it demand further inspection on my part. Going back to the first two items in this definition, environmental sounds are described to have "real events as their source" and are "meaningful, in the sense that they specify events in the environment" (VanDerveer 1979: 17). This characterization can be reduced to core concepts such as events, sources, meaningfulness and environments. I have already touched upon some of these in the previous chapter. However, the concept of event is of particular significance in discussing the meaningfulness of sounds. I will now offer a closer look at this concept, followed by an overview of various perceptual models addressing how we experience our *eventful* environments.

Event

Our experiences with physical objects provide us with a variety of ontological metaphors to view events as self-contained entities (Lakoff and Johnson 2003: 26). The term "event" represents the unit with which we make sense of our immediate surroundings. The sun rises, the traffic light turns red, the water boils and the clock ticks. Multimodal stimuli originating from events are picked up by our sensory mechanisms and are processed by our cognitive systems. "Sensations of one modality can be combined with those of another in accordance with the laws of association" (Gibson 1986: 245). One component of these multimodal stimuli is sound. When an event occurs in our immediate surroundings, it emits an environmental sound, given that the physical unfolding of this event entails it.

Cognitive representations of acoustic phenomena are therefore multimodal (auditory as well as visual, kinesthetic, vestibular etc.) (Dubois et al. 2006: 869). In the logician Charles Sanders Peirce's model of semiosis, there are three types of relationship between perceived forms and the meaning which these forms signify. *Symbols* establish an arbitrary relationship between the form and the communicated content; *icons* are based on the similarity between the two and the *indexes* indicate a causality between the sign and the signified (Jekosch 2005: 193).

> Treating the object of perception as a sign carrier leads to associations, to denotations, connotations and interpretations, i.e. to the assignment of meaning. The object is processed as a sign, semiosis occurs and something is communicated. (200)

Environmental sounds are in an indexical relationship with events. An event, in its simplest form, is "a thing that takes place" (Oxford Dictionary of English) and "a sound is news that something's happening" (Jenkins 1985: 117). Therefore, environmental sounds are "processed and categorized as meaningful events providing relevant information about the environment" (Guastavino 2007: 54).

This implies that, in daily life, we listen to events rather than sounds themselves (Gaver 1993: 285). This idea is evidenced in several cognitive studies: Marcell et al., who conducted an experiment on confrontation naming of environmental sounds, stated that sounds in our daily environments "convey action and movement-related information" (2000: 833). In another experiment-based study on the categorization of everyday auditory events, Dubois et al. similarly found that, besides the few acousticians who took part in the experiment, a great portion of the participants classified sounds based on either source or action characteristics (2006: 867). That is to say, event-related meaning (i.e. semantic features) of a sound subdues its physical attributes (Guastavino 2007: 60). This is because the human perception is geared towards processing beyond acoustic patterns and recognizing events (Ballas and Howard 1987: 97).

Such reports portray an intrinsic relationship between environmental sounds and events on the basis of source and action properties. Several other experiment-based studies delineate these properties as the most salient features used by people when describing everyday sounds (Brazil et al. 2009: 2; Gygi et al. 2007: 853). Action, in this context, is the process which an object is going through (e.g. shattering is the action a glass can go through). While certain studies demarcate *source* as an object-action compound, others declare only the object as such and allocate a separate category for actions. As I mentioned in Chapter 2, my experimental method follows the latter, as I intend to draw a distinction between objects, actions and concepts as sources.

Models of Experience

Physically dissimilar sounds produced by the same type of events are perceived to be more analogous to each other than any sounds produced by different events; this perceived uniformity amongst different sounds from similar sources helps listeners develop "mental models of sound-producing events" (Gygi et al. 2007: 849). These mental models, or memorized experiences of acoustic phenomena (Dubois et al. 2006: 869), can be likened to the psychologist Lawrence W. Barsalou's concept of *perceptual symbols*:

> Once a perceptual state arises, a subset of it is extracted via selective attention and stored permanently in long-term memory. On later retrievals, this perceptual memory can function symbolically, standing for referents in the world, and entering into symbol manipulation. As collections of perceptual symbols develop, they constitute the representations that underlie cognition. (1999: 577)

Perceptual symbols can emerge in all modalities of experience including vision, audition, smell, taste, touch, action, emotion and introspection (Pecher et al. 2003: 120). The cognitive scientist Nigel Thomas attests that Barsalou's theory of perceptual symbols is conceived fairly close to the concept of *mental imagery* on the premise that such symbols are immediate causes of imagery experience. Thomas describes mental imagery as a quasi-perceptual reconstruction of a past perceptual experience in the absence of an external stimuli (Thomas 2010).

A similar model had been described by the developmental psychologist Jean Piaget: Various performances of the perceptual system become integrated and abstracted into systems of experience called *schemas*, which "provide techniques to process objects of perception as signs" (Jekosch 2005: 200).

Although rooted in different research perspectives, namely auditory perception, cognitive science and psychology, such models are intended to describe how we navigate our daily lives. We experience the environment in terms of events and we store multimodal representations of these experiences; upon an encounter with a new event, we assimilate and accommodate "non-fitting data of perception" (204) and relate them to a previous experience of a similar event in an attempt to satisfy our innate mechanisms of anticipation. This helps explain why listeners are able to identify real-world referents to sounds that are not only synthesized, but are synthesized without a poietic goal of instigating such references.

The composer Barry Truax's concept of *earwitness accounts* similarly attempts to address the mediation of the *now* through memory processes but does so from an *acoustic communication* perspective. Acoustic communication investigates the relationship between the sound, the listener and the environment by regarding them as parts of a system rather than as isolated entities (Truax 1984: xxi). Studies in this field focus on the reciprocal relationship between an acoustic environment and its inhabitants (Çamcı and Erkan 2013: 20). Research in acoustic communication therefore assumes an *ecological approach*, which has been described by Gaver as relying on patterns of information grounded in sources and environments, unlike "typical research" that focus on primitive components of sounds such as loudness and frequency (1993a: 5). Truax dichotomizes these research perspectives as the *energy transfer model* and the *communicational model*. While the former deals with sound as a physical phenomenon in isolation, the latter investigates the exchange of information and the cognitive processes which underlie this exchange (Truax 1984: 3, 9).

> Instead of thinking of sound as coming from the environment to the listener and perhaps being generated back again, we will think of it as mediating, or creating relationships, between listener and environment. (11)

This proposal, which is aimed at describing our relationship with acoustic environments, is particularly congruent with Nattiez's esthesis-poiesis model described in Chapter 3. It should be kept in mind that the esthesis-poiesis model was proposed to explain the communication between the composer and the listener, rather than the listener and the environment. These two approaches converge, however, when the trace of a composer's poietic activity is considered a spatiotemporal artifact to be experienced by the listener, much like an environment. I will further elaborate on this interplay in the next chapter.

Another approach to perception commonly facilitated in musical research (Östersjö 2008; Windsor 1995; Nussbaum 2007) is the model of *affordances* developed by the psychologist James Gibson. Gibson's studies on ecological perception stemmed from his experiments in aviation during the Second World War. Focusing mainly on an active observer's perception of its environment, Gibson postulated that invariant features of visual space represent the pivotal information for perception. Invariants are features of an object which persist as the point of observation changes (Gibson 1986: 310). While most items in Gibson's list of invariants pertain to the visual domain, his concept of *affordances* has been applied to other modalities of perception including hearing.

According to Gibson, objects in an environment, by virtue of their invariant features, afford action possibilities relative to the perceiving organism. For instance, a terrestrial surface, given that it is flat, rigid and sufficiently extended, affords for a human being the possibility to walk on it (Gibson 1986: 127). His main motivation to propose this seemingly straightforward idea is to refute the prevailing models of perception which assume that ecological stimuli are chaotic and therefore that the perceiver extracts meaning out of sensory input by imposing mental structures upon disorganized information. Gibson suggests that there are certain kinds of structured information available prior to perception in the form of invariants. The nature of these invariants is relative to the complexity of the perceiving animal (Gibson 1966: 73) and an object will have different affordances for different perceivers: a stone, on account of its physical characteristics, affords the action possibility of *throwing* for a human being, while at the same time affording the action possibility of *climbing* for an ant.

One of the criticisms of Gibson's model is associated with his demarcation of the roles of learning and memory in ecological perception. In his review of Gibson's seminal book, *The Ecological Approach to Visual Perception* (originally published in 1979), the psychologist Bruce Goldstein writes:

> Learning must occur before the information in the light can indicate what something affords, but [Gibson] mentions learning only briefly at the end of the [eighth] chapter when he states that 'affordances ... are usually perceivable directly, without an excessive amount of learning'. What is missing here is the amplification of this statement. Learning must be involved in a person's understanding of the meanings of objects, and this involvement deserves more discussion than Gibson gives it. (Goldstein 1981: 193).

This criticism, I believe, is directed mainly towards Gibson's epistemological stance: Gibson proposes the idea of *perceptual knowing* to challenge the dichotomy between perception and cognition, which at the time was prevalent in the field of psychology. Relying on the concept of invariants, Gibson suggests that "perceptual seeing is an awareness of persisting structure" (Gibson 1986: 258) and knowledge is in the environment to be picked up. Although Goldstein argues otherwise, the role of learning is patently brought into discourse, not only in Gibson's 1979 book, but also in his writings prior to that. He deems it unquestionable that an infant has to learn to perceive, and that he does so by exploring the environment with all of his organs, "extending and refining his dimensions of sensitivity" (Gibson 1963: 15; Gibson 1966: 51, 285). The perceptual system matures with learning and therefore the information it picks up becomes more elaborate and precise as life goes on (Gibson 1986: 245).

> Knowledge of the environment, surely, develops as perception develops, extends as the observers travel, gets finer as they learn to scrutinize, gets longer as they apprehend more events, gets fuller as they see more objects, and gets richer as they notice more affordances. Knowledge of this sort does not "come from" anywhere; it is got by looking, along with listening, feeling, smelling, and tasting. (Gibson 1986: 253)

When viewed in the light of modern experimental studies on perception, I consider Gibson's proposal of *perceptual knowing* as an addition to, rather than a replacement for, the existing models of learning that are based on memory processes. This sentiment is clearly materialized in Gibson's writing as well when he states: "To perceive the environment and to conceive it are different in degree but not in kind. One is continuous with the other." (258) The ecological approach addresses certain stages of our perceptual experience and complements higher-level mental processes. In that respect, Gibson's model of invariants aligns with the previously described models of experience, such as perceptual symbols and schemas. This is evidenced by the role of invariants in such models:

> Given repeated encounters with a set of objects that share certain features, birds for example, the neural units responding to the most invariant features (e.g., feathers and beaks) will grow into a highly interconnected functional unit, whereas the more variable features (e.g., color, size) will be excluded from the set of core elements (…) An assembly of neurons that forms in this fashion will exhibit many of the properties Barsalou attributes to perceptual symbols. It will be schematic, in that it represents only a subset of the features that any actual object manifests at any given time. It subserves categorization, in that the same assembly responds to varying instances of some class of objects that have features in common. It is inherently perceptual, dynamic, and can participate in reflective thought. (Schwartz et al. 1999: 632)

The complementary roles of perceptual and conceptual knowledge can be extrapolated to evolutionary processes on a grander scale. As organisms physiologically adapt to their environments, this adaptation in return informs their behavior relating to perceptual knowing. As Huron states, the *stable* features of an environment are instrumental in the formation of innate behavior over generations (Huron 2006: 61). However, behavior towards the rapidly changing characteristics of an environment needs to be learned. Although *instinctual knowledge* may appear to contrast the idea of pre-structured perceptual knowledge, it should be noted that in Gibson's model, the role of the nervous system in registering the differences between invariants is not ignored (1966: 284).

In the context of my research, affordances relate to physiological determinants of music cognition as discussed in Chapter 3. Perceptual knowing is tightly coupled with evolutionary traits which were described in Section 1 of that chapter as pertaining to low-level characteristics of sound. For this purpose, I find the concept of affordances useful when discussing features of electronic music that are corporeally relevant for the listener. For instance reverberation affords a relative sense of space while low frequency gestures afford an awareness of large entities. I will offer further examples of affordances in the following chapter when I discuss the physical dimensions of electronic music, and the *virtual* action possibilities they afford.

GESTURES IN ELECTRONIC MUSIC

Building up on the models through which we experience reality and the events contained within, I will now offer a look at the experience of electronic music. As Lakoff and Johnson states: "Human purposes typically require us to impose artificial boundaries that make physical phenomena discrete just as we are: entities bounded by a surface" (2003: 26). When the human mind is processing information, it looks for hierarchies and structural units to form systematic organizations (Özcan 2007: 198). We utilize these units to navigate through the progression of our experiences. This is valid whether we are walking down the street or watching a movie. Events, as discussed above, function as these units within everyday settings, by virtue of their meaningfulness: we make sense of and describe what transpires around us in terms of events.

Naturally, the tendency to extract events of unitary functions applies to our experience of electronic music as well. To denote the particular structures of electronic music scrutinized in this book, I propose the word *gesture*. Granted, the word is somewhat saturated with definitions from various fields of study ranging from psychology to human-computer interaction. But as I relate it to the functional characteristic of our cognitive systems discussed so far, it will become clear how such divergent perspectives contribute to a consolidated understanding of the concept of *gesture* as a unitary structure in electronic music.

From the *Oxford Dictionary of English*:

> ***gesture***
> noun
>
> a movement of part of the body, especially a hand or the head, to express an idea or meaning: *Alex made a gesture of apology*; mass noun: *so much is conveyed by gesture.*
> - an action performed to convey a feeling or intention: *Maggie was touched by the kind gesture*; *a gesture of goodwill*.
> - an action performed for show in the knowledge that it will have no effect: *I hope the amendment will not be just a gesture*.

As seen above, the conventional usage of the word *gesture* is mostly related to bodily movements. But, yet another time, the dictionary definition of the word includes concepts that are intrinsic to my interpretation of it, such as "meaning", "action", "conveyance" and "intention". Amongst these, *intention* is fundamental to my motivation to differentiate between gestures and events within the theoretical framework of this book. As in VanDerveer's definition, environmental sounds, which are meaningful in the sense that they denote events, are not part of a communicational system. Environmental sounds causally emanate from events.

Sounds in electronic music, although being similarly communicative of meaning, are designed. These qualities indicate an *intentionality* inherent to social systems of communication (Leydesdorff 2008: 1). I have stated in the previous chapter that a composer's concept does not necessarily have to match the listener's percept. This principle implicitly extends to the concept of intentionality in music (Jensenius 2007: 41). While I propose gesture due its implication of intentionality, not every unit recognized by the listener will have been guided by the composer's purposeful design. Nevertheless, once a unit is recognized (i.e. once an event is identified), intentionality will be associated with it.

> [A] gesture is a movement or change in state that becomes marked as significant by an agent. This is to say that for movement or sound to be(come) gesture, it must be taken intentionally by an interpreter, who may or may not be involved in the actual sound production of a performance, in such a manner as to donate it with the trappings of human significance. (Gritten and King 2006: xx)

Meaning in environmental sounds has been experimentally described to be grounded in actions and causalities in the real world. Gesture is similarly rooted in physical movement but is not the self-evident outcome of an event in the way environmental sounds are. The composer Fernando Iazzetta describes gesture as a movement, but one that can *express* and embody a special meaning (2000: 260). An abstraction of this concept is *musical gesture*, which specify movements in both sound and body (Leman 2012: 6).

> Musical gesture is biologically and culturally grounded in communicative human movement. Gesture draws upon the close interaction (and intermodality) of a range of human perceptual and motor systems to synthesize the energetic shaping of motion through time into significant events with unique expressive force. (Hatten 2003)

As a precursor to this description, the music theorist Robert S. Hatten defines *human gesture* as "any energetic shaping through time that may be interpreted as significant" (2006: 1). The significance of such a shaping lies in its ability to convey an affectively loaded communicative meaning (1, 3). Our interpretation of a gesture relies on the cognition of not merely an object, but of an event, whose movement displays a functional coherence with "the gestalt perception of *temporal continuity*" (2).

