Making Things Louder: Amplified Music and Multimodality

PhD Thesis

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Submitted April 2013

Certificate of Authorship/Originality

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text. I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

Johannes Mulder

Acknowledgments

I am very grateful to Theo van Leeuwen who both inspired and supervised this thesis. In a relatively short time he has shared a vast amount of his own work and insights, forming the 'roots' of this work. Bert Bongers' for his invaluable and continuing friendship, support and our never-ending critical dialogue. Tony Mitchell has kindly and patiently proofread this dissertation, which has been crucial in eliminating the inherent quirks of bilingualism (which in itself sounds like a Dutchism). Some of my best friends are live sound engineers: Paul, Joke, Bart, Jeroen, Carl, Marc, you are all part of this. Two people, Martje van Riel and Xander Lub were instrumental in making me go back to University. I particularly want to thank my friend Arnoud van Deelen (the self appointed chair of my fan club) for his long lasting support morally, and financially. Finally, but foremostly I owe to my parents Ankie and Arjen, my brother Wim and my uncle Case for sharing their unrestricted passion for music and insatiable curiosity. Each word is dedicated to their love and support.

Table of Contents

List of tables

Abstract

This thesis looks at the use of electronic amplification at concerts of music. A broad introduction, constituting both a technological and a musical history, precedes a literature review that identifies the topic as under-researched in musical, technological and critical discourse. Proceeding from that broad approach which covers the first three chapters the analytical focus is narrowed by applying key concepts from social semiotic multimodal discourse analysis, as developed by amongst others Gunther Kress and Theo van Leeuwen and rooted in the work of linguist Michael Halliday. In addition, elements of the work of sociologist Erving Goffman are explored; notably his use of 'decorum', the 'participation framework' and 'production formats'. Amplification is treated as a semiotic mode; the different meaning potentials of the use of technology are outlined and contrasted with the notion of reproduction technology as a neutral channel. Questions of the relation between original (or acoustic, ie the sound that is amplified) and the amplified sound are analysed using the concept of linguistic modality, so as to investigate how notions of musical truth such as authenticity or fidelity, are encoded in expressions. Music is considered as social action, and this encompasses both the music itself and the musical experience in which it is embedded. In social semiotics making meaning is an activity, and technological practices form an integral part of this. The final chapter therefore interrogates matters of agency in relation to the use of amplification and its use in musical performances.

Introduction

> When in 1926 at the festival of the International Society for New Music at Frankfurt the *Apocalypse* had its first and so far its last performance (under Klemperer) this extremely difficult part was taken and sung in masterly fashion by a tenor with the voice of a eunuch, named Erbe, whose piercing communications did actually sound like "Latest News of World Destruction." That was altogether in the spirit of the work, the singer had with the greatest intelligence grasped the idea. – Or take as another example of easy technical facility in horror, the effect of being at home in it: I mean the loud-speaker effects (in an oratorio!) which the composer has indicated in various places and which achieve an otherwise never realized gradation in the volume and distance of the musical sound: of such a kind that by means of the loud-speaker some parts are brought into prominence, while others recede as distant choruses and orchestras.
>
> Thomas Mann, *Doctor Faustus*

The Bega Bowlo

In may 2012 I found myself in the concert hall of the Sydney Opera House at a tribute concert to Jimmy Little, an indigenous Australian Country musician, a legendary performer since the late 1950s who had passed away the month before.[1] His long time band was accompanying different singers playing many of his songs. I was struck by the idea of witnessing a variety of North-American folk-pop music performed by indigenous Australians in a classical concert hall built in compliance with a remnant of Western European – the other side of the planet – culture. On a backdrop pages from a scrapbook were projected showing a collection of tickets, flyers and other memorabilia of Jimmy

[1] James Oswald Little, an Australian Aboriginal man from the Yorta Yorta people, musician and educator (1937-2012).

Little performances all through Australia; one of them at the Bega bowling club.[2] The difference between this concert at the Sydney landmark and the rural Bega Bowlo could not be greater. Whether in a small club or in a large concert hall microphones and loudspeakers assure that all can hear, by making voices and instruments louder. Or so it seems! The question pursued in this thesis is exactly that, does amplification just make things louder or is there also an impact on whatever it is that is made louder? Is it a neutral technology that just blows something up like a balloon, with all aspects staying intact, just bigger? Is amplifying a band in the concert hall of the Sydney Opera House the same as amplifying a band in a small club, apart from perhaps using more or bigger loudspeakers?