The composer Wilson Coker offers a converging view when he describes gesture as "a recognizable formal unit" that signifies musical or non-musical objects, events and actions (1972: 18). A similar delineation of a discernible unitary musical structure is apparent in Stockhausen's proposal of the concept of *moment form*. Stockhausen describes a *moment* as a formal unit which is recognizable by an unmistakable character (1963: 200). These approaches, as I view them, put the emphasis on the act of listening, whether on the composer's or the listener's part. When preparing material for an experiment on auditory perception, Marcell et al. designated sample durations based on the natural progression of sound events; a choice which they deem to be "artistic" (2000: 834). Our knowledge of the natural unfolding of a sound is gained through our exposure to daily sonic environments. The recognition of a unit, therefore is based on our pre-existing expectations on how a sound should start, evolve and end. Given the amalgamation of musical languages described in the previous chapter, it is the composer's decision to abide by, evade or warp these expectations.

François Delalande's gestural taxonomy (quoted in Iazzetta 2000: 262) includes *geste effecteur* (effective gesture) and *geste accompagnateur* (accompanying gesture) which are corporeal manifestations of a gesture. A third category, *geste figuré* (figurative gesture), indicates a metaphorical use of the term. Iazzetta relates Delalande's third category to the musicologist Bernadette Zagonel's conception of *mental gestures*. Mental gestures are products of inner hearing, and are inherent to listening and composition processes as models of experience stored in memory (Iazzetta 2000: 262).

In his analysis of gesture in contemporary music, the composer Edson Zampronha criticizes the procedures adopted during the early years of electronic music for facilitating "non-motivated combination[s] of parameters" (2005). In the same article, he goes on to assert that by the 1980s, gesture was being considered as a replacement to such procedures in dealing with the compositional panorama of contemporary music. Zampronha retrospectively describes this tendency towards gestural composition as an endeavor to "ground music in nature" by taking references and signification into account, and considering gestures as movements of sound entities. He describes gesture as a musical unit of delimited configuration in which parameters are treated interdependently. Although he does not state this explicitly, Zampronha contrasts parameter-based and gestalt perspectives towards music. The *action* segment of the poietic process might deal with parametric morphologies, but the perceived interplay between parameters will induce event gestalts. As Stockhausen states, individual properties of sound, such as timbre, pitch, intensity and duration, may have been dealt with by the composer separately, but "we perceive a sound-event as a homogeneous phenomenon rather than as a composite of four separate properties" (Stockhausen 1962: 40). According to Hatten, musical gestures are "emergent gestalts that convey affective motion, emotion, and agency by fusing otherwise separate elements into continuities of shape and force" (2003).

By consolidating this plethora of perspectives regarding gesture, I arrive at a unified understanding of this concept in relation to electronic music. This understanding is directly informed by poietic insights gained from my artistic practice as well as the esthesic reports obtained from the listening experiments. Paramount to this understanding is that gestures represent events: the way our cognitive faculties deal with a daily environment is not intrinsically different from how we navigate a piece of music. Therefore, ***a gesture in electronic music***,

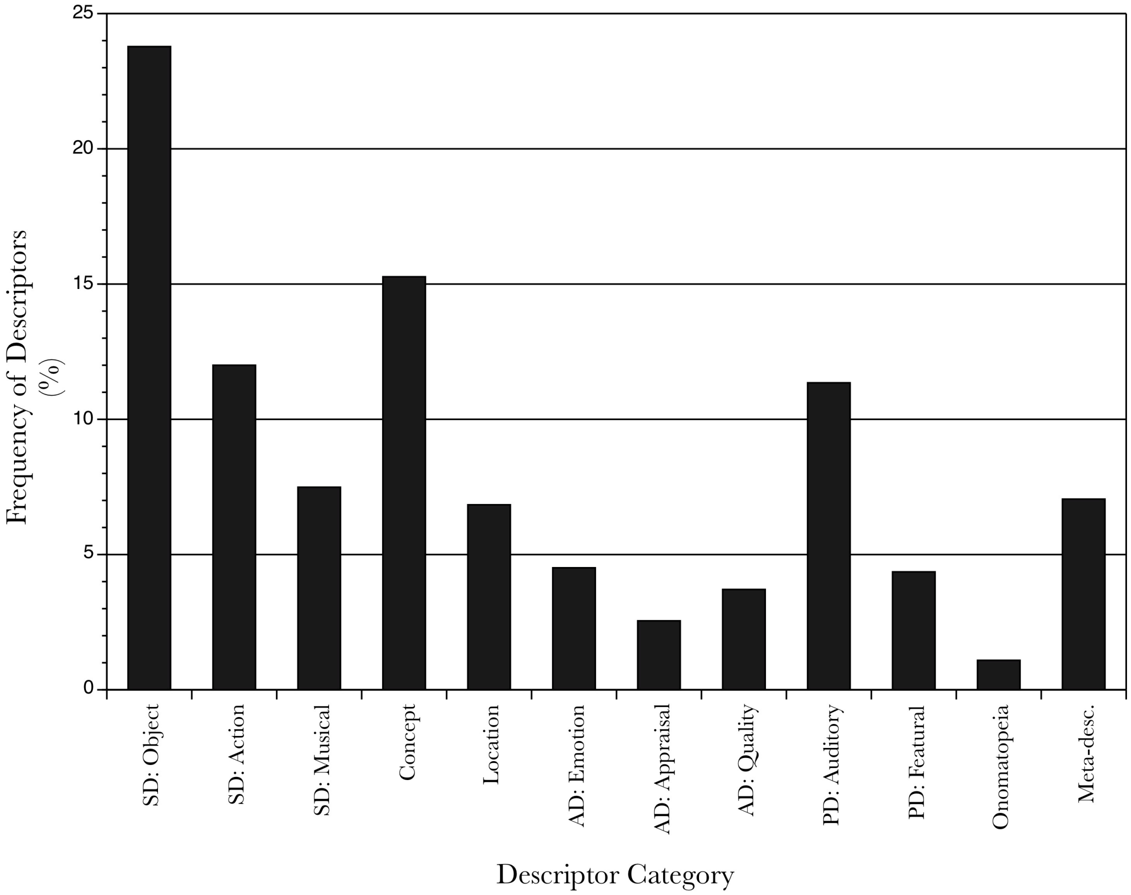
1. ***communicates meaning***,

> An object of any kind takes on meaning for an individual apprehending that object, as soon as that individual places the object in relation to areas of his lived experience—that is, in relation to a collection of other objects that belong to his or her experience of the world. (Nattiez 1990: 9)

From a poietic point of view, I, as a composer, may intend to design gestures which contribute to the narrative I would like to communicate in a piece. The meaning of a gesture can be abstract; the gesture can be intended to incite an emotion or a perceptual awareness. This meaning can also be representational. Then its purpose, as I conceive it, would be to trigger mental representations. From an esthesic point of view, my intentions, except in so far as they concern me as the listener, are irrelevant. But the gesture will instigate a semantic play regardless of these intentions. This communicated meaning is mediated by our past experiences and triggers cross-modal interactions. Although the composer and the listener meets in an absence of multimodal cues that could simplify the negotiation between the concept and the percept, sounds nevertheless induce event-related information (i.e. percepts) in multiple modalities (Warren et al. 1987: 326).

In an experiment conducted by Guastavino on the categorization of environmental sounds, participants often used the source of a sound as a metonym to describe a *sound event* (2007: 55). In another experiment, Dubois et al. similarly found that either source or action descriptors were used by separate participants to classify the same acoustic phenomenon (2006: 867). This behavior was apparent amongst the participants of my experiment as well. For instance in *Birdfish*, the same gesture was described as "water" and "boiling" by different participants. In another example, the descriptors "fly by" and "bird wings" were used by separate participants to denote the same gesture.

In a yet another experiment on environmental sound categorization, Marcell et al. produced a list of 27 labels based on the descriptors provided by the participants (2000: 830). These labels were primarily based on object types, followed by event types and finally on the location or the context within which the event is heard. Descriptors pertaining to the perceptual qualities of sounds were not consistent enough to warrant a separate label (Gygi et al. 2007: 840). In the experiments I conducted, a similar categorical disposition is observable in Graph 4.1.



Graph 4.1: Overall categorical distribution of real-time descriptors

Obviously electronic music and environmental sounds do not warrant a one-to-one comparison. This is particularly clear from the salience of the *concept descriptors*. Furthermore, perceptual descriptors (PD) are also relatively prominent. However, the source (SD) and location descriptors combined constitute an overwhelming majority. Such a distribution can be attributed to the survival function of auditory perception. A sound signifies, and that is the principal utility of a sound. Here, Meyer's distinction between designative and embodied meanings, briefly touched upon in the previous chapter, are of further relevance:

> A stimulus may indicate events or consequences which are different from itself in kind, as when a word designates or points to an object or action which is not itself a word. Or a stimulus may indicate or imply events or consequences which are of the same kind as the stimulus itself, as when a dim light on the eastern horizon heralds the coming of the day. Here both antecedent stimulus and the consequent event are natural phenomena. The former type of meaning may be called designative, the latter embodied. (Meyer 1956: 35)

Applying these two types of musical meaning to the continual association between events and electronic music, I propose a diagram of a relationship between the two:

Electronic music —*embodied meaning*—> Environmental sound —*designative meaning*—> Event

The electronic music gesture and the environmental sound are of the same modality. As discussed in the previous chapter, both representational and abstract sounds of electronic music rely on our knowledge of environmental sounds. The spectromorphological (Smalley 1997) unfolding of a gesture can be in an embodied relationship with an environmental sound. An environmental sound, on the other hand, communicates a designative meaning pertaining to an event and cannot exist as a disembodied phenomenon stripped of its causality. The sound of a bouncing ball points to an object which is not itself a sound. The semantic relationship between an electronic music gesture and an environmental event can be severed by obfuscating the embodied meaning between the gesture and environmental sounds.

2. ***serves a unitary function***,

> The flow of abstract empty time, however useful this concept may be to the physicist, has no reality for an animal. We perceive not time but processes, changes, sequences, or so I shall assume. (Gibson 1986: 12)

Gibson conceives event as the timescale of the environment. Gestures can accordingly be considered the scale at which a piece of electronic music *ticks*. Gestures are cognitive units through which we make sense of our experience of electronic music. We segment the auditory stream into self-contained structural units. This self-containment can be determined by perceptual qualities: in *Birdfish* and *Diegese*, I have utilized low frequency pulses as gestures that articulate motivic changes. Examples of these are heard at 2'45" in *Birdfish* and 1'29" in *Diegese*. These moments were marked by separate participants with perceptual descriptors such as "bass", "voluminous bass", "fat bass" and "sub".

But more significantly, the meaning of a gesture, as discussed above, can assume a pivotal role in shaping a unit. In *Christmas 2013*, a gesture of low frequency rumbling, which lasts from 0'47" to 0'54", was particularized with such descriptors as "thunder", "storm", "storm coming", "something is going to happen" and "expectation" by different participants. In terms of temporal and spectral qualities, this gesture is highly similar with the two instances mentioned in the previous paragraph. The reverberant characteristics and the amplitude envelope of this gesture charge it with semantic traits.

Another factor contributing to this sort of differentiation is a gesture's relevance to the remainder of the piece. In other words, a unitary function can also emerge from contextual meaning[16]. All of the descriptors mentioned above were submitted before the 7-second unfolding of the said gesture was completed. In other words, the sound was regarded as a self-contained element prior to the revelation of its boundaries. The anticipatory nature of some of the descriptors conforms to this semantic endowment of a unitary role. The same gesture repeats from 1'08" to 1'17" before it blends into the background as shorter duration gestures take stage. However, the first 7-second segment of this iteration is almost identical to the previous one. Interestingly, the participants who submitted the previous descriptors did not repeat their impressions. This unanimous behavior can be linked to the fact that, by this time in the piece, these participants have already encountered this gesture and witnessed how it resolved. Two participants who were not amongst those who submitted the aforementioned descriptors referred to this gesture as "rumble'.

Last but not least, gesture exhibits an inter-disciplinary analytical value as a unit, largely due to its myriad adaptations across various fields of study. In my experiences of teaching the composition and analysis of electronic music, gesture has been received by students from a large variety of backgrounds as an intuitive phrase in articulating the discernible and unitary qualities of a sound.

3. ***reveals causality***,

A gesture is a temporal unfolding in itself. Moreover, a multitude of gestures can mark the temporal unfolding of a higher-level form while serving their unitary functions as events. The brain constructs narratives out of one's experience of the world (Roads [forthcoming]). We make sense of the passage of time through the coherent relationships between the events we observe. In Roads' dramaturgical model of sonic behavior, a gesture in electronic music can be thought of as performing three activities: entering, acting and exiting (10). In his further elaboration of this model, he describes that in *acting*, a sound can stay the same, mutate (change in some way), transmutate (become something else, change identity) or "interact with other sounds, form harmonies, consonances, or contrasts/clashes" (10). The latter behavior reveals causal relationships between gestures:

> Interactions between different sounds suggest causalities, as if one sound spawned, triggered, crashed into, bonded with, or dissolved into another sound. Thus the introduction of every new sound contributes to the unfolding of a musical narrative. (Roads 2004 quoted in Roads [forthcoming])

Causalities in electronic music can be abstract or concrete in nature. An abstract causality is the outcome of an arbitrary relationship defined conceptually or by convention. Between 3'07" and 3'24" marks in *Element Yon*, the second of the four concluding *elements* display a harmonic progression resolving to a pitch about 25 cents below B2. While the progression towards this root is particularly apparent between 3'17" and 3'20", the resolving gesture is spatially distinct from this progression in an almost disembodied fashion.

[16] In the next chapter, I will revisit contextual meanings when discussing the concept of semantic coherence.

Concrete causalities become apparent when a sound object imitates the motion trajectory of a physical object. Causal relationships between sound objects, and particularly the adherence of abstract sound elements to a physical law have been of particular interest to me while composing some of the pieces associated with this research. Most particularly, the first movement of my piece *Hajime* from 2009 is a demonstration of what I have previously referred to as a *sonic Rube Goldberg machine*. Sound objects extracted from a sound recording of my voice are subjected to processes of granulation, pitch-shifting, time-stretching and micro-montage. While designing each consecutive gesture, I relied on the behavior of the previous one. For instance a grain repeating at gradually expanding durations with its pitch shifting down in each iteration implies a bouncing object that is slowing down to a halt. When it finally reaches its destination, it contacts another object and starts a new motion trajectory. Imitating the chain reactions of a Rube Goldberg machine, I composed a choreography of sonic causalities. This metaphor of causal juxtapositions was also applied to the first movement of my 2010 piece *Shadowbands*.

4. ***operates at various time scales***,

Gestures can range from the briefest sound one can hear to the longest sound one can discern as having a form. This quality of gestures is also shared by environmental sounds: both the sound of a drill working throughout the day and the sound of a buzzer going off once represent singular events. Regardless of their temporal extent, we are able to discern them as self-contained phenomena. As Gibson states, ecological events can be "nested within longer events" and they "do not flow evenly in the manner of Newton's "absolute mathematical time"" (Gibson 1986: 110).

A background gesture in the second movement of my piece *Shadowbands* begins at 1'37" and lasts for 25 seconds, which is almost one sixth of the entire duration of the piece. This is in stark contrast with the gestures from the first movement, most of which operate at sub-second time scales. As described in Chapter 1, this particular gesture, and the other gestures of extended periodicity accompanying it, are intended to reveal harmonic relations as a metaphor of order.

This is one of the qualities of the electronic music gesture which differentiate it from a gesture in instrumental music on a practical basis. In electronic music, gesture is decoupled from duration (Barrett 2012; personal communication). The electronic medium allows for a composer's gestures to extend beyond and contract below what is humanly possible. I can stretch or compress a gesture temporally to produce new gestures. I can also infinitely duplicate it. By enforcing a rhythmic grid to the timeline of a composition, I can achieve a superhuman precision in periodicity. Furthermore, by means of this grid, I can *snap* gestures of varying durations to each other and maintain exact synchronicity or proportional metric relations between these gestures.