Live Sound

In the early 90s, three years into studying recording engineering at the The Hague Conservatoire I was enticed to drop out for a year and work as assistant sound engineer on a theatrical musical comedy revue. It proved to be a definite step into not becoming a well-educated recording engineer but something slightly different: a 'live sound' engineer, often a euphemism for a roadie.[3] From operating the radios at the aforementioned show to going slightly mad mixing 238 performances of the musical *Annie* in one season took about four years. In the meantime, besides rigging loudspeakers and loading and unloading trucks I tried to finish my studies part time but never quite got there.

By that time the person who first introduced me to the live sound 'business', Paul Jeukendrup, had become a well-known live sound engineer and I was (and occasionally still am) working for him. Paul, who had graduated from the same course a few years before me, had already established a name working for composers of contemporary music, and the prestigious Holland Festival. As a part of that festival he designed and engineered all the sound technology for the premiere of Karlheinz Stockhausen's *Helicopter String Quartet* in 1995. My 32 minutes of fame were spent sitting back-to-

[2] 'Bowlo' is Australian colloquial for Bowling Club; in addition to their sportive function they often serve as bars and restaurants, and sometimes as music venues. Bega is a town in the South of New South Wales.
[3] I use the colloquial 'roadie' as a 'nom de guerre'; to be sure I did load and unload my share of trucks.

front in an Alouette-III helicopter with Irvine Arditti, the primarius of the Arditti String Quartet.

Concertgebouw

One of the famous cultural landmarks in Amsterdam is the concert hall at the Museum Square, conveniently called 'Het Concertgebouw' which translates into the 'Concert Building'. Built as a copy of the 'Gewandhaus' in Leipzig, Germany, which was famous for its acoustics, the Concertgebouw, or its main hall to be precise, is renowned for having excellent acoustics for the romantic and late romantic symphonic repertoire (the building's recital hall has great acoustics as well). It opened in 1888 and its resident orchestra (the Concertgebouw Orchestra) played an important role in establishing a tradition in the Netherlands, where the audience is silent and experiences the music in concentration (or contemplation). This concert hall was a private initiative and (still is) a private venture. One of its initial goals was to make enough profit from operating the concert hall to provide for a professional orchestra. The concert hall, in order to generate enough income, was rented out for a very broad range of events. This meant the hall was also available for different sorts of concerts from the 'highbrow' culture of the classical concert. Even so, after two decades the concert business proved not profitable enough and the orchestra needed an allowance from the city council.[4] But the concert hall continued to be used for performance of musics that were considered non-classical. Notably one of the first concerts of Paul Whiteman's Orchestra outside the United States in 1926 and concerts by jazz orchestras such as Cab Calloway's and Duke Ellington's in the 1930s. In the 1950s and 1960s a whole series of jazz and later pop and rock concerts was organised, bringing amplified music to the famous symphonic acoustics (and occasional horror to the more conservative music fan). According to letters of complaint from the fifties and sixties and from more recent times, patrons were often surprised and disappointed about the way a jazz or pop concert at the Concertgebouw sounded; given the famous acoustics, everything should be sounding fabulous in there! However, the musical quality of a hall's acoustic is not a function of a reputation, but of the kind of

[4] Nowadays the Royal Concertgebouw Orchestra (RCO) is a separate body, funded largely by the national government, although it manages to create considerable income from selling recordings through their own record company.

music that is being performed. Music with a relatively continuous articulation (like jazz with its pulsating rhythms) benefits from a dry acoustic with little reverberation, in contrast to more harmonic music with less repetitive and pulsating rhythms like orchestral, choral or organ music which needs bigger acoustics with more reverberation (see Howard & Angus 1996, p. 268), or as Philip Tagg (2013, p. 48) writes: 'Quick, quiet notes are indiscernible if there is a lot of reverberation while slow, long, loud ones are hard to sustain if there is little or no reverb.'