5. ***coexists with other gestures***,

Just as we are able to separate simultaneous events transpiring in our immediate environments from one another, we can also make a meaningful segmentation of concurrent gestures in music. In his seminal lecture *Four Criteria of Electronic Music* presented at the Oxford Union in 1972, Stockhausen describes his third criterion, namely *multi-layered spatial composition*, as follows:

> Building spatial depth by superimposition of layers enables us to compose perspectives in sound from close up to far away, analogous to the way we compose layers of melody and harmony in the two-dimensional plane of traditional music. This is really very important, and nothing new in human experience: I mean, it happens everywhere, (Stockhausen 1989: 106)

The coexistence of gestures is inherently coupled with their ability to operate at various timescales. In *Diegese*, between 0'24" and 0"49", gestures of different timescales are layered on top of each other. This variety in timescales is crucial in articulating the figure and ground roles between gestures. In the farthest layer, an ambient texture persists throughout the entire section. Coming closer, a low frequency textural element is initiated at 0'32". This gesture, which gradually fades out, lasts for almost half the duration of the previous background gesture. In a concurrent layer, an organic gesture pulsating at granular scale establishes a third texture. Although this layer is in a closer proximity to the listener when compared to the first two layers that are submerged in reverberation, it is stripped of a figure role through an audio decorellation of the left and right channels. Lastly, in a fourth layer superimposed on the previous three, another organic gesture consisting of transient percussive components assumes an unmistakable figure role as it travels the entire spatial extent of the piece which has so far been articulated by the first three gestures. Separate participants addressed these four layers with the following descriptors respectively: "ambient", "saw" (oscillator), "bug" and "someone on the door".

In the next chapter, I will return to the coexistence of gestures in figure and ground relations when I investigate the spatial and semantic configurations in electronic music.

6. ***implies intentionality.***

Unlike environmental sounds, gestures are part of a communication system. Poietic intentionality is what separates a gesture in electronic music from an environmental sound. Furthermore, gestures arouse mental imagery. Similar to all devices of communication, mental imagery too bears intentionality "in the sense of being *of*, *about*, or *directed at* something" whether that something is real or unreal (Thomas 2010).

Actions on the part of the electronic music composer result in intentional electronic gestures. An action itself can be a single physical gesture. However, as I stated in the previous chapter, a gesture can also be a composite of numerous actions performed separately. Nevertheless, the resulting gesture will imply an intentionality. As noted before, not all gestures are the outcome of a poietic initiative, as in the case of algorithmic composition. Electronic music composition can encompass approaches that are completely devoid of narrative arcs. But the esthesic intentionality of gestures is persistent regardless of poietic intent. Referring to the work of Jean Piaget, the acoustic communication researcher Ute Jekosch points out that gestalt forms are "as much constructed by ourselves as they are given by the perceived items". In other words, a gestalt is the product of both an object and its interpretation. This understanding coincides with Molino's communication schema which situates the *trace* as an embodied artifact in the absence of a communicational hierarchy between the producer and the receiver. The act of esthesis performed by the receiver, which is in our case the listener, is imposed upon a trace of its own. The traces of poiesis left in the symbolic form are not always perceived (Nattiez 1990: 17):

> The esthesic process and the poietic process do not necessarily correspond (…) [T]he listener will project configurations upon the work that do not

> always coincide with the poietic process, and do not necessarily correspond to what Deliège happily dubbed "realized intentions". (17)

Or, in Molino's terms, the sender and the receiver do not have to come to the same understanding of the trace (Frisk and Östersjö 2006: 7). This is in agreement with Duchamp's perspective in which the artist and the viewer represent two poles of an artistic work and there does not need to be a correspondence between the artist's intention and the viewer's interpretation of the work (8). This sentiment, which can be applied to any form of artistic experience, is valid for electronic music as well. The composer's conception of a musical work, in terms of goals and techniques, will not necessarily translate to what is perceived by the listener (Smalley 1997: 107).

What embodies a gesture in the trace is intentionality. A gesture can originate in both the poiesis and the esthesis. Imposing a perceptual or a semantic unitary function to the physical artifact that is the trace, the listener extracts an intentional gesture. Conflicts of intentionality between the poietic and the esthesic are impossible to avoid: the perceived (or esthesic) intentionality will result in gestural hierarchies which may or may not serve the narrative goals of the composer; but they will nevertheless be obedient to the listener's construction of a narrative. But a translation of intentionality is also possible. Here is a general impression response from the preliminary studies conducted with the previous version of *Birdfish*:

> The sounds heard and experienced by a baby in its mother's womb prior to birth, and its eventual coming to earth.

In terms of its actors and context, this description is in strong disagreement with the narrative I was trying to communicate with the piece. However, there is an uncanny congruence between metaphors: my piece, at least the way I conceived it, narrates a story of evolution in which organic forms (i.e. fish and amphibians) transform as they travel from beneath the ocean into the sky. In this particular case, once the listener has constructed a narrative, poietic intentionality of the gestures was translated. But they nevertheless served functions similar to what I intended to communicate within my narrative arc. For instance, the reverberant gestures implying a cave and the gestures intended to create a sense of underwater were combined in a gestalt perception of a womb. Once this setting was established, the remainder of the gestures was contextualized and interpreted accordingly.

Intentionality will serve a further function in establishing the presence of the composer in the spatiotemporal universe of a piece. I will later discuss the ways in which the degree of this presence can be manipulated. This is one of the instances where the meta-descriptors submitted by the participants of my experiments will be of particular use.

In the next chapter, I will offer a narrative contextualization of gesture, and how the above characteristics operate at the semantic and the spatial layers of electronic music.

CHAPTER 5

DIEGESIS: A SEMANTIC PARADIGM

DIEGESIS

Narratologist Gérard Genette defines *diegesis* as "the spatiotemporal universe" referred to by a narrative (1969: 211). The concept of diegesis can be traced back to Plato's dichotomization of narrative modes into imitation and narration (1985 [c. 380 BC]: 247). However, it has since yielded various incarnations that have been used for describing narrative structures in art, and situating the components of an artwork in relation to one another. On a meta-level, the resulting narratological perspectives also provide insights into the fabric of the artistic experience by delineating relationships between the artist, the artistic material and the audience.

As an artistic form of temporal nature, music too prompts narratives. The narrative mode of music is determined by its language. In instrumental music, narratives are conveyed to the listener through a culturally embedded musical language that has been established over the course of centuries. Since the material of electronic possesses a cognitive disposition which extends beyond the well-ingrained structures of a traditional musical language, electronic music can assume a mimetic role: listeners are *presented* with sounds that can *represent* extra-musical events while the medium of the recounting remains the same as that of the recounted. However, when this material meets the esthesic capacity of the listener, the physical artifact is inevitably succeeded by the manifestation of a story. Therefore, a diegesis (i.e. a spatiotemporal universe) emerges in the intellectual domain. The cognitive processing of electronic music institutes a bond between the mimetic and the diegetic. As a result, the figure and ground relations between gestures extend beyond those of physical forms, and a narrative unfolds both in the spatial domain of the concert hall and in the semantic space superimposed onto this domain by the listener.

In this chapter, I will discuss the semantic and physical dimensions of electronic music and describe how these two dimensions come in contact with each other. I will assess the explicit and implicit aspects of the listener experience while, at the same time, questioning the extents to which the listener is inside or outside the musical material. Rather than merely contrasting the mimetic and the diegetic aspects of electronic music, I will describe the role of their coalescence in actively shaping our experience of electronic music.

An Interdisciplinary Contextualization of Diegesis

Throughout history, the concept of diegesis has come to assume several meanings. Most of these meanings can be associated with the modern field of narratology. In Platonic mimesis, events "either past, present, or to come" are presented through imitation. Diegesis on the other hand, relies on narration (Plato 1985 [c. 380 BC]: 247). Therefore, under Plato's taxonomy of narrative forms, theatre is mimetic, because actors imitate (i.e. re-enact) situations, while poetry is diegetic because the poet, speaking in their own person, recounts events as a narrator who is external to the immediate world of the story.

Art forms, and moreover, how artistic material is experienced, have indeed evolved considerably since Plato's delineation of these concepts. For example, in Plato's time, reading poetry was not a recreational activity one would enjoy individually. Rather, the artists themselves recited their poems to the public during gatherings. Due to changes in such practices, concepts of diegesis and mimesis have also been redefined several times to accommodate new art forms and new esthesic routines. These redefinitions have inevitably given rise to contradicting views amongst theorists who have elaborated new demarcations of the terms specific to particular art forms.

In film, for instance, the sounds that occur within a scene (e.g. a dialogue between two characters, or music coming from a radio in the scene) are considered diegetic, while the film score that emerges from outside of the universe of the story is labelled as non-diegetic sound (Taylor 2007). Diegesis serves broader functions in film theory. A prominent perspective is that all film is diegetic because the director chooses certain parts of the story's universe to be displayed on the screen. The director therefore assumes the role of a narrator, and all that is going on on-screen is illusory (Hayward 2006). But then we can question which form of art fails to meet this criterion. Even a generative work of art necessitates a moment in time when the artist initiates an algorithm, thus creating a narrative context for the piece. From this point of view, all artistic material can be deemed to display diegetic features, even when these are communicated through a representational form that is mimetic in the Platonic sense.

Genette applies the term *diegesis* exclusively to literary theory. By describing such subcategories as *heterodiegetic* and *extradiegetic* (1980: 50; 1969: 202, 212), he creates a narratological terminology, which he utilizes to situate the author, the reader and the components of a literary text (i.e. characters, venues, time) in relation to one another. Differentiating between cascading layers of a narrative by starting from the physical world of the author on the outermost level, Genette outlines the concept of diegesis as the *spatiotemporal universe* to which the narration refers. Therefore, in his terminology, a *diegetic* element is "what relates, or belongs, to the story" (translated in Bunia 2010: 681). Here we can observe a thread emerging between Genette's literary definition of the term and its usage described above in the context of film where a diegetic sound originates from a source that belongs to the scene.

Coalescence of Mimesis and Diegesis

As previously described, in Plato's categorization, tragedy and comedy (i.e. theatre) are mimetic modes of narrative, while poetry and mythology (i.e. literature) are diegetic. The distinguishing factor between the narrative actions pertinent to each mode, namely re-enactment and recounting, is whether the medium of representation remains the same as that of the represented, or, in other words, whether there is a mediation between the expression and the expressed. Electronic music, in this sense, is mimetic. While it may represent extra-musical events, it does so through connotations of sound. It is not narrated like diegetic poetry, but speaks for itself; it represents not as a mediator but as a portion, or an abstraction, of reality. The loudspeaker will detach the sound from its source but the medium of the phenomenon remains unchanged. Here, we can revisit the semantic relation between gestures in electronic music and environmental sounds described in the previous chapter:

Electronic music —*embodied meaning*—> Environmental sound

Mimetic

The embodied meaning which constitutes the semantic relationship between electronic music and environmental sounds is mimetic in nature because the medium of both is sound. However, electronic music does evoke more than memories of sounds, just as an environmental sound signifies more than the physical entity which emitted it. What is auditorily perceived can be an artifact of a phenomenon but not the phenomenon itself:

> Let us begin by noting that *information about* something means only *specificity* to something. Hence, when we say that information is conveyed by light, or by sound, odor, or mechanical energy, we do not mean that the source is literally conveyed as a copy or replica. The sound of a bell is not the bell and the odor of cheese is not the cheese (…) Nevertheless, in all these cases a property of the stimulus is univocally related to a property of the object by virtue of physical laws. (Gibson 1966: 187)

Furthermore, every sound we hear triggers a semiotic web, allowing us to imagine and comprehend more than what the sound immediately represents. The mimetic acting of tragedy engenders a similar reaction. What we witness on stage is just a portion of the world we imagine and situate the characters within. Here a bond between Plato's mimesis and Genette's diegesis comes into being. Although a narrative form might be purely mimetic, it will nevertheless imply a spatiotemporal space different from that which the audience inhabits. Electronic music *presents* to listeners sounds that *represent* events; it does not speculate about — or recount — sounds. Electronic music is therefore mimetic in the spatial domain of the concert hall, but it creates a diegesis for the listener in the semantic domain.

Electronic music —*embodied meaning*—> Environmental sound —*designative meaning*—> Event

Diegetic

(Re)presentation

However, the listener can be absent from the artwork's universe. If we go a little further with the adaptation of dramaturgical concepts, electronic music engages with listeners in a similar fashion to *representational acting*. This type of performance ignores the presence of an audience and situates them outside the context of the unravelling universe of the story. This is unlike presentational acting, which acknowledges the audience and moreover, addresses them. Actor Constantin Stanislavski's typology of these terms, although from an entirely different perspective, reveals new threads across separate art forms. Stanislavski asserts that presentational actors "must live the part every moment that [they are] playing it" (Stanislavski 1948: 19) and expose the character through their understanding of it, *becoming one* with their role. Representational actors on the other hand, do not live the part but *play* it. The actor "remains cold toward the object of his acting but his art must be perfection" (22).

Parallel to Stanislavski's definition of presentational acting, American visual artist Sanford Wurmfeld describes *presentational art* to be "structured by a human being and presented as a statement (…) to be experienced or received by an active viewer. By its sensory nature, such art is untranslatable and the ideas or feelings transmitted by it are tied to the particular object that expresses them" (Wurmfeld 1993). The ideas of untranslatability and affixing of affect to the art-object intrinsically relate Wurmfeld's discourse to the previously described experience of a musical material expressed through a culturally embedded musical language, whether it is in the context of an instrumental or an electronic work. Furthermore, in instrumental music, the presence of an external performer *presenting* a composer's work is explicit. We could therefore align the experience of a traditional musical language with Wurmfeld's and Stanislavski's definitions and classify it as having presentational qualities. As I will discuss in the next section, presentational qualities in electronic music can manifest themselves in two ways — through the composer's presence in the work, or through the listeners' awareness of their physical selves.

Narrativity

Deleuze and Guattari describe that the artist's greatest challenge is to make an artwork stand up on its own. For them, this requires "from the viewpoint of lived perceptions and affections, great geometrical improbability, physical imperfection, and organic abnormality" (1994: 465). The idea of the "abstract, as a negation of reality" discussed in Chapter 3 applies to such imperfection and abnormality; an improbability is intrinsically defined in relation to our preconceived notions of what is probable. In literature, a text that demands too much interpretation prompts the reader to naturalize it by "using acquired knowledge to simplify it" or resolving semantic inconsistencies by turning to the narrative structure (Mikkonen 2011: 113). An assumption of *world semantics* is transferred from the real world to the fictional world (Bunia 2010: 699). Impossible fiction is therefore considered "an ostensible oxymoron" (Ashline 1995: 215).

While there is no narrator in non-vocal music comparable to that in a literary text, listeners partly assume this role by constructing stories out of their experience of the narrative. Narration "can inform us about a universe and yet restrict its information to a small set of events and characters populating this universe" (Bunia 2010). The artwork does not need to provide every element of the diegesis, since the listener expands the physical experience with the semantic by filling in the gaps. This license on the listener's part is further apparent in Souriau's interpretation of diegesis, which he describes as "all that belongs, 'by inference,' to the narrated story" (Gorbman 1980: 195). A similar attitude is described using the term "the principle of minimal departure" (Ryan 1980). This principle states that we structure our interpretation of alternative realities as closely as possible to our own realities (403): we project things we know about the real world upon the implied reality of a story (406). A narrative can restrict the information it communicates about a universe to a small set of actors and events that populate it (Bunia 2010: 686). But by virtue of the principle of minimal departure, we are able to form "reasonably comprehensive representations" of such worlds even though they are always described incompletely. An imagined spatiotemporal universe can be insufficiently narrated, but the universe will nevertheless be logically complete.

Genette describes narrative as a statement or a discourse which signifies a story (Genette 1980: 27). Cultural theorist Mieke Bal describes *narrative text* similarly as a text in which a story is told. However, Bal divides what Genette refers to as a story into two layers, namely *story* and *fabula*. In Bal's definition, a story is "a fabula presented in a certain manner" (1997: 5). By this, Bal means that a fabula consisting of a series of chronologically connected events can be communicated to cause different appraisals and therefore different stories. Furthermore, Bal emphasizes that a text can be understood as a narrative in any medium including "language imagery, sound, buildings, or a combination thereof" (5). When situated in Nattiez's semiological model, Bal's *text* corresponds to the trace[17] and *fabula* is the outcome of the reader's esthesis (or interpretation) of the text manipulated by the story (9). Genette's and Bal's approaches can be differentiated with the below adaptations of the semiological schemas discussed in Chapter 3:

Genette's approach: Narrative (trace) —*esthesis*—> Story

Bal's approach: Producer —*poiesis* (story)—> Text <—*esthesis* (fabula)— Receiver

Deriving from Bal's model, Meelberg describes narrative as "the representation of temporal development". He further emphasizes that narrative represents a succession of events in a process and it is not the process itself (2006: 39). Theorist David Herman characterizes narrative as "a basic human strategy for coming to terms with time, process, and change" (2009: 2). According to Roads, we constantly construct narratives from our sensory experiences "by anticipating the future and relating current perceptions to past" ([forth-coming]). From this point of view, it is inevitable for listeners to extract narrative structures from their musical experiences due to the simple fact that a piece of music encapsulates a series of events between a starting point and an anticipated ending in the future. Recalling the discussion on gestural intentionality in the previous chapter, the extent to which the extracted structure is concordant with the composer's design does not jeopardize its materialization.

In instrumental music, the narrative emerges in the abstract realm of the musical sound: musical expectancy is built upon either culturally or physiologically evaluated traits of music. Music can narrate emotional experiences (Walton 1994: 60), or simply a form unfolding over time (Meelberg 2006: 1). But as stated in Chapters 3 and 4, electronic music adds to this experience a distinct form of representationality made possible by the electronic medium. A layer of meaning attribution intercepts the passage from physical phenomenon to musical appraisal. Listeners inhabiting the spatial domain of the concert hall superimpose semantic representations over their embodied experience of the sounds. The affective quality of the artwork is immanently informed by this act. Here are two general impression entries about *Birdfish* as written by two participants:

> I heard robotic bugs moving around being commanded by more intelligent robotic beings. There was water, stepping into water, robotic dialogues and also progress made by the robotic bugs in their task.

> This music reminded me of a cartoon I used to watch when I was in high school. I related the piece to the story of the cartoon which told the struggles of liquid-like alien creatures who on the one hand were not from this world but on the other hand had to adapt to survive.

In the real-time descriptors of the first participant, the same narrative is apparent but the robotic bugs are replaced with "bugs" as the workers who are "flying" and "walking" while

[17] Although Bal provides another definition of *fabula* as "a memorial trace" of a story "that remains with the reader after completion of the reading" (1997: xv), trace, as she refers to it, has a different meaning than how Nattiez uses the term in his model described in Chapter 3.

making progress on a given task. In the second participant's real-time descriptors, instead of aliens, there are other creatures referenced as actors such as "baby bird", "huge ant", "snail" and "worm". The story, on the other hand, persists with such descriptors as "sent to earth", "can't fit in" and "struggle again". The timing of the latter coincides with that of such descriptors by the first participant as "some adjustment" and "project continues". A correspondence chart between two stories can therefore be constructed as seen below:

Character	Setting	Action
Bugs (robotic)	A project	Making progress
Creatures (aliens)	Earth	Struggle

In these cases, we can observe two distinct stories constructed from the same narrative. However, there is an apparent pairing between how these two separate diegeses are populated and how the actors populating these universes act. In the next section I will examine those physical and semantic features of electronic music which contribute to the construction of such stories from a given narrative. I will return to congruences across different stories that emerge from the same narrative when I discuss the effects of semantic context on the construction of diegeses.

DOMAINS OF EXPERIENCE

As described in Section 1 of Chapter 3, there are several mental mechanisms which underlie the evocation of musical emotion. Said mechanisms were brain stem reflexes, evaluative conditioning, emotional contagion, visual imagery, episodic memory, and musical expectancy (Juslin and Västfjäll: 559). These mechanisms do not function in a mutually exclusive manner but rather assume complementary roles in inducing musical emotion (563). Juslin and Västfjäll offer a somewhat simplified scenario to explain how these mechanisms might be activated when listening to a piece of instrumental music:

> A sudden, dissonant chord induced a strong feeling of arousal (i.e., brain stem reflex), causing [the listener's] heart to beat faster. Then, when the main theme was introduced, he suddenly felt rather happy – for no apparent reason (i.e., evaluative conditioning). In the following section, the music turned more quiet . . . The sad tone of a voice-like cello that played a slow, legato, falling melody with a trembling vibrato moved him to experience the same sad emotion as the music expressed (i.e., emotional contagion). He suddenly recognized the melody; it brought back a nostalgic memory from an event in the past where the same melody had occurred (i.e., episodic memory). When the melody was augmented by a predictable harmonic sequence, he started to fantasize about the music, conjuring up visual images – like a beautiful landscape – that were shaped by the music's flowing character (i.e., visual imagery). Next, the musical structure began to build up towards what he expected to be a resolution of the tension of the previous notes when suddenly the harmonics changed unexpectedly to another key, causing his breathing to come to a brief halt (i.e., musical expectancy). He thought, "This piece of music is really a cleverly constructed piece! It actually made me reach my goal to forget my trouble at work." Reaching this goal made him happy (i.e., cognitive appraisal) (563)

While such so-called goals are rarely a conscious part of the listener's experience, these mechanisms constitute components of how we navigate through not only musical experience, but also the experience of daily life because, as Juslin and Västfjäll conclude, "music evokes emotions through mechanisms that are not unique to music" (559). In Chapter 3, I identified survival instincts and the evolution of our perceptual mechanisms as the bases of our appraisal routines. Therefore, studies on the cognition of sound provide us with insights into how the human mind copes with external stimuli, whether these may emanate from environmental phenomena or the speakers in a concert setting. Throughout this section, I will introduce evidence from both my experiments and other empirical studies to trace out compositional strategies which exploit the semantic and the physical domains of electronic music. I will bring these findings together with the theoretical perspectives presented in the earlier sections to portray various dimensions of narrativity in electronic music.

The Physical Domain

The physical domain represents the empirical reality which the listener inhabits as a corporeal entity. Sound is a part of this reality as an acoustic phenomenon. Time in the physical domain progresses at a steady rate. The discussion below relates to physical objects and the measurable qualities of sound, as well as the implications of such qualities on the listening experience.

Perceptual Properties of Exposure

According to Moore and Hedwig, when hearing a sequential stream of sounds we can either perceive it as coming from a single source (i.e. fusion or coherence), or from multiple sources (i.e. fission or stream segregation) (2012: 919). They describe the "degree of perceptual difference" as determining the extent to which stream segregation occurs (2002: 320). This degree is dependent on various attributes of a sound such as lateralization between the two ears, frequency, temporal envelope and phase spectrum (320): "[w]hen the differences between successive sounds are very large, fission nearly always occurs, whereas when the differences are very small, fusion nearly always occurs" (2012; 919). Differences of intermediate size bring into being a property called "bistability" during which the percept flips between one or multiple streams (919). This provides an empirical ground for the compositional strategy of articulating a gesture by shifting its spectral, dynamic or temporal characteristics. Although in visual perception figure and ground configurations establish depth relationships between concurrent elements, Moore and Hedwig's findings pertaining to the auditory domain supports the idea that non-layered sequential sounds can be imbued with figure or ground roles through perceptual segregation.

In an fMRI-based experimental study of emotional and neural responses to music, Chapin et al. found that tempo fluctuations caused emotional arousal in both experienced and inexperienced listeners. In another experimental study on the perception of emotional expression in musical performance, Bhatara et al. concluded that timing variations alone had more impact than variations in amplitude, although the latter was also found to communicate a significant amount of expressive information (2011: 932). Huron similarly draws attention to the effects of the dynamic and temporal characteristics of music on emotional experience. For instance, frisson response is found to be correlated with loud passages in music (Huron 2006: 34). On the effects of temporal organization, Huron offers an intriguing perspective on *repetition*. In what he refers to as an *orienting response*, individuals turn their heads in the direction of an unexpected sound as a basic reflex. However, when such a stimulus is repeated, the individuals will habituate to it after a while and cease the orientation reflex. A sufficiently novel change in the sound however will cause *dishabituation* and the individuals will reorient to the stimulus (49).

The opening impact sound of *Christmas 2013* recurs twice in its unaltered form and once more in a less reverberant environment. This is an unmistakable and relatively loud gesture. Participants referred to the first instance of this sound with "bam", "sudden start" and "percussion" which describe the abruptness of the sound. The subsequent instances of the gesture however went unmarked by these participants which indicates a habituation.

Additionally, other impact sounds of comparable amplitude appearing throughout the piece were usually noted only once by the other participants.

From an entirely different yet convergent perspective, Truax describes *habituation syndrome* as individuals' adaptation to annoying noises in their acoustic environments as a result of extended exposure (1984: 90). He further characterizes habituation as a form of desensitization (90). When a noise lacks an immediate significance, we are able to habituate to it and disregard it as background noise. However, as the level of background noises increase, so does their "information load on the brain" (23). A musical correlate of this is explored in an experimental study by the music psychologist Diana Deutsch where she found that unstructured musical sequences "imposed a much heavier memory load" on the listener than structured ones.

With the help of Stockhausen's *Unity of Musical Time,* which characterizes *noise* as event sequences of irregular durations (1962: 41), these two different research perspectives can be linked together: a lack of periodicity, which is typical of daily soundscapes, can be considered to cause a more mentally demanding experience for the listener when compared to that of an even temporal structure in music. In that respect, a clear rhythmic grid can be utilized as a device of relief, for instance, in an electronic music piece which exhibits a temporal complexity matching of everyday sounds. A powerful representation of this is heard at the end of Roads' piece *Touche pas*, where he uncharacteristically introduces looping of a 3-second segment towards the end of the piece, which had thus far evaded such patterned structures. While one participant distinguished this moment as being funny, another participant entered the number of times the loop repeated, only to immediately correct himself, almost taking pleasure in his ability to keep track of the number of instances. Many other participants used descriptors, such as "repetition", "counting", "rhythmical", "coda" and "loop", which indicate a clear engagement with the section.

Although individual events in daily life might exhibit periodic behaviors (e.g. "an engine running"), multiple periodic events almost never align to a temporal grid, meaning that environmental sounds do not share a rhythm. As a result, rhythmic patterns are almost always *crafted* and indicative of musical structure. A rhythm in the context of an electronic music piece that is composed mostly without a rhythmic grid therefore represents a powerful tool, as it is capable of disrupting the diegetic experience by inciting an immediate awareness of a musical structure. Amidst the uneven temporal configuration of *Christmas 2013*, a half-measure reprise of the *Silent Night* at 1'26", which lasts a relatively brief duration of approximately 1 second, was enough to incite tempo-related descriptors such as "rhythm", "rhythm again", and "little beat" indicating a tendency to latch onto temporal patterns.

Another example in the same vein is *Element Yon*, in which the composition of abstract sounds constantly reveals temporal and spectral contrasts. For this reason, the piece can be characterized as consisting of "unstructured musical sequences", to use Deutsch's term. The impact of this quality is apparent in the real-time descriptors, such as "exhausting", "chaotic" and "confused", submitted by participants who listened to *Element Yon*. Furthermore, in his general impressions, one participant stated that "sounds without a rhythm made [him] curious but at the same time they were really exhausting". A moment in the piece which this participant accordingly marked as "exhausting" was marked by another participant as "I repeat and repeat but you don't get it". This participant had already elaborated on this section in his general impressions when he likened his experience to witnessing a redundant argument between people. In his general impressions, another participant described a section towards the middle of the piece as having become boring because of unclear sound structures.

Awareness of the Physical Self

The sounds of electronic music come into contact with the listener in the physical domain. The embodied experience of the listener can cause a perceptual focus on the physical characteristics of a sound. But, furthermore, a sound can make the listener aware of his or her own physical presence. For instance, boundary cases in loudness and frequency are capable of prompting such phenomena: spectral extremes at sizable amplitudes, such as very high and very low frequencies that are clearly audible, make listeners conscious of their acts of listening. As I discussed in Chapter 3, when we fail to identify a source for a sound, we tend to focus on its acoustic properties. Given the abstract nature of *Element Yon*, it was therefore expected that the listeners would be more inclined to describe the spectral characteristics of the piece. But more interestingly, the results have revealed that *Element Yon* has generated a much more articulated sense of self when compared with the results from other pieces. Participants who listened to *Element Yon* reported their general impressions mainly in prose form and using the first person (i.e. "I felt (…)"). Contrastingly, participants who listened to *Birdfish* commonly assumed the role of an outside viewer who observes and reports the unfolding of certain events (i.e. "(…) happened"). In this sense, the experience of *Birdfish* can be likened to that of watching representational acting, during which the audience is situated outside the diegesis. The self-awareness apparent amongst the listeners of *Element Yon* is akin to what is experienced by audience members when they are personally addressed by the actor during a play. The music becomes a *presentational object* as the material addresses the audience by making the listener acknowledge his or her own presence.

Almost half of the participants who listened to *Element Yon* expressed a form of annoyance with the high frequencies by submitting such descriptors as "disturbing", "annoyed" or "irritating". Two participants described physical pain in such comments as "painful sometimes" and "it hurts", although they later reported having had a comfortable listening experience. However, three quarters of the participants particularly noted the rests in the piece either by pointing out the pockets of silence themselves, or by describing the relief they induced. While *Birdfish* incorporates the momentary use of high frequency gestures comparable to those in *Element Yon*, only one participant used the descriptor "harsh high" to indicate a similar annoyance. Furthermore, although the silences are structured very similarly between the two pieces, none of these silences were denoted as bringing relief in the context of *Birdfish*.

This kind of self-reference is apparent also in the general impressions of the participants who have evaluated *Element Yon* more conceptually. This indicates that the aforementioned boundary cases are capable of piercing through the diegesis and bringing the listeners back to a cognizance of their physical presence in the concert hall.

The Experienced Listener

As I mentioned in Chapter 2, the participants in my experiment varied greatly in terms of musical background. Amongst this variety of participants were students of sound engineering, sonology and sonic arts. These students therefore had either been exposed to a repertoire of electronic music or were capable of discussing auditory phenomena in technical terms. A visible tendency in the results obtained from these participants was the incorporation of *technological listening* (Smalley 1997: 109) in their impressions. This was mostly evident in the meta-descriptors submitted by these participants, which addressed the technology or technique behind the music rather than their experience of the music *per se*. Such impressions ranged from the description of synthesis techniques to spectral, spatial and formal analyses of the works. Descriptor characteristics did not otherwise vary significantly between experienced and inexperienced listeners: while prior exposure was of use in the characterization of abstract elements, the descriptors denoting representational forms were consistent in terms of both content and frequency across participants of varying musical backgrounds.

Presence of the Composer in the Work

Just as sounds can make listeners aware of their physical selves, they can also make them aware of the composer as an external being. Gestures which accentuate the presence of the composer are presentational. These gestures can also take place in representationally rich pieces. From a narratological perspective, the presence of a composer in a representational narrative implies an *extradiegetic narrator* who is outside the diegesis but inside the spatiotemporal universe of the *narration* "understood in terms of physics" (Bunia 2010: 683). In the experiment results, such instances manifested themselves in meta-descriptors that refer to the material being of the piece in a way that acknowledges a poietic entity. For instance, in their real-time descriptors, several participants directed questions towards the pieces, as in "where is it going?" (*Christmas 2013*), "what's the point?" (*Element Yon*), "is it repeated?" (*Birdfish*), and "repetition, why?" (*Touche pas*). Other descriptors referred to those aspects of the piece that are conceived at the level of narration, such as "final crescendo" (*Birdfish*), "development", "harmonic progression", "motif" (*Touche pas*), "chaotic composition" (*Element Yon*) and "gesture" (*Diegese*). These meta-descriptors refer to the works as the conscious products of a composition process.