In my family the Concertgebouw took an important place as the embodiment of music of the highest possible standard. For decades my grandparents travelled to Amsterdam every month to enjoy the Orchestra, and my mother lived literally next door to it when she studied musicology in Amsterdam. As a boy I listened to a Sunday morning radio show with the promising title *Für Elise* (after Beethoven's famous ditty), broadcast live from the famous building. For its 150th broadcast it put together a huge orchestra of amateur musicians young and old. After not rehearsing my part for weeks I sat on that famous stage with my little violin looking at the enormous hall filled with people and did not play a note. As a teenager one of my (grand) parents would take me to a concert occasionally, although I probably was not very enthusiastic about classical music as an adolescent. Later, when I studied recording engineering in The Hague, we listened to famous recordings made in that famous hall and marvelled at the acoustics. And we learned a little bit about those acoustics, and why they worked so well for the symphonic repertoire. As part of my studies I was involved in many concerts that needed amplification, and I developed rapidly in that direction.

Rocking the Concertgebouw

From the mid 1990s I began occasionally working, free-lance, on concerts at the Concertgebouw, initially for concerts of music by contemporary composers that used amplification or combinations of acoustic and electronic music. Later on I became involved in jazz and 'world music' concerts at the famous hall, with the occasional pop or rock band. These concerts proved very problematic. The famous acoustics were very complicated to deal with for amplified performances. With small steps and better technology (particularly with the so-called line array loudspeakers, as detailed in the first

chapter) some acceptable results were achieved. At other times the different elements did not come together very well, ending in little disasters with many complaining patrons. For me learning how communicating with the stakeholders (musicians for starters) improves outcomes was more important than the technology. After almost a decade of working perhaps ten or twenty concerts each year my interest began to shift from solving the challenges 'on the floor' to the question: how did these amplified performances end up in this hall in the first place? In some occasions these decisions appeared to be just a bad idea. I had the chance to go back to university and decided on a Masters in Arts Management and Administration resulting in a thesis looking at early jazz concerts at the venue after WWII, when amplification was first used for musical performances. After the research project I had the opportunity to work as a production manager at the Concertgebouw, allowing me to go through the processes of amplified concerts 'from the other side'. That valuable experience allowed me to discover the different interests of different stakeholders, a subject that will be addressed in chapter five.

After graduating I met, by coincidence, Theo van Leeuwen who encouraged me to take my research further by way of this PhD, which took me to Sydney. While working on my Masters' thesis my supervisor urged me to look for an appropriate theoretical framework to explore questions of amplification and music, something that at that time I failed to identify. Unfortunately Simon Emmerson's (2007) book *Living Electronic Music* had not yet been published; I will discuss his approach to the functionality of electronic amplification in the literature review.

With Emmerson's work as a point of departure, this thesis attempts to set out a theoretical framework for discussing and analysing concerts of amplified music. One aspect that was lacking to support such work was a well-documented history of both the crucial technical elements (microphones, amplifiers, loudspeakers) and of first usages of the technology, including the question that drove the desire to 'make things louder'. The first two chapters aim to fill that gap with a brief historiography.

Problematisation

The central problem addressed by this thesis is the relation between music and sound amplification. Is amplification a neutral carrier of music or is there an interaction between the two? In other words, is (electronic) amplification used only to make music louder, or can it also be considered a musical parameter? [5] I will analyse that question by putting historical and practical considerations in an analytical framework of social semiotic multimodality (more about which in chapter four) establishing amplification as a semiotic mode.

No empirical work is reported in this thesis, its aims being strictly theoretical. Besides an extensive analysis of existing related literature the thesis will contribute an approach that allows for a disambiguation of different musical practices, by looking at both the functionality and the level of amplification. That is to say, how loud, and for what reason the technology is applied. The thesis is accompanied by examples from my own practice and the work of colleagues. Those examples are used to describe different amplification practices and for the analysis of questions of agency, ie who makes certain decisions related to the use of amplification at musical performances.

Music

This thesis looks at electronic amplification of music. Any kind of music can be amplified and amplification can become part of any musical practice. Writing about such subjective matter is never unbiased which I am happy to acknowledge: I was raised and trained in a tradition of classical and jazzy snobbery (something I am very happy about) but with an open mind. I love Bach as much as I love Zappa. I am schooled as a jazz pianist and played violin as a boy, I am passionate about going to classical concerts (one of the biggest advantages of working at the Amsterdam Concertgebouw; several concerts a week, best job in the world). I worked and enjoyed working as an engineer for concerts from rock to Stockhausen, hip-hop and Broadway musicals. With respect to the questions central to this thesis there will be a focus on typically acoustic musics from Western

[5] I have put electronic in brackets here; in the first chapter I will discuss comparable technologies that can be labelled as mechanical.

Europe and typically amplified musics grounded in both the Northern American and the European traditions.