> [W]e will have to mark the contrast between mimetic and diegetic by a formula such as: *information* + *informer* = *C*, which implies that the quantity of information and the presence of the informer are in inverse ratio, mimesis being defined by a maximum of information and a minimum of the informer, diegesis by the opposite relationship. (Genette 1980: 166)

The more the composer (i.e. the informer) articulates his or her presence in the piece, the less of a self-sustaining environment the diegesis implies. This is an aesthetic choice which impacts the listener's experience considerably. The choice is made between the intelligibility of a human performer versus the autonomy of a diegesis, or between the listener being left unattended in the universe narrated by the piece, and the listener coming into contact with the composer.

A lack of thought concerning the implications of self-presence in a piece is another sign of the novice composer. Adorno refers to the aesthetic paradox of "making the impossible possible" when he asks how making can "bring into appearance what is not the result of making" (Adorno 2002: 107). If it is indeed the intention of an electronic music composer to suggest a spatiotemporal universe entirely separate from that which the listener inhabits, the *craft* should be extracted from the artifact. If the listener can visualize the hands of the composer as they change a parameter, the implied intentionality will amount to a presentational gesture that will take over the narrative. This becomes apparent, for instance, when creating parameter automations: if the imperfections of performing a parameter-change by hand are not smoothed out, the experience of the listener can immediately swing from hearing a wind blowing to a visualizing a performer changing the cut-off frequency of a filter on the mixer. The latter too can be expected of electronic music, but it should nevertheless be the product of a poietic initiative rather than a lack of precision.

The Semantic Domain

The semantic domain of an electronic music piece first emerges during the composer's act of poiesis and becomes translated into the physical domain. Another semantic domain is later constructed by the listener. This domain accommodates the story extracted from the narrative. Every instance of new material primes the listener contextually for what is to come, and the flow of gestures constitute a constant semantic realignment. Even when an explicit sound element is removed from the scene, it implicitly persists. The diegesis established thus far in the piece maintains a semantic context. In the listener's mind, past diegetic actors interact with present ones, and the listener starts filling in the gaps. Through imagining the implicit world of a piece, the listener, for example, can obtain semantic polyphonies from perceptual monophonies and construct implied figure and ground relations. This act of *world making* creates an immersive listening experience.

Effects of Semantic Context

In an experimental study which examined the effects of context on the identification of everyday sounds, Ballas and Mullins found that contextual inconsistencies had a negative impact on the identification of sounds (1991: 199). In another study on semantic distance effects, Vigliocco et. al. used visual representations of objects and actions to demonstrate a similar impact of semantic context on identification (2002: B61). Furthermore, Orgs et al. offered corroborating evidence of a comparable effect with a cross-modal study (i.e. between visually displayed words and sounds) on conceptual priming (2006: 267). In another study by Ballas, sound identification time and causal uncertainty were found to be highly correlated (1993: 250). Finally, Guastavino's study on environmental sound categorization affirmed the determinant role of presentation context of a sound (2007: 54).

These findings can be correlated with the concepts of contextual meaning and semantic coherence briefly touched upon in Chapter 4. According to Wishart, "[c]ontextual cues may not only change our recognition of an aural image, but also our interpretation of the events we hear" (1996: 152). Cognitive cues instigate the formation of semantic contexts for gestures. In *Birdfish*, clear references to water and organic creatures, which were the two most salient types of descriptors for this piece, caused listeners to imagine possible environments (i.e. contexts) such as "underwater", "lake", and "aquarium". When the recognition of amphibian-like sounds was evaluated within a space articulated with reverberation, such descriptors as "cave" and "dungeon" appeared with the former being one of the salient descriptors in the preliminary studies. Similarly, a combination of water-like sounds with the inference of a cave formed general impressions such as "water dripping off of a cave wall", and "slimy rocks and stalactites". Such combinations of descriptors instigate high-level semantic processes beyond what the individual components of these combinations could achieve alone. In other words, the semantic coherence between the actors can imply environments or even new actors, since, as the neuroscientist Moshe Bar states, "recognition of an object that is highly associated with a certain context facilitates the recognition of other objects that share the same context" (2004: 617). This is true "even if these objects are ambiguous when seen in isolation" (619). Furthermore, when such a coherence is present between an actor and its context, high-level semantic processes, in which the listener embellishes the diegesis with other appropriate objects, are activated. "[A]n ambiguous object becomes recognizable if another object that shares the same context is placed in an appropriate spatial relation to it." (619).

> [E]ach context (for example, an airport or a zoo) is a prototype that has infinite possible exemplars (specific scenes). In these prototypical contexts, certain elements are present with certain likelihoods, and the spatial relations among these elements adhere to typical configurations. Visual objects are contextually related if they tend to co-occur in our environment, and a scene is contextually coherent if it contains items that tend to appear together in similar configurations. (617)

When an object is not congruent with its context, it is processed more slowly: typical items and relations will have faster processing times when compared to novel ones (618). In other words, contexts gathered from the recognition of objects feed back into how the individual objects in the extracted context will be perceived. Bar describes context frames as "prototypical representations of unique contexts" (618). This concept is reminiscent of models of experience such as *perceptual symbols* and *schemas*, already discussed in Chapter 4. Prototypical contexts imply both the likelihood of certain elements and their spatial configurations (617).

Once listeners establish a semantic context, they have a tendency to hold on to it for the remainder of the piece. For instance, a listener of *Birdfish* who established, early on in the piece, a scene implying a sea with such descriptors as "underwater", "sand", "water" and "waves", described the ending of the piece with "big waves", "sea is projected in the air", "and explodes". Another participant who extracted, from the same piece, a story of robotic bugs working on a project as mentioned earlier, described the ending of the piece with "workers are pleased", "big cheers" and "project successful". Here we can see that both participants felt a need to address the climactic ending of the piece. But how this climax was situated in the diegeses of their imaginations shows a semantic coherence with the contexts which had already been established.

Reverberation provides information regarding the static size (i.e. the spatial affordance) of an environment. However spatial movement, such as the panning of a sound object across a stereophonic panorama, not only can establish an equivalent sense of a static space (i.e. spatial context), but can also instigate in the listener's mind a semantic gestalt as a context. This is apparent, for instance, when the "spatial activity of insects" causes the imagination of a "hive" or a "swarm".

As discussed in Chapter 3, the contextual segmentation of everyday sounds relies greatly on those distinctions between sound events which denote sources, and ambient noises in which background sounds are blurred together (Guastavino 2007: 57). The ambient noise context affects how a listener reacts to an environmental sound (Raimbault and Dubois 2005: 342). These everyday tendencies are without a doubt reminiscent of figure and ground configurations in music, but their impact becomes even more prominent in the context of electronic music, in which everyday sounds themselves constitute a frame of reference. The blurring effect is a cognitive artifact of selective attention; however, the composer can predetermine this selection by actually obscuring sound events, and therefore building this cognitive artifact into the work. This phenomenon is exercised in the second movement of *Birdfish*: the organic gestures from the first movement which there assumed figure roles are subjected to such processes as low-pass filtering, reverberation and frequency shifting in the second movement. Although the temporal density of these gestures remains the same, by pushing them backwards in the spatial structure of the piece, I establish a stage for new figure elements. These gestures, which now serve a ground function, are no less evident yet the contrast in spatial configurations between the two layers imposes a sense of blurriness upon the background, since while we pay analytical attention to short-term details in the foreground, we tend to group background elements in gestalt patterns (Truax 1996: 58).

Playing with Anticipation

As Huron states, the contrast between the predicted and the actual outcome of an event amplifies the emotional response to it (2006: 22). On the other hand, we are better at detecting and perceiving events when they conform to our expectations (43). As composers design new worlds, they also establish a framework of expectations. Roads states that a sense of causality between sound events will imply predictability: if listeners fail to associate these events with an underlying syntax, the piece turns into "an inscrutable cipher". This, however, does not deny the power of strategically used juxtapositions ([forthcoming]).

> [Research has] provided evidence that one product of readers' narrative experiences are *causal networks* that represent the relationships between the causes and consequences of events in a story. Some story events form the main *causal chain* of the story whereas others, with respect to causality, are dead ends. When asked to recall stories, readers find it relatively more difficult to produce details that are not along that main causal chain. (Gerrig and Egidi 2003: 44)

The final section of *Element Yon*, which I have described in Chapter 1 as being composed "to obfuscate any motivic closures to the piece", generated several descriptors and impressions relating to listener anticipation. One participant in her general impressions wrote: "Unpredictable. I liked that a lot". Later, in her real-time descriptors, this participant marked the final section of the piece with the word "unpredictable". At an approximate moment in the piece, another participant submitted "when it's over, I can't tell" as a descriptor.

In *Christmas 2013*, the juxtaposition of a Christmas carol with causally unfolding electronic gestures was intended to establish a sense of nostalgia in a vast post-apocalyptic environment devoid of human beings. An inexperienced listener wrote in her general impressions that the opening was familiar, but as the melodic component dissipated, the piece took a turn to what she would later refer to in her real-time descriptors as causing "suspense":

> It started to sound like bits and pieces of sounds and noises that I failed to make sense of. Bu these sounds, when they are together, they gave me this tense, mysterious feeling I don't know why.

Human or Not

In a study on environmental sound categorization, a free-sorting task conducted with 26 participants revealed that the presence of human activity is one of the most salient features for the hedonic judgement of urban soundscapes (Guastavino 2007: 54): "Soundscapes where human sounds are predominant tend to be perceived as more pleasant than soundscapes consisting of mechanical sounds predominantly" (61). Correspondingly, based on semantic criteria proposed by Murray Schafer and Bernard Delage, Raimbault and Dubois construct a soundscape classification consisting of “road traffic (car–truck–motorcycle), other transportation (railway, aircraft), working machines (street cleaning, working site), music, people’s presence (speech, walking), and nature (wind, animals)” (2005: 343).

The preference for a human presence in soundscapes can be broadened to a distinction between the presence of animate and inanimate objects. Based on the results of their neuroscientific study on domain-specific knowledge systems, Caramazza and Shelton assert that animate and inanimate conceptual categories are products of evolution and are “subserved by distinct neural mechanisms” (1998:1). It is suggested that dedicated neural substrates[18] have evolved for the categorical representation of animate objects in semantic memory, owing to the survival advantages of being able to identify such objects (Vigliocco 2002: B62). These claims imply that humans display a particular ability (supported by a dedicated system) to distinguish semantically between animate and inanimate objects. However, unlike Guastavino’s cognitive approach, Caramazza and Shelton’s findings deal with performance rather than appraisal.

Accordingly, in a study on affective appraisal, Tajadura-Jiménez and Västfjäll found that “self-representation sounds”, which are associated with bodily functions such as breathing and heartbeat sounds, increased the corporeal awareness of the listener and might have “a stronger potential for inducing an emotional experience” (2008: 66). In another study on the categorization of environmental sounds, harmonic content has been found to indicate for participants either a vocalization or a signaling (Gygi et al. 2007: 852). This also coincides with the assertion made in Chapter 3 that harmonic sounds do not occur in nature but are rather fabricated.

Gliding pitch variations in intonation are expressive of not only meaning (Gussenhoven 2002: 47) but also personality and emotion (Scherer and Oshinsky 1978: 332). Furthermore, this is true not only of humans but also of vocalizing animals in general (Amador and Margoliash 2013: 11136). The gestures consisting of rapid frequency modulations of monophonic lines in *Element Yon* were therefore suggestive of an organic origin, as evidenced in descriptors such as “I guess he is trying to tell us something”, “communication”, “conversation”, “crying”, “scream”.

Contacts between the Physical and the Semantic Domains

The two domains previously discussed are immediately and intrinsically attached to each other. The physical domain constantly informs the semantic domain with new material. In return, the semantic content of gestures contribute to the listener’s selective focusing on the material. Contacts between these two domains can occur in various ways. Below I will offer a number of examples of such contacts supported by experimental data.

Meyer explains that the connotative capacity of a phrase in instrumental music is intrinsically connected to how much it diverges from a “neutral state”:

> A tempo may be neither fast nor slow; a sound maybe neither loud nor soft; a pitch may seem neither high nor low, relative either to over-all range or the range of a particular instrument or voice. From the standpoint of connotation these are neutral states. Connotation becomes specified only if

[18] Memory, language acquisition and facial recognition are other examples of neural substrates.

> some of the elements of sound diverge from such neutral states. (Meyer 1961: 263)

We can assume that a ground element in music, such as an accompaniment texture, sets a neutral state, in terms of spatial attributes, for a melody to diverge from. Taking the cognitive idiosyncrasies of electronic music into consideration, we can think about semantic dimensions of figure and ground. Meyer's rationalization of connotative capacities, which come into being through contrast, can also be applied to the semantic domain. Our auditory systems allow us to perform the acts of foreground and background listening simultaneously. This way, we can achieve a gestalt perception of our daily soundscapes with certain sonic phenomena highlighted as figures, while others remain out of focus.

Spatialization and loudness determine the perceived physical proximity of a figure. In tandem, these two parameters help establish the semantic concept of *motion*. Sounds from stationary speakers follow choreographies designed by the composer and imply for the listener an animation of objects, albeit detached from any actual moving sound source. These objects can be cognitively abstract or concrete; regardless, the listener hears — and furthermore imagines — beyond the mere changes in parameters and extracts the gestalt (i.e. the motion) emerging from the interplay between them.

As for ground elements, spatialization and amplitude, along with spectral dynamics, can set the reverberant characteristics of a sound, which in return establishes another semantic concept, that of *location*. This highly representational concept transcends the metaphor of musical ground: once a location is semantically associated with a texture, a scene is established for successive figure gestures, which will then be evaluated by the listener in reference to *where* they occur. This conditioning does operate both ways, since the semantic content of a figure gesture will inevitably feed back into how a consecutive ground gesture will be received as I have previously discussed.

Inside and Outside the Diegesis

The interplay between the semantic and the physical attributes of a sound implies links between the diegesis and the concert hall. A sound can travel from an alien territory into the concert hall and weave a contact between the representational and the presentational. A stark example of this phenomenon is evident in Luigi Nono's *La Fabbrica Illuminata*, a 1964 piece for voice and 4-channel tape. The piece exhibits a mixture of live and recorded voices in multi-channel audio accompanied by electronic sounds, as it narrates a story about textile workers who had been trapped in a factory fire. For the fixed sounds, Nono made location recordings at the factory in which this event originally took place. The voices on tape transform from quiet speech into loud vocal lines and mix with the live singing. Quiet sections of the recorded voices create the illusion of a mumbling crowd, which can easily be mistaken for the audience at the concert hall where the piece is being performed. In an interview, Nuria Schönberg-Nono describes that, to achieve such surround affects, the spatial configuration of loudspeakers for Nono's pieces would be adapted to each particular performance space. In the same interview, Schönberg-Nono recounts the composer's particular focus on the spatial aspects of auditory experience:

> The Basilica of San Marco in Venice was, from his early creative days, a great influence − the idea that music should come from all different directions and that you were in the centre, instead of having all the sound coming to you just from one single source. There are some wonderful films

> that we have in which he explains these things about how in Venice, when you walk around, you hear so many things coming from different places and he believes that the capacity to hear all these things is in us, but that it has been shut out and it needs to be developed. (quoted in Souse 2008)

In *La Fabbrica Illuminata*, while the performance of the singer embodies a more traditional musical act, it also anchors the experience in the physical domain by serving a presentational function. This amplifies the disorientation when the recordings of the mumbling voices suddenly turn into roaring vocal phrases that are clearly in a space different from that which the audience inhabits. The listener travels back and forth between the concert hall and the burning factory, and the journey amounts to an immensely eerie experience through the interplay between the explicit and the implicit worlds.

The physical and semantic aspects of a piece can complement each other or one can overpower the other. The auditory attributes of a sound can alter the imagined universe, or the semantic content of a sound (or lack thereof) can draw attention to its physical characteristics. In *Diegese*, between 0'25" and 0'50", during which several sonic layers populate the scene, a gesture design inherited from *Birdfish* embodies the former case: the spatial configuration of these organic gestures relative to the remainder of the concurrent layers causes them to be highly noticeable. While several participants identified these sounds as "bugs" and "insects", one participant submitted "take out these bugs from my ears" as a real time descriptor. This indicates a distinct physical engagement with the semantic content of the gestures.