I share many people's dislike of loudly amplified music, but when done well I do not mind 'a full' sound (a common euphemism for loud amplification). This thesis does not try to answer the question: when is it done well? As I will tease out in the following five chapters there are too many people involved, too many different stakeholders with different agendas or personal preferences. What I do hope to achieve is a framework that aids those stakeholders to achieve results that more people can agree on.

Outline

This thesis is set up in the following way: in the introduction I will explain the background and motivation for this study, followed by an exploration of the subject and a brief overview of some terminology and technical concepts. The first chapters are a review of primary and secondary literature of the history of amplified music. A history of the specific technology (limited roughly to 1932); is followed by a chapter taking a broader perspective, the application of that technology. The third chapter is a literature review looking at what has been written about the subject in a broad section of social science authors, architecture and concert reviews. In the fourth chapter I will detail the theoretical framework used for this research, social semiotic multimodality, elaborating on a more specific question: can electronic amplification be considered an additional mode with regard to the performance of music? In the final chapter I will look at the question of agency in practices of music amplification, building on the framework established in chapter four, followed by a general conclusion. This 'spiral' approach keeps 'amplification' as the main topic, examining it from different perspectives (historical, technical, semiotic and social), which at times causes some repetition.

Transducers

This thesis is about musical use of a technology and its critical reception and implications. Even though technology is not the focal point of this thesis some background into the physics of sound and the workings of *transducers* (microphones and loudspeakers, artefacts that translate sound in air to an electric signal and vice versa) is

provided.[6] Rather than putting all of these technicalities in one general introduction they are presented as part of the chapters, when they first become relevant. At the end of the second chapter I will briefly discuss what I call 'transduction effects': consequences of the use of microphones, loudspeakers and associated technology that can always be identified whether for amplification, recording or radio broadcast. These effects discuss adaptations in frequency range, dynamic range and directionality.

Interestingly, in the recent Oxford Handbook of Sound Studies, Trevor Pinch and Katherine Athanasiades (2012) use the term transduction to denote the translation of music and sound into a value system, it is 'turned into a symbolic form that a community of users can appraise and rank' (ibid p. 498).[7] The study reported in that chapter looks at the use of a website called ACIDplanet.com that allows users to create, share and discuss sounds and music, to which the authors refer as a 'sonic sociotechnical community'. In the same book Stefan Helmreich (2012) discusses the transduction of sound to underwater environments, emphasising the broad use of the term.

Amplified Music

> *I don't need 18 violins, I need 1 –amplified.* Steve Reich (in Kid 2008, p. 3).[8]

There are different ways of making sounds louder, acoustically by making use of the reflective properties of surfaces, or by bundling the sound towards one direction using a conical shape, as found in the megaphone or phonograph horn. Electronic amplification differs from other electroacoustic technologies such as the telephone, sound recording and radio broadcast, in that a sound is picked up by a transducer (microphone) and

[6] A transducer is a device that converts variations in a physical quantity, such as pressure into an electrical signal, or vice versa. Sound propagates through air by means of variations in air pressure; in the electronic domain sound is represented by variations of electronic properties (ie voltage or current).

[7] A talk by Pinch on this topic can be found on YouTube: http://www.youtube.com/watch?v=IKvHp-Tyu2M <viewed 12 March 2013>

[8] The full quote: 'My music's life's blood is rhythmic vitality and clarity which is best orchestrated by having one player to a part. To make the strings, for instance, as loud as they need to be to balance the percussion, I amplify the strings. In the orchestra in the nineteenth century, microphones did not exist and loudness was a function of the number of players. Hence, 18 first violins, 16 seconds, and so on. Gargantuan. It works for German romantic music, but it's acoustic foolishness with mine. I use amplification for balance and to keep rhythmic agility. No other way to do it.' (Reich 2002, p. 218)

relayed instantaneously through a second transducer (a loudspeaker) in the same space. This is essentially a special case of telephony, or a radio broadcast (from a historical perspective at least), where both the sound source and its immediate reproduction are audible in the same location. To make this more apparent, consider the following ways of listening to a violinist playing in a recital hall:

1. One could sit in the hall and listen to the violinist's performance (an acoustic performance).
2. One could sit in a room that is not the concert hall and listen to a loudspeaker that relays the sound of that performance captured with a microphone close to the instrument (a sort of one-way telephony or paging system).
3. One could stay at home and listen to a loudspeaker relaying a live radio broadcast of that performance captured with a microphone close to the instrument (radio broadcast).
4. One could stay at home and listen to a recording made with the same close microphone, of a similar performance of that work in the same hall, played back through a loudspeaker (recorded performance).
5. One could sit in the hall and listen to that same recording, played back through the same loudspeaker, set up in the hall for that purpose (recorded performance). The violinist could be mimicking the performance in sync with the recording.
6. One could sit in that hall and listen to the same violinist playing the same work picked up by the same microphone, and relayed to that loudspeaker in the hall so that this amplified sound is perceived equally loud, not as loud, or louder than the acoustic source, the violin (electronically amplified sound).

There are many more, philosophically appealing possibilities to add to these examples, such as listening to a recording or a radio broadcast of the performance on our mobile phone whilst seated in the hall. Or video recording and broadcasting could be included, but for the scope of this thesis these examples suffice.[9] A rather exceptional example can be found in Stockhausen's *Helicopter String Quartet*: an audience in a concert hall listens

[9] Other amplifying variations that include hearing aids and cochlear implants can be thought of as well.

to the sounds of string instruments and helicopters broadcast from the airborne machines while watching a video link of the musician's performance.

From the perspective of the electroacoustic transformations listed above a definition of amplified sound could be:

> Electronic amplification of sound is a special kind of telephonic broadcast in which the amplified source, and the transducers (the microphone and the loudspeaker) are within the same acoustic space.

Acoustic space may not cover every situation: it can be limited by a cultural context: a sports stadium or a field near the village of Woodstock. But essentially, both sources, the amplified instrument and the loudspeaker, are in the same acoustic environment (easy to establish indoors but harder outdoors). To make this cultural context more apparent (this is not an engineering thesis) the definition could be updated by using the word 'venue' instead of 'acoustic space'. A venue, literally 'a place where something happens', can be any performance space, from very small (in Dutch we would say 'between the sliding doors'), to concert halls, sports arenas and stadiums and outdoor fields that may hold several hundred thousand people.[10] An alternative to the first definition could be:

> Electronic amplification of sound is a special kind of telephonic broadcast in which the amplified source, and the transducers (the microphone and the loudspeaker) are within the same venue.

The significance of using venue rather than 'acoustic space' is that it includes the cultural context of what delimits a venue, depending on the kind of activity that is taking place. The notion that the sound technology is used within the same venue, at the same time is reflected in the term 'live sound engineer'; the technology is used in an activity that yields an immediate result. That term will be used to indicate people working in that field; the person operating a mixing desk or sound desk will be called a 'mixer'.

[10] Sliding doors partition the living room from the dining room in many ordinary (older) Dutch houses: 'tussen de schuifdeuren'.

Public Address

When looking at electronically amplified sound it helps to discriminate between public address (PA), and paging systems, although there is some overlap. A paging system can be found in an office building, a mall or a railway station. The source, someone talking into a microphone (or a pre-recorded message), is usually unseen. In the situation of a PA system the source can usually be seen: ie someone delivering a speech or a performing musician.

In central Europe in the days of Soviet occupation, urban areas were fitted out with paging systems covering most public space. Radio programs or agitprop could be relayed to each and everyone at any time as described by Milan Kundera (1982, p. 216). A powerful system, since, unlike radio, listeners cannot switch it off. Earlier Goebbels had assured a level of social control by appointing 'Funkwärte' or 'Wireless Wardens' in neighbourhoods, who monitored whether people were actually listening: '…it is the function of the Ministry not to discover public opinion, but to create it…' (quoted in Bramstedt 1965, p. 55). Paging systems with their focus on spoken word are outside the scope of this thesis, but occasionally examples from amplified speech are used, for instance in the discussion of 'social distance' in §3.2.

Important Aspects

The six different listening situations or technologies bring up a number of important points about the relation between the source and the listener. A performance of an acoustic instrument in a recital hall is not non-technological; first of all, musical instruments are technology, and secondly, as I will argue in this thesis, room acoustics optimised for music performance can equally be considered technology. In such a situation listener and performer are present in the same room, in each other's proximity and at the same time. There is no temporal dislocation and the listener cannot only hear but also see the performer. There is a direct and constant relation between the sound level produced by the performer and what the listener perceives. With paging technology there is usually a relation between where the announcement is made and where it is heard, for

instance a train station or an airport, in contrast to radio and recording that can be listened to anywhere else.