Such interactions will determine where listeners will situate themselves in the narrative. Listeners can witness the unfolding of the musical narrative from both inside and outside the diegesis. When a piece weaves a web between the physical and the semantic domains, gestures that are presentational on account of their auditory qualities draw listeners into the diegesis by making them aware of their physical selves. A participant, who visualized "insects flying in a cave" when listening to *Birdfish*, observed the diegesis from outside. Several participants who listened to *Christmas 2013*, on the other hand, described themselves as the subject of a similar action by expressing such impressions as "flying over a city", "makes you feel as in space", "brings you to the air", "[I imagined] open space, empty or a plain, sea (but still open space behind)".

The articulation of space and spatial activity enhances the immersion and creates a contact between the physical and the semantic domains. The listeners describe a bodily experience, but this experience is contextualized in the diegesis rather than the concert hall. Practically speaking, such impressions can be attributed to the fact that the spatial design of *Christmas 2013* consists of a stable reverberant field and intermittent low-frequency rumbles which were intended to create the illusion of a vast space. But the piece also exploits immediate and intermediate spaces which were constantly articulated with impact sounds traveling *around* the listener. Furthermore, the transitory objects displayed spectral behaviors reminiscent of Doppler shifts[19] which may have established a more convincing image of a sound source moving in relation to the spatial position of the listener. Other participants described their corporeal involvement with the piece in phrases such as "inside the brain", "being inside a drum set randomly playing itself" and "music in the air and deep inside the body". All these

[19] For a comprehensive overview of such localization cues, please refer to the pioneering composer John Chowning's paper *The Simulation of Moving Sound Sources*, which was of guidance in the design of various gestures in *Christmas 2013*.

impressions denote an internalization of the material which in return causes the participant to situate themselves inside the diegesis. How much of the material is internally (or corporeally) evaluated can therefore be a determinant of the extent to which the listener is inside the implicit world of the story.

Sense of Time

A narrative is temporal and the time needed to consume it is the time needed to traverse the narrative (Genette 1980: 34). In literature, this time is borrowed from the pace of the reading. In music, the physical time needed for traversing a narrative is set in advance by the composer. However, our understanding of time is a result of the "experience of successions" (Fraisse 1963: 1). As mentioned in the previous chapter, the perceived time ticks in events. The time experienced by the listener can therefore speed up or slow down relative to the unremitting progression of seconds. This temporal relativity constitutes another point of contact between the physical and the semantic domains.

Participants listening to *Element Yon* referred to a lack of or a slowing down in movement with such general impressions as "something still and stable, not dynamic, not moving" and "slow movement; heaviness". Real-time descriptors such as "heavy", "static", and "waiting" also point to this quality. This can be a correlate of the previously discussed increase in memory load due to a lack of structure in the piece.

In *Birdfish* a participant stated in his general impressions that "the sense of time changes over the piece". The same participant provided the real-time descriptor of "time" after the second movement of the piece commenced. In this part, the ongoing textural density of the piece is pushed into the background. New figure gestures, which exhibit pulsations at slower frequencies, are distributed more sparsely in the foreground. Yet, the event-based pace of the background continues to move forward at the pace of the first movement. This was indeed intended to create a contrast between coexisting timescales.

In *Christmas 2013* another form of temporal shifting is observed. Different participants referred to their experience of time in their general impressions with comments such as "trying to stop time by going ultra slowly", "objects in slow motion" and "the piece made my brain slow down for a moment". This can be attributed to the general decaying behavior in the spectral content of the gestures. For instance each transient of the causally unfolding impact gestures exhibit a gradually decreasing frequency. Additionally, more ambient elements also exhibit a similar behavior. This is different from the aforementioned Doppler shifts in the piece which exhibit an increase in frequency followed by a decrease, in conjunction with the spatial displacement of the gestures. The decaying behavior can be reminiscent of "slowing down" by physical law. If a cyclically operating object emits sounds at a sustained pitch, this pitch gradually falls as the object slows to a halt. This behavior can be observed in most mechanical devices used in our daily lives such as washing machines, cars and vacuum cleaners. Another highly pertinent yet somewhat antiquated example is the tape machine. If the perceived slowing down in time reported by the participants is indeed correlated to the decays in spectral content, then this implies an intriguing metaphorical link between the functional pace of objects and the perceived pace of time.

Diegetic Affordances and Affect

Emerging from two distinct fields of study, namely philosophy and psychology, the concepts of affect and affordance, discussed in Chapters 3 and 4 respectively, have significantly convergent characteristics. Recalling previous discussions of these concepts, the following correspondence chart can be formed:

Affordance	**Affect**
Pre-personal, structured information available in the (material) environment	Pre-personal intensity
Precedes cognitive processes	Unqualified experience
Action possibility	Affective potentiality
Relative to the observer's form	A corporeal phenomenon

As seen above, these two concepts, by their definitions, are contiguous with each other. Both represent capacities, one pertaining to the perceived object and the other to the perceiver. If a link is therefore to be formed between the two, an affordance can be characterized as inductive of affect. While Massumi characterizes emotion as a sociolinguistic fixing of the experiential quality that is *affect*, he later dilutes the one-way succession of affects into emotions by stating that affect also includes social elements and that higher mental functions "are fed back into the realm of intensity and recursive causality" (2002: 30). Affects, anchored in physical reality, are therefore both pre- and post-personal (217). He further states that what he terms affect is "the simultaneous participation of the virtual in the actual and the actual in the virtual, as one arises from and returns to the other" (2002: 35). This transposable take on affect is also apparent in Freud's interpretation of the concept: unconscious affects persist in immediate adjacency to conscious thoughts and they are practically inseparable from cognition (Seigworth and Gregg 2010: 2).

> [The] meaning that listeners attribute to sound, the spatial dimension, or the interactions with other sensory modalities, are as important as the physical properties of sound in evoking an affective response. (Tajadura-Jiménez and Västfjäll 2008: 63)

In Chapter 3 I quoted from the article *Percept, Affect, and Concept*, in which Deleuze and Guattari elegantly described "how the plane of the material ascends irresistibly and invades the plane of composition of the sensations themselves to the point of being part of them or indiscernible from them" (1994: 466). Affect, as I would like to therefore interpret it, represents a landscape of experiences from which emotions sprout. This landscape is superimposed on the material. The affordances of the material evokes affects with the perceiver. An object represented in electronic sound constitutes a material of second order which induces a virtual affective experience. Simultaneously with the ascension of the embodied sound into affect, the representation ignites an affective thread of its own. The imagined spatiotemporal universe of the story will have its own dimensions, landscapes, surfaces and objects.

However, such landscapes and surfaces will only afford *diegetic* action possibilities to the listener. Gibson describes a similar behavior for surrogate objects in the visual domain, such as a photograph or a motion picture (1986: 294). While these objects also specify invariants, they instigate indirect awareness and provide "information about" (Gibson 1966: 245). The electronic music listener can too make out acoustic invariants characteristic of a certain object. While a representation in electronic music will be "a structured object in its own right" (Nussbaum 2007: 24), the action possibility will nevertheless remain virtual for the listener since the imagined object is an external representation: "[t]he perception or imagination is vicarious, an awareness at second hand" (Gibson 1986: 295).

Affects are semantically processed, fed back into the established context and experienced as the result of *diegetic affordances*. When watching a horror movie for instance, the viewers are aware that they are in a theatre. But once they have been acculturated into the story of the film, a mundane and seemingly non-affective act, such as switching on the lights in a room, becomes loaded with affect. Because threat, as an affect, "has an impending reality in the present" (Massumi 2010: 54). Listeners of electronic music, concoct diegeses from the poietic trace left by the composer. In semantic consistency with these diegeses, listeners populate the landscapes of their imaginations with appropriate objects, situated in various configurations based on cognitive or perceptual cues. As they do so, they also *experience* this environment with implied affordances true to the objects of their imagination, and affects attached to these diegetic possibilities.

> The beholder [of a film] gets perception, knowledge, imagination, and pleasure at second hand. He even gets rewarded and punished at second hand. A very intense empathy is aroused in the film viewer, an awareness of being in the place and situation depicted. But this awareness is dual. The beholder is helpless to intervene. He can find out nothing for himself. He feels himself moving around and looking around in a certain fashion, attending now to this and now to that, but at the will of the film maker. He has visual kinesthesis and visual self-awareness, but it is passive, not active. (Gibson 1986: 295)

Accordingly, the listener of electronic music experiences passive aural kinesthesis. Earlier in this section, I have provided several examples from listener impressions which display such forms of involvement. An inexperienced participant, who listened to *Diegese*, narrated a highly visual story of her experience in her general impressions:

> Glass/metal ping pong balls are constantly being dropped on the floor as we walk through an empty salon with bare feet; we leave this room and go out in a jungle, moving through the grass stealthily; passing through cascading rooms; we arrive in another salon.

While many of the objects in her narrative also appear in descriptors provided by other participants, details like "walking with bare feet" and "moving stealthily" are indicative of the participant's individual affective experience of the diegetic environments of her imagination.

Physical Attributes of the Imagined Source

In Chapter 3 I argued that even purely synthesized sounds can instigate a mental association to a sound source and, in Chapter 4, that the poietic intent of the composer and the esthesic construction of the listener do not necessarily have to match. The principle of minimal departure discussed earlier in this chapter implies for the experience of electronic music that when a source for a sound object is imagined, the mind will bridge the gaps as necessary to achieve a base level of consistency by attributing featural qualities to the source. This ability, as discussed in Chapter 3, is informed by our mental catalogue of auditory events we extract from our daily environments: we possess a sophisticated understanding of how a certain object in action will sound in a certain environment. As Gaver states, the material, the size and the shape of a physical object will intrinsically determine how the object vibrates and therefore produces sounds: for instance, vibrations in wood damp much more quickly than in metal, "which is why wood "thunks" and metal "rings" and "big objects tend to make lower sounds than small ones" (1993a: 7).

Therefore, even the most elementary attributes of a sound can indicate a physical causality. In that respect, granular synthesis bears a significant capacity. In granular synthesis, the metaphorical relationship between a microsound and a particle can be extended to a physical model in which a microsound *behaves* like a particle[20]. In the experiment results, gestures produced using granular synthesis were described by various participants as particles (pieces, cells, glass, metal) dividing (breaking) and merging (coming back together, colliding). These reports highlight the implication of physical causality inherent to granular synthesis. The frequency and the amplitude envelope of a grain can be altered to specify a particle's size. *Touche pas* is particularly rich in similarly shaped objects of various sizes, as evidenced in the real-time descriptors referring to spherical objects of diverse proportions. Furthermore, the timbral characteristics of grains can be altered in order to imply different surface materials. In *Diegese*, which quotes a particular granular texture from *Touche pas*, listeners differentiated between timbral varieties by defining different material types and objects. Separate participants described imagining "glass/metal balls", "ping pong balls", a "pinball machine", "champagne" (cork sound), a "woodpecker" and "knocking on the door". Here the materials vary from metal and plastic to wood. For *Touche pas* both "coins", "marbles", "ping pong balls", "bowling ball" and "xylophone" were provided as descriptors, indicating a similar spectrum of materials.

An important determinant of such descriptors is the motion trajectory of a grain. The particular motion trajectory used in *Diegese* is inspired by the concurrent loops of unequal durations heard in Subotnick's seminal piece *Touch*, a behavior which is also apparent in *Touche pas*[21]. When multiple loops are blended together, the resulting texture implied for most participants a sense of "bouncing" (i.e. "marbles bouncing") or "falling" (i.e. "rocks falling together"). One participant wrote: "the clicking sounds (…) resembled a dropped ball bouncing on a surface, since each sound came in slightly quicker than the previous one". Another participant described *Touche pas* as displaying a "convincing physicality". Once a motion trajectory is coupled with the imagined material of the object, higher semantic evaluations occur: while one participant described "bouncing on wood" followed by "marimba", another participant wrote that marbles made her think about "childhood", "fun" and "games".

The cognition of motion trajectories can be a function of temporal causality. VanDerveer draws attention to temporal coherence as "possibly the primary basis for the organization of the auditory world into perceptually distinct events" (1979 : 41). To examine the effects of temporal factors in the identification of environmental sounds, Gygi et al. used event-

[20] This is discussed extensively in Roads 2001.

[21] For a further explication of the relationship between these three pieces please refer to Chapter 1, Section 2.

modulated noises[22] (EMN) which exhibited extremely limited spectral information (2004: 1252). By vocoding an environmental sound recording with a band-limited noise signal, the event-related information was reduced to temporal fluctuations in dynamics of a spectrally static signal. From experiments conducted with EMN, researchers concluded that, in the absence of frequency information, temporal cues can be sufficient to identify environmental sounds with at least 50% accuracy (1259). The idea of a sonic Rube Goldberg machine, which features in the compositions *Shadowbands* and *Hajime*, relies heavily on temporal articulations of sound events in order to reveal physical causality. Such articulations are apparent in most of my pieces, and particularly in gestures that form connections between consecutive sections (e.g. 0’33” to 0’39” in *Christmas 2013* and 1’27” to 1’30” in *Diegese*).

In *Birdfish* I utilized short-tailed reverberation and low frequency rumbles to establish the sense of a large but enclosed environment. These were reflected in the real-time descriptors with such entries as ”cave”, “dungeon” and “big spaceship”. Similar cues in *Christmas 2013* prompted listeners to submit “open sea”, “open space” and “sky” as descriptors. The spectral and reverberant attributes of the sound specify environments in various spatial proportions with the listener. This information implies, for instance, the affordance of locomotion (which in several cases manifested itself as that of “flying”).

In *Element Yon*, which inhabits a strictly abstract sound world, the frequency and damping characteristics of certain gestures instigated such descriptors as “metal balls getting bigger and smaller”, “high tone falls and hits the ground”. Here, distinctly perceptual qualities are situated in metaphors, while retaining their embodied relationship with the listener. Another similar example is observed in the responses to high frequency gestures in *Birdfish*, which listeners characterized with such descriptors as “ice”, “glass”, “metal”, “blade” and “knife”. These descriptors imply both a metaphorical association and an affordance structure between high frequencies and a perceived sense of sharpness.

Earlier in this section, I referred to various aspects of recognizing an organic sound source. In relation to these aspects, linguist John Ohala points to the cross-species association of high pitch vocalizations with small creatures, and low pitch vocalizations with large ones. He further delineates that the size of an animal, as implied by the fundamental frequency of its vocalizations, is also an indicator of its threatening intent. Many descriptors submitted by the participants of the experiment denoted living creatures. However, a portion of these source descriptors were augmented by featural descriptors to form such noun phrases as “tiny organisms”, “baby bird”, “little furry animal”, “huge ant” and “huge animal”. Here, featural descriptors signify the proportions of the perceived organisms. In these cases, featural information available in the sounds afforded the listeners a spatial hierarchy between the imagined creatures and themselves. Based on Ohala’s deductions, the spatial extent of an organism communicated in its vocalization characteristics, which would possess a survival value in a natural environment, is a diegetic affordance of threat. Featural descriptors can therefore be viewed as indicative of affect.

[22] A similar vocoding technique can be heard in the introduction section of my composition *Shadowbands*, in which the semantic content of a voice recording vocoded with filtered noise is intelligible for the most part.

Music as a Diegetic Actor

The layer of meaning attribution in electronic music has a peculiar effect on how the listener engages with more traditional forms of musical material in the context of an electronic music piece. Such forms could include a tonal melody, a discernible rhythm, or even a gesture that displays a timbral similarity to a physical instrument. While these forms would be expected to cause an immediate affective appraisal in an instrumental music context, experiment results revealed a meta-evaluation of such forms when encountered in an electronic music piece. Prior to an affective appraisal, the listener identifies the phenomenon as the musical form that it is, situated in the universe of the piece. That is to say, abstract musical elements effectively turn concrete and become diegetic objects in the context of the piece, almost like *a television in a movie scene*.