	Technology	**Proximity**	**Temporal**	**Visibility**	**Relative Level**
1	*Acoustic*	Co-present	Yes	Yes	Acoustic
2	*Paging*	Associated	Yes	Possible[11]	System
2'	*Telephony*	Anywhere	Yes	No	System
3	*Radio*	Anywhere	Yes	No	Variable
4	*Recording*	Anywhere	No	On Cover	Variable
5	*Recording/Sampling*	Yes	Possible	Possible	Variable
6	*Amplified*	Co-present	Yes	Yes	Acoustic + Amplified

Table 1 Spatial and temporal dislocations

The proximity is important as will become apparent in the discussion of 'social distance' in chapter three. There is an important relation between visibility and relative level, in the first example the violin is visible and the sound (unless the listener is far away, at the back of the hall) will convincingly be perceived as coming from the instrument. In the final example, when electronic amplification is in use, the sound may appear to be coming from the loudspeaker. This is dependent on the relative level when the amplification is soft the instrument can still be 'localised', when the amplification is louder, the acoustic sound can be drowned out. Now the sound of the violin will be perceived as coming from the loudspeaker rather than from the instrument. This issue of 'detachment' will be discussed in the third chapter.

When the sound is so detached from the visible source, the sound we hear might as well be a recording being played back, which brings us into the realm of lip-syncing and related questions about authenticity (discussed in chapter four). Pre-recorded material is obviously used in performances by DJs but also in 'mixed' music traditions, described in chapter two.

[11]An example of this situation can be found on board an airplane where some passengers might see an airline attendant talking into a microphone, while hearing her voice from the overhead loudspeakers.

Temporal Dislocation

Although using similar technology, the difference between amplified sound and a recording is the severance of a temporal immediacy; the recording can be played back at any time after the recorded event. In the case of amplified sound some minute temporal disconnections are in place: the difference in speed of sound that can be observed in relation to different media. Sound in air travels relatively slowly, it takes a soundwave roughly three milliseconds to travel one meter. In the electronic domain the soundwave is represented as an electronic charge moving through a conductor (usually a copper wire); the electrons move at 70-90% of the speed of light (ie roughly a million times faster).[12] In the case of a live radio broadcast the sound (say from a presenter's voice) travels through the air to the microphone, the electronic soundwave travels through all the devices and paraphernalia to be transmitted by an antenna as electromagnetic waves in air (in the past referred to as 'the ether'), marginally (0.03%) slower than the speed of light.Synchronicity of seeing and hearing is always relative; this is easily perceived in internet videoconferencing systems such as Skype, the image and the sound can often be out of sync, an irregularity we usually adapt to easily.

This touches on another related problem, the difference between seeing and hearing an event in relation to the huge difference in propagation speeds.[13] Synchronicity of seeing and hearing is always relative; something that is easily perceived in internet videoconferencing systems such as Skype, the image and the sound are often out of sync, an irregularity we usually adapt to easily. Michel Chion (2009, p. 37) in his *Film, A Sound Art* writes about this issue:

> The idea that a sound should be heard in synch with an observable event is not entirely self-evident, though we may observe such things a thousand times a day. By its very nature, the auditory lags behind the visual, like the *carabiniers* of Offenbach's operetta – always late – and for two reasons. First, sound is often an

[12] The speed of sound in dry air is 340 meters per second at a temperature of 20 degrees Celsius. The speed of light is 299,792,458 meters per second.

[13] There are two more important quantitative differences: the range: '…the highest frequency of visible light is less than 2 times as great as the lowest, whereas the highest frequency of audible sound is 1,000 times greater than the lowest'; and the size in relation to objects and surfaces in our environment, light wavelengths are very small in comparison, sound wavelengths range from 3.5 meters (100Hz) to 3.5 centimetres (10kHz) (cf Blesser & Salter p. 215).

> effect, not a cause, and therefore comes afterwards, however minute the delay. Second, sound simply travels more slowly …[14]

Cognitively, what is referred to as temporal auditory visual integration (cf Bertelson & Aschersleben 2003; Vroomen & Keetels 2010)[15] ensures that the timing difference between what we see and what we hear as a consequence of the different velocities of sound and light does not hinder our perception at distances within circa 20-30 meters (cf Lewald & Guski 2004).[16] This was established outdoors using synchronised little LED lights and noise bursts at different distances, an experimental set up that is not easily translated into a concert hall, with many different possible sounds (for instance a sound's attack has some influence) and lighting conditions. However, we do not readily notice a lag when we see and hear a musical performance from the back of a concert hall (for which 20-30 meters seems a good average), but as a consequence of the reverberant acoustics we may have lost the auditory localisation of the source. At larger distances eg at a stadium concert such a lag is clearly noticeable, often enhanced by 'diamond vision' or 'jumbotron'; the big video screens zooming in visually on what is going on stage.[17]

With the advance of digital technology in sound engineering a precise level of timing control became available; it allows momentarily storing a digitised sound signal, passing it on a desired amount of a few milliseconds (or more) later.[18] The need to 'time align' loudspeakers in a sound system was identified as early as in 1925 when a patent was filed by inventor B.S. McCutchen, proposing a public address system that incorporated a delay network.[19] Magnetic tape technology offered a means of tape delay and non-electronic, acoustic delays were experimented with (for instance using a garden

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[14] Chion refers here to Offenbach's *Les Brigands* (1869).

[15] Some consequences of the A/V integration are found in what is known as the Ventriloquism effect and the famous McGurk effect.

[16] Sound and light emitted simultaneously from the same object may be perceived as synchronous up to a distance of approximately 20 – 30 meters. This distance may represent the 'horizon of simultaneity' beyond which we are able to notice sound-transmission delays.

[17] Sometimes the video walls that zoom in on the action at a stadium concert or a game are referred to as 'diamond vision' after the video wall introduced by Mitsubishi.

[18] The level of control is never absolute as the use of digital technology in a sound system always introduces an amount of latency; computers do, whatever they do, very fast but it always takes some time, however little. Practically the amount of latency is insignificant in relation to physical (speed of sound) and cognitive (A/V integration) aspects.

[19] US patent 1,642,040 September 13, 1927, his proposed delay network did not work.

hose, cf Olson 1967, p. 317).[21] David Collison (2008, p. 183) remembers a different solution: highly directional microphones were positioned on a theatre's balcony and aimed at the loudspeakers next to the proscenium. This signal was fed into a separate system addressing the audience on the balcony and further down in the venue. In this way the extra meters were covered by sound travelling through air rather than through a wire at the speed of light. Barry Blesser, co-author of *Spaces Speak, Do you Listen* worked on one of the first digital delay devices:

> The first commercial application of digitized audio technology was the prosaic delay line (Blesser & Lee 1971), which replaced the garden hose as a means for creating long audio delays in sound reinforcement. (Blesser & Salter 2006, p. 200)

The 'Haas Effect'

One important psychoacoustic aspect of timing and amplified sound is what is referred to as the precedence or 'Haas' effect, after Helmut Haas (1951) who first described it in a publication. It is also known as the 'law of the first wave-field'. Within a time window of 2-20 milliseconds our psychoacoustic system suppresses early sonic reflections, provided the difference in level is less than 10dB. In a sound system this means that delaying the signal that feeds the loudspeakers, with respect to the acoustic source, can aid localisation of that acoustic source. Within the window of those values our perception can be tricked into hearing a sound 'coming from' the source under amplification rather than from the loudspeakers (cf Blesser & Salter 2006, pp. 200, 343; Litovskya & Shinn-Cunningham 2001).

Loud Sound and Sound Pressure Level (SPL)

This is an objective physical quantity that can be measured (Howard & Angus 1996; Levitin 2007; McCarthy 2007); it is expressed in decibels (after Graham Bell) multiplied

[21] The Roland 'Space Echo' was (they are still in use and a valuable vintage artefact) a dedicated tape recorder/player that created echoes using multiple playback heads on the same tape loop.

by ten (for ease of use) hence deci-bel.[22] The decibel (dB) is a logarithmic unit that is dimensionless and always refers to a ratio. It is used to express changing values over large ranges; hearing changes in amplitude are not linear but (roughly) exponential, covering a very large range of pressures. Our hearing senses from about 0.00002 to 20 Pascal (the unit for air pressure ie Newton per square meter), the lower figure is the threshold of hearing; the higher is closer to the threshold of pain.[23] The value 0.00002 Pa is used as the reference in the ratio for Sound Pressure Level (SPL or SPLs for the plural), which is denoted in the addition of $_{SPL}$. There are many different possible measurements that are expressed in dBs. Without an indication of the reference level they are not always useful. The value at 20 Pa is 120 dB_{SPL}, which is roughly our 'working range' of hearing; to a certain extent, above a value of 100 dB_{SPL} hearing damage looms after even a short exposure time.