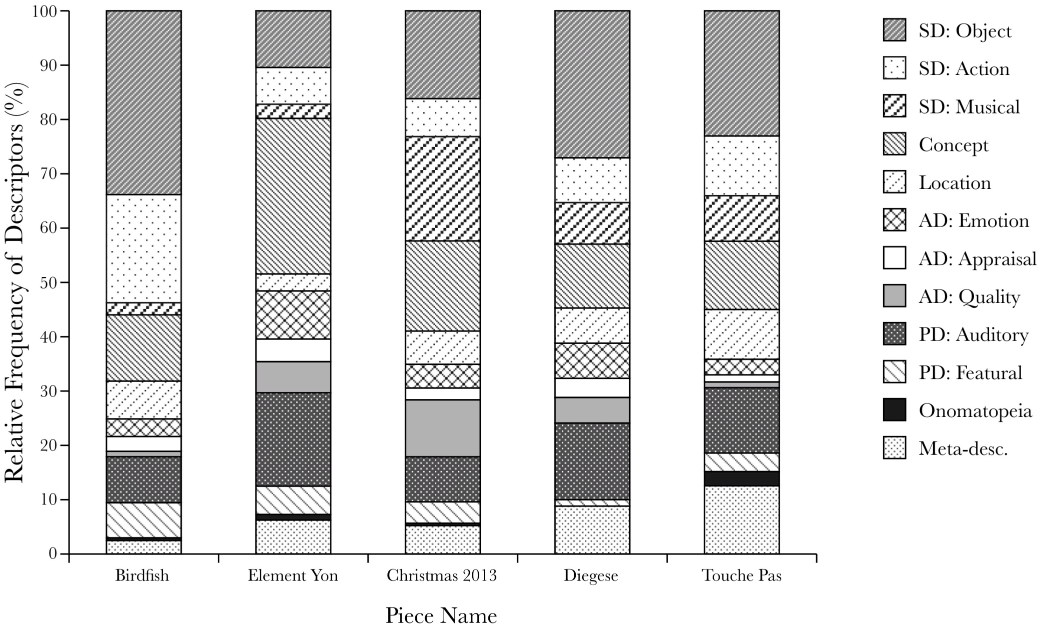
As described in Section 2 of Chapter 1, one gesture in the representational sound world of *Birdfish* is an abstract leitmotif consisting of three notes in octaves played legato. This gesture is at times supplemented by almost imperceptible resolutions in the lower spectrum that remain in a territory between underwater rumblings and a significantly low-pitched pedal point. The piece is otherwise almost devoid of any material that could be aligned with structures common to instrumental music. Amongst all the narrative components of the piece, which are conspicuously set underwater, this leitmotif creates a moment of stark contrast. One participant of the preliminary studies described the final recurrence of this leitmotif at the very end of the piece as a “musical climax”. Out of all the impressions provided by this participant, such as “water dripping off of cave walls” and “factory noises”, this is the first and only reference to a musical form. It is also interesting that the leitmotif inspired a need to pronounce the *musicality* of a gesture in a piece of music. An audience member from a performance of *Birdfish* characterized this leitmotif as a “musical souvenir”. This expression appropriately illustrates the diegetic quality assumed by a traditionally musical form in the context of an electronic music piece.

Quoting Music within Music

Quotation has a long history in music. Given its inherent capability to capture and reproduce sounds, the electronic medium grants the composer an “unprecedented ability to include exact quotations from pre-existing sources” (Beaudoin 2007: 149). Notable examples of such quotations are found in Vladimir Ussachevsky’s *Wireless Fantasy*, which cites Richard Wagner’s *Parsifal*, Pierre Henry’s appropriation of Anton Bruckner’s symphonies in *Comme une symphonie envoi a Jules Verne*, and Karlheinz Stockhausen’s *Hymnen*, which is composed of recordings of various national anthems from around the world.

Two of my pieces used in the experiments explored the idea of quoting music within music. As described in Chapter 1, in *Diegese* there are two quotations: the first is a recreation of the granular texture from *Touche pas*, and the second is a recorded snippet of Beethoven’s op. 90. Since the former is an emulation of a texture rather than an exact quotation, its effect appears in the experiment results only in the form of cognitive similarities between the descriptors submitted for the two pieces. These similarities were extensively interpreted above. However, in the latter quotation the listeners can clearly discern the piano segment even if they could not point out a particular piece as a source. Two thirds of the participants made note of the piano sound in their real-time descriptors. One participant included an appraisal descriptor and referred to the quotation with “nice piano” followed by “lovely” at 1’15”. Another participant made note of the quotation in his general impressions as “the frantic piano sound". Other participants did not use such appraisal adjectives when referring to the quotation.

In *Christmas 2013*, a similar quotation is from the Christmas carol *Silent Night*, as played by a jazz trio. While the entirety of the piece was composed out of sounds extracted and processed from this recording, between 0'4" and 0'20" the quotation can be clearly made out. Furthermore, brief references to the quotation are sparsely distributed through the remainder of the piece. As a result musical source descriptors constituted the most salient descriptor category for *Christmas 2013* as seen in Graph 5.1.



Graph 5.1: Categorical distribution of real-time descriptors by piece

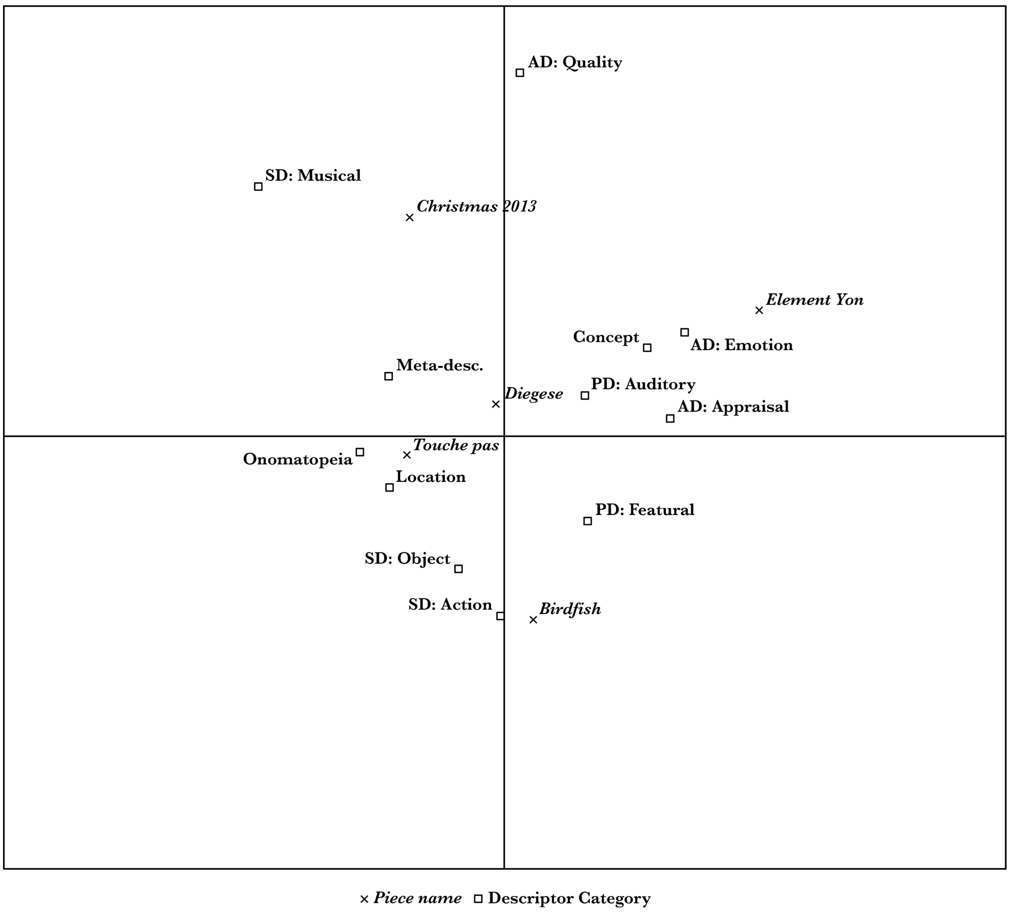
Three quarters of all participants who listened to *Christmas 2013* used the real-time descriptor "piano" at least once. Participants who did not directly refer to the piano, alternatively submitted "music I know", "bar, dance" and "ballet". Participants who attended an individual general-impressions session on *Christmas 2013* provided concurring feedback. The quotation was referred to with "real instruments", "acoustic instrument", "a phantom harmonium" and "cosy trio". Unsurprisingly, "Christmas" was another salient descriptor. The final ambient crescendo was described by two participants as "Pink Floyd"[23]. Other than the descriptors denoting musical instruments or forms, participants also submitted quality descriptors such as "familiar" and "cliché". One participant, a Sonology bachelor student, offered an intriguing perspective on the structuring of the piece by defining "planes in a dimension". He described the impact sounds, which indicate the temporal and spatial unfolding of the piece, as establishing a plane. According to this participant, "rooms" represent another plane. More interestingly, he refers to the quotation also as a "cliché" and explains that this too becomes a plane on its own. I find this *objectification* of the cliché to be an apt description of my poietic intent, which was to assign a diegetic function to the quotation.

[23] In hindsight, I can clearly hear the brief moment that is reminiscent of the band's *Shine On You Crazy Diamond* from the album *Wish You Were Here*, which was a defining piece for my taste in music as a child. Although this "quotation" was entirely unintended, I find the comparison gratifying.

As I explained extensively in Chapter 1, my aim with contrasting the two sound worlds of *Christmas 2013* was to establish a sense of *future nostalgia*. Congruently, one participant described his experience as a "memory of an event" and related his sense of "something recalled from the back of the mind" to the tonal thread of the piece. One of the participants denoted that besides "flight" and "movement", "nostalgia and space" dominated his experience and the open ending with the piano enhanced his feeling of "nostalgia/longing". Another participant wrote:

> I had the impression of being in the air (like an angel) and moving over a city on Christmas evening. The sounds escaped from human festive activities, some became distorted and merged over with other ones, others still referred to remembrances (nostalgia) of childhood (acoustic instruments).

Another notable outcome of the quotation was observed in the affective quality descriptors. Some of these descriptors were "smooth", "mellow", "familiar", "childish", "relaxing", "incongruent", "creepy", "dark" and "weird". Moreover, *Christmas 2013* yielded the highest number of affective quality descriptors (as well as musical source descriptors) across all the pieces used in the experiment. This result can be clearly observed in the correspondence analysis as seen in Graph 5.2.



Graph 5.2: Correspondence analysis between pieces and descriptor categories

These descriptors reveal a significant duality which was expressed in various ways in most of the general impressions (e.g. earth/nostalgia versus space, imaginary versus real, childhood versus distance/melancholia). This might be interpreted as the outcome of a possible priming caused by the musical quotation early on in the piece. The precedent this section sets with a relaxing, mellow and familiar feeling, amplifies the disorienting sensation of the ensuing diegesis.

Regarding the final piano part in the piece, a participant with no musical background submitted the descriptor "sounds like music". In his general impressions, another participant recounted that although most of the sounds caused him to feel like being in "a place not on this earth", the piano sound made him "come back to earth and reminded [him] that it was music [he] was listening to". Along a similar line, one participant wrote "in an imaginary world, suddenly something real begins to move". Another participant referred to the quotation as "something to hold onto in the insecure environment".

The difference in the relative frequency of musical source descriptors between *Christmas 2013* and *Diegese* can be a result of the extents and the forms of the quotations. In *Christmas 2013*, the listeners can not only recognize a multiplicity of instruments, but they can furthermore identify a musical form in the quotation. That's why such descriptors as "song", "soundtrack" and "music" were exclusively apparent in the feedback for *Christmas 2013*.

A Diegetic Actor as Music: Electronic Music and Science Fiction

> [The] sense of disorientation produced in some listeners by the impact of electronic sounds was the basis of the early use of electronic sound-materials for science fiction productions. The inability of the listener to locate the landscape of sounds provided the disorientation and sense of strangeness which the producer wished to instil in the listener. (Truax 1996: 139)

The choice made by film and game studios to incorporate electronic sounds to evoke various emotions in the audience has a discernible impact on the experience of electronic music, particularly with inexperienced listeners. With *Birdfish*, science fiction was a prominent point of reference for the participants as evidenced in such descriptors as "star wars", "R2D2", "Starcraft", "spaceship" and "robot". Various general impressions for other pieces also delineated similar concepts: "I get images of science fiction: spaceships etc.", "[synthetic sounds] reminded me of a world that you may find in a movie like Tron" (*Element Yon*); "sounded like a soundtrack for a horror or science fiction movie" (*Diegese*); "astronomical documentary, museum of science" (*Christmas 2013*). Some participants associated their experience more loosely with movie soundtracks in general: "It reminded of sound effects used for tense moments in thrillers"; "I feel like they would fit to a dramatic tense moment of a film" (*Christmas 2013*). In these cases, memories of diegetic film sounds acted as a reference for the musical experience of the listener. Two participants provided more specific descriptions of this relation: "[I imagined] sound design people working on a sci-fi film, enjoying their work"; "the brief tonal sounds reminded me of R2D2" (*Birdfish*). The latter is a fairly reasonable account of how a sound as generic as a brief synthesized tone can be connotative of a robot. However, due to the listener's tendency to establish a semantic coherence across various sound elements, unintended references to diegetic sounds of science fiction might influence the entire story, as evidenced in some of the examples provided earlier in this chapter.

A Semantic Paradigm for Electronic Music

Just as we can evaluate the extent to which the listener is inside or outside the musical material, we can also question how much of the material is internal or external to the listener. How much of the content of an electronic music piece is objectively out there in the concert hall? From a poietic standpoint (i.e. looking from within the artwork) the listeners can be outside of the diegesis. But the listeners, when exposed to the artwork, construct semantic universes around themselves in the physical domain of the concert hall and they *observe*.

When Meyer describes collective image processes, he refers to a common ground shared by every listener, which would inevitably be appended by the private, or individual image processes, and ultimately amount to an affective appraisal. The emotional assessment of sounds will naturally be attached to our individual experiences. However, the layer of meaning attribution, in which the diegesis emerges, generates overlapping universes amongst different individuals – listeners and composers alike – owing to a shared mental catalogue of auditory experiences. The semantic and physical aspects of electronic music discussed throughout this chapter cogently indicate that a composer's orchestration of cognitive cues can play a significant role in shaping the experience of a piece. We can hear both abstract and representational sounds in electronic music. The possibilities in between yield an experiential depth for the listener as evidenced by the diversity of categorical distributions for each piece.

The diegetic approach discussed in this chapter suggests new perspectives towards understanding and communicating the experience of electronic music. I have outlined a coalescence of representational modes informed by the discipline-specific interpretations of diegesis. This allowed me to situate electronic music in a broader context of artistic forms. Using this framework as a semantic paradigm for electronic music, I have delineated various relationships between the analyses of the listening experiments and the domains of experience in electronic music. For instance, meta-descriptors were used to explain the perceived presence of the composer in a piece. The source and perceptual descriptors were highlighted to articulate the boundaries of a diegesis. Other examples revealed how affective appraisal and quality judgements were conditioned by the cognitive disposition of a piece. Furthermore, the general impressions were used to reveal the contextual relationships between concurrent gestures. These examples demonstrated how the cognitive continuum mediates the interplay between the semantic and the physical domains of experience in electronic music.

CONCLUDING REMARKS

In her book *Listening Through the Noise*, Joanna Demers claims that artists have little time to contemplate why electronic music is ontologically different from other musics (2010: 5). For me, embarking on an artistic research greatly alleviated this problem. Halfway through my research, the hierarchical relationships I had initially formulated between the components of my methodology began to dissipate. Looking back at the pieces I composed during the four-year span of my doctoral study, I can discern certain research goals that were instrumental in my creative process. However, it is also clear to me that these pieces were composed *with* research, and not *for* it. As I began conceiving this research, now almost 7 years ago, I was concerned whether such an undertaking would skew my vision to the detriment of my artistic output. But during this period I have witnessed time and again how the research discussed in this book and my artistic practice inspired one another, and how this reciprocity facilitated production in both domains. I now look forward both to future artistic endeavors informed by the knowledge gained from this research, and to future research projects these endeavors will inspire.

Throughout this book, I have attempted to communicate the outcome of these reciprocations to the best of my ability and I truly hope that the insights offered in this book will aid or stimulate new studies in various fields. There are not only more styles of electronic music to be investigated through different research questions, but also more disciplines to be integrated in such investigations. This book offers an account of my "research through practice", but I expect it to be of value also in terms of the methodology it suggests for the interdisciplinary contextualization of the said practice.

Early on in this book, I empathized with the early 20th century audiences when I addressed the evolution in music at that time by questioning whether it was still music. Such a question continues to be raised in response to electronic music to this day: *Is this music?* Weeding out the instances that were intended to start an ontological debate about what music is, I can recall this question being directed towards me in various forms throughout my artistic career. I greatly appreciate this question because it is nevertheless a question. It is infinitely more promising than an unhesitating dismissal such as "this is not music". It implies that the uninitiated listeners, for instance, are open to the idea of accepting what they have heard as music, or that they are at least willing to question this possibility. More excitingly, when I answer this question with a candid "Yes.", a common reaction is a brief moment of contemplation followed by a highly enthusiastic description of what the listener thinks was happening with the piece he or she just heard.

It is trivial for me to express this sentiment but I will do so regardless: electronic music is an exceptionally powerful form of art that is capable of creating an immense variety of experiences for the listener; but it is a form of art which has at the same time failed to convey its potential to larger audiences. It is indeed different from what is conventionally regarded as music, and it may require a bit of "getting used to". But, as evidence suggests, so does all music! As various studies cited in this book have asserted, our appreciation of music is socioculturally conditioned to a great extent. During his seminal lecture at the Oxford Union in 1972, Karlheinz Stockhausen was asked whether a traditional understanding of music impeded the appreciation of his electronic works and what implications this would have in terms of the education of the public. Stockhausen responded: "Well, I have six children and they pick it up as the most natural thing in the world."

The highly rewarding experience of electronic music is in fact everywhere. It persists throughout our daily lives. Our immediate environments are rich in events that emit sounds that are extremely complex in nature. The ways we experience this reality constitute a considerable portion of how we experience electronic music. Electronic music engages with the complexity of listening we take for granted during our everyday routines and reflects it back on us. The current study has shown that electronic music is capable of making us feel emotions, become aware and unaware of our physical beings, and maybe most importantly, that it is capable of making us use our imaginations in unique ways. Conducting this research has significantly expanded my comprehension of the experiential depth of electronic music. It has also affirmed my belief that we have much more to gain from the electronic medium, and that the cognitive continuum is one of its most remarkable offerings.

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SUMMARY

In this book I have investigated the cognitive idiosyncrasies of electronic music through a tripartite methodology involving artistic practice, cognitive experimentation and theoretical discourse. In doing so, I have attempted to address questions as to how we experience electronic music, how it operates on perceptual, cognitive and affective levels, which common concepts are activated in the listener's mind, and why and how these concepts are activated. I argued that our experience of electronic music is guided by a cognitive continuum rooted in our everyday experiences, and that this continuum spans from abstract to representational based on the relationship of gestures in electronic music to events in the environment.

In Chapter 1, I established an artistic framework for the current study. First, I offered a historical overview of electronic music, focusing on the formations of pioneering styles and thought movements. In conjunction with an ensuing nomenclature analysis, this overview served to delineate the stylistic scope of the current discussion. In the following section, I provided a compositional report on the artistic practice carried out during the course of my research. This report included information regarding materials, composition techniques, narrative structures and program notes of the eight pieces which were referenced as case studies throughout the book. This report was aimed at revealing both my artistic intents and the studies conducted to materialize these intents in the form of electronic music pieces. Furthermore, by exposing the technical and aesthetic links between these pieces, I highlighted the poietic dimensions that would be subjected to scrutiny in the following chapters.

In Chapter 2, I offered an in-depth account of the experiments conducted as part of my research. Starting from the scientific trends of the 1950s, which set a historical precedent to such studies, I provided an overview of analytical and experimental approaches to electronic music. Next, I explained the motivations behind my experimental design by addressing the shortcomings of comparable approaches and particularizing areas of focus which were instrumental in technical decisions. After an overview of preliminary studies, I presented an extensive report on the aims, stimuli and the applied sequence of the experiment. In the next section, I enumerated statistical information on the results of the experiment which was followed by an analysis of the data. The analysis methods I detailed here included data visualization, comparative analyses, categorization of the descriptors, correspondence analysis and discourse analysis. Interpretations of these analyses were offered throughout the book.

In Chapter 3, I set out to specify the cognitive foundations of electronic music. To establish a frame of reference for my discourse, I first delved into a discussion of evolutionary and cultural determinants of musical behavior in humans. By offering empirical evidence from a breadth of music cognition studies, I established grounds for evaluating the material and the language of instrumental music. Moreover, I offered an overview of the semantic and affective processes involved in music appreciation. In the following section, I first demarcated the compositional characteristics of electronic music: in combination with ontological

perspectives and practical explications, I expanded upon the historical progression of the style. In doing so, I emphasized the primacy of the listening experience in the formation of a modern composition practice and the role of a strong union between technology and the composer in establishing this understanding.

Further in this section, I introduced an adaptation of the musicologist Jean-Jacques Nattiez's model of musical semiosis, which is structured around the acts of poiesis and esthesis. My intention in doing so was to liberate the act of listening from a communicational hierarchy between the artist and the audience, and to place the emphasis on the complexity of listening instead. Furthermore, I identified the particular cognitive tendencies at play during this act of listening. The material introduced into music by aid of the electronic medium, and the language this material motivates, was evaluated with respect to these cognitive tendencies in a discussion supported by scientific research. Finally, relying on the evidence gathered from the experiments conducted as part of this study, I described an amalgamation of musical languages which grants the electronic music composer a cognitive continuum from abstract to representational.

In Chapter 4, building upon the cognitive idiosyncrasies of electronic music, I constructed a semantic network across events in our daily environments, our perception of the sounds these events produce, and the gestures in electronic music. By describing the convergent aspects between models of experience originating from various fields of study such as perception, neuropsychology and semiology, I situated the role of our cognitive faculties in our experience of electronic music. Later, I provided a variety of existing perspectives on musical gesture which involved both embodied and metaphorical interpretations of the concept. From there, I formulated a definition of gestures in electronic music, intrinsically informed by the preceding discussion on environmental sounds. A gesture in electronic music was thus characterized as communicating meaning, serving a unitary function, revealing causalities, operating at various time scales, coexisting with other gestures and implying intentionality. Each item of this definition was motivated with excerpts from listener reports. As I developed this model around a tight-knit web of interdisciplinary knowledge, I revealed further insights into the dynamics of the communication between the electronic music composer and the listener.

In Chapter 5, I contextualized the concept of diegesis in the experience of electronic music with the aim of addressing the embodied and semantic dimensions of this experience. By referring to various interpretations of diegesis developed in pertinence to various art forms, I traced out a coalescence of mimetic and diegetic modes which comes to being while we listen to electronic music. A following discussion of narrativity in electronic music, helped me further relate the gesture/event model to the narratological scrutiny in this chapter. In the following section, I combined data from the experiments with empirical studies from a variety of fields to specify practical implications of the theoretical discourse from the previous sections. In an extensive discussion of the semantic and physical domains, I offered various excerpts from the experiential spectrum of electronic music. By addressing the characteristics of these domains in the form of compositional strategies, I further united the esthesic report from the listening experiments with poietic practice.

SAMENVATTING

In dit boek onderzoek ik de specifieke cognitieve eigenschappen van het luisteren naar elektronische muziek. Ik maak hierbij gebruik van een methodologie waarbij artistieke praktijk, cognitieve experimenten en theoretische vertogen de basis vormen. Op deze manier tracht ik specifieke vragen te beantwoorden die betrekking hebben op de manier waarop wij elektronische muziek ervaren en hoe deze muziek werkt op het niveau van waarneming, cognitie en affectie. Daarnaast onderzoek ik welke concepten in het brein van de luisteraar geactiveerd worden en waarom en hoe dit gebeurt. Ik stel dat onze ervaring van elektronische muziek wordt geleid door een cognitief continuum dat geworteld is in onze alledaagse ervaringen. Het strekt zich uit van abstract tot representatief, en is gebaseerd op de relatie tussen gebaren in elektronische muziek en gebeurtenissen in de natuurlijke, alledaagse omgeving.

In hoofdstuk 1 is het artistieke raamwerk voor deze studie ontwikkeld. Eerst schets ik een historisch overzicht van elektronische muziek, waarbij ik me richt op de ontwikkeling van nieuwe stijlen en de theorievorming omtrent deze vorm van muziek. Gecombineerd met een analyse van gangbare termen die betrekking hebben op elektronische muziek, beoog ik met dit overzicht de stilistische reikwijdte van de discussie in dit boek aan te geven. In de daaropvolgende sectie geef ik aan welke artistieke activiteiten ik tijdens mijn onderzoek heb ontplooid. Dit overzicht bevat informatie over het materiaal, de compositietechnieken, de narratieve structuren en de programmatoelichtingen van de acht composities waar in dit boek naar wordt verwezen. Dit heeft tot doel om zowel mijn artistieke intenties uiteen te zetten, alsook om aan te geven wat voor onderzoek ik heb gedaan om tot daadwerkelijke elektronische muziekstukken te komen. Bovendien was ik op deze manier in staat om de poietische dimensies van deze stukken te laten zien, dimensies die in de volgende hoofdstukken worden onderzocht.

In hoofdstuk 2 geef ik een uitgebreid overzicht van de experimenten die ik in het kader van mijn onderzoek heb uitgevoerd. Ik bespreek eerst de analytische en experimentele benaderingen van elektronische muziek, waarbij ik begin bij de wetenschappelijke ontwikkelingen in de jaren vijftig, die een historische precedent hebben geschapen voor dergelijke onderzoeken. Daarna zet ik mijn motivatie achter het experimentele ontwerp uiteen en geef ik aan wat de beperkingen van gelijkaardige benaderingen zijn. Na een opsomming van voorlopige studies die ik uitgevoerd heb, doe ik uitgebreid verslag van de doelen, de drijfveren en de manier van uitvoering van het experiment. In de daaropvolgende sectie schets ik een overzicht van de statistische resultaten die het experiment heeft opgeleverd, en zijn deze data geanalyseerd. De methodes om dit te bewerkstelligen bestonden onder meer uit datavisualisatie, vergelijkende analyses, categorisering van de beschrijvingen en discoursanalyse. De interpretatie van deze analyses is doorheen dit boek verwerkt.

Hoofdstuk 3 heeft als doel de cognitieve grondslagen van elektronische muziek te specificeren. Hiertoe breng ik eerst de discussies omtrent de evolutionaire en culturele aspecten die bepalend zijn voor het muzikale gedrag van mensen in kaart. Empirisch bewijs, geleverd door een breed scala van onderzoeken op het gebied van muziekcognitie, vormde de basis waarop ik het materiaal en de taal van instrumentale muziek kon bespreken. Daarnaast heb ik een overzicht gegeven van de semantische en affectieve processen die een rol spelen bij het waarderen van muziek door luisteraars. Vervolgens bespreek ik de eigenschappen van het componeren van elektronische muziek. Op deze manier benadruk ik het belang van de luisterervaring bij het componeren, alsook de rol van technologie bij het componeren.

Vervolgens introduceer ik in dit hoofdstuk een adaptatie van het model van muzikale semiose, dat oorspronkelijk ontwikkeld is door de musicoloog Jean-Jacques Nattiez. De concepten poiesis en esthesis spelen in dit model een cruciale rol. Met behulp van deze adaptatie wil ik het luisteren loskoppelen van een communicatieve hiërarchie tussen kunstenaar en publiek, teneinde de nadruk te kunnen leggen op de complexiteit van het luisteren. Daarnaast identificeer ik de specifieke cognitieve activiteiten die een rol spelen tijdens het luisteren. Tenslotte beschrijf ik een samensmelting van muzikale talen, een die de componist van elektronische muziek een cognitief continuum biedt van abstract naar representatief. Hierbij maak ik gebruik van de resultaten van de experimenten die in het kader van dit onderzoek zijn uitgevoerd.

In hoofdstuk 4 construeer ik een semantisch netwerk dat de relaties tussen alledaagse gebeurtenissen, onze waarneming van de geluiden die deze gebeurtenissen produceren, en de gebaren in elektronische muziek weergeeft. Ik specificeer vervolgens de rol die onze cognitieve vaardigheden spelen in onze ervaring van elektronische muziek, waarbij ik gebruik maak van modellen die ontwikkeld zijn in de neuropsychologie en de semiotiek. Daarna bespreek ik wat een muzikaal gebaar is, en geef ik zowel een belichaamde als een metaforische interpretatie van dit concept. Dit vormt het uitgangspunt voor mijn definitie van gebaren in elektronische muziek, een definitie die intrinsiek beïnvloed is door de discussie van omgevingsgeluiden eerder in dit hoofdstuk. Een gebaar in elektronische muziek kenmerkt zich doordat het een communicatieve betekenis in zich draagt, eenheid creëert, causaliteit impliceert, werkt op verschillende tijdsschalen, samen met andere gebaren klinkt en intentionaliteit impliceert. Elk aspect van deze definitie wordt geïllustreerd met fragmenten uit luisterverslagen, verzameld tijdens de luisterexperimenten. Deze interdisciplinaire benadering van muzikale gebaren stelt mij in staat om nieuwe inzichten te bieden in de communicatie tussen de componist van elektronische muziek en de luisteraar.

In hoofdstuk 5 betrek ik het concept “diegese” bij de luisterervaring van elektronische muziek, met als doel de belichaamde en semantische dimensies van deze ervaring onder woorden te brengen. Na een bespreking van verschillende interpretaties van diegese, die betrekking hebben op verschillende kunstvormen, concludeer ik dat het luisteren naar elektronische muziek een samenspel van mimetische en diegetische luistermodi is. Vervolgens zet ik uiteen op welke manieren elektronische muziek narratief kan zijn, waarbij ik gebruik maak van mijn gebaar/gebeurtenis-model. De uitkomsten van mijn experimenten combineer ik daarna met empirische onderzoeken teneinde de praktische implicaties van het theoretische vertoog eerder in dit hoofdstuk onder woorden te brengen. Ten slotte verenig ik de esthesische verslagen van de luisterexperimenten met de poietische praktijk die het componeren van elektronische muziek is, door de kenmerken van de semantische en fysieke domeinen uit het ervaringsspectrum van elektronische muziek te benaderen in de vorm van compositiestrategieën.

ABOUT THE AUTHOR

Anıl Çamcı was born on 25 April 1984 in Kdz. Ereğli, Turkey. He became involved with digital audio workstations and electronic music at an early age. In 2002, he moved to Istanbul to study Electrical Engineering at the İstanbul Technical University. He earned his Bachelor of Science degree with honors in 2006. The same year he was accepted to a graduate music program at the İstanbul Technical University, Centre for Advanced Studies in Music, where he focused on sound engineering and electronic music composition at an academic capacity. In 2008, upon obtaining his Master of Arts degree, Çamcı was accepted for graduate studies at the Media Arts and Technology Department of the University of California, Santa Barbara, where he worked with Curtis Roads. Çamcı completed his studies here with a 4.00 grade point average and gained a Master of Science degree in Multimedia Engineering. He was subsequently accepted for a doctoral study in Holland at the Leiden University, Academy for Creative and Performing Arts, docARTES program. He completed his PhD study in 2014. Throughout his academic career, Çamcı was awarded several scholarships and grants including the prestigious Audio Engineering Society Fellowship in 2009. In 2010 he started working as a faculty member of the İstanbul Technical University, Centre for Advanced Studies in Music. In 2012, Çamcı founded Turkey's first sonic arts graduate program at this institution, where he currently teaches. Çamcı's work has been presented throughout the world in concerts, exhibitions, radio programs, lectures and conferences.