Our sensitivity to differences in loudness is frequency dependent, which is expressed in the so-called Fletcher-Munson equal loudness contours.[24] These contours are averages of many individual measurements; the response of our hearing to loudness is subjective. Nevertheless, in general our ears are less sensitive to low- and high frequency sounds in comparison to sounds in the 'midrange' between 800 Hz and 3 kHz. At higher SPLs these contours flatten, with the midrange sensitivity decreasing. As a consequence of this non-linearity SPL measurements are frequency-weighted using different standardised curves that are roughly the inverse of the Fletcher-Munson contours. The A-weighted curve $dB_{(A)}$ is the inverse of the equal loudness contour at lower levels (ca 40 dB_{SPL}); it is used for measurements at music events and discotheques and where applicable legalised values are in that same weighting. The problem (or rather, one of the problems) is that the A-curve compensates frequency dependency at lower levels but is used for regulation at higher levels. B-weighted curves are hardly used, but the C-

[22] No one knows where the second 'l' in Bell went.
[23] The ratio of the two values is arrived at by the base ten logarithm of the square of the higher value over the square of the reference, in this case 120 dB_{SPL}. For more detailed information see for instance Joe Wolfe's excellent pages at UNSW: www.animations.physics.unsw.edu.au/jw/dB.htm <viewed 5 May, 2012>
[24] The contours depict sensitivity for single frequencies, response is different when multiple frequencies are present simultaneously, for instance as a consequence of 'masking'. The term loudness is used on Hi-Fi equipment to indicate a filter setting that compensates for our decreased sensitive to sounds below the midrange frequencies, at low sound pressure level.

weighted curve, which allows for more low frequency energy is often quoted in conjunction with an A-weighted value. When it comes to sound level a measurement of one instant is often not useful, usually the value is averaged over a certain amount of time, a time-averaged or equivalent continuous sound level that is expressed as dB_{LAT} or dB_{Leq}.

Hearing damage can occur when our ears are exposed to loud sounds over a certain level over a period of time. This is evaluated in a range from 8 hours exposure to 85 $dB_{(A)}$ in the USA and 80 in the EU. Every 3 dB increase equals a doubling in the pressure our ears are exposed to, and as a consequence halves the time it is considered safe. Even though the A-weighted curve relates to our hearing at SPLs of 40dB it is used in this context.

Time	**EU dB(A)**	**USA dB(A)**
8 hours	80	85
4	83	88
2	86	91
1	89	94
30 minutes	92	97
15	95	100
7.5	98	103
4.0	101	106

Table 2 Maximum exposure times

The fact that there is a difference in legislation between the EU and the USA does suggest there is room for interpretation of the data; the hearing apparatus is not different between the continents. The matter is discussed further in the section 'why loud?'[25]

[25] While working on this thesis in Australia, a large number of venues, festivals and event organisers in the Netherlands, together with the 'hoorstichting' (the hearing council), joined in a convenant aimed at bringing down the number of concerts with dangerous SPLs. They agreed to a maximum of 103 dB(A) measured over a fifteen minute time window. The 'hoorstichting' warns that that level is still dangerously loud but it is an important step, empowering stakeholders to avoid concerts being even louder (with 110 dB(A) not being an exception. The agreement in Dutch can be found here: www.hoorstichting.nl/plaatjes/user/files/pdf_3260.pdf <viewed 7 March 2013>

A further complication is the distance. Soundwaves lose energy when travelling, depending on several factors including the directionality of the source, humidity and acoustics, and again, the influence of such factors is frequency dependent.

Earl Vickers (2010) in a discussion of the 'Loudness War' cites Greg Milner (2009), referring to the non-linearity displayed in the Fletcher-Munson curves:

> This quirk of hearing has played an important role in enabling the loudness war. If you play the same piece of music at two different volumes and ask people which sounds better, they will almost always choose the louder, partly because more of the frequencies are audible.

Basic Terminology

At this point I define some keywords that are used in this thesis to distinguish between the different sources and processes:

- *Venue*: a recent book specialised in the architecture of popular music performance spaces is *Live Architecture* by Robert Kronenburg (2012) who distinguishes between adopted spaces, adapted spaces, dedicated spaces and mobile space: 'All performances take place somewhere, inside or outside, in spaces designed for other uses or increasingly, in places specifically designed for popular music.'
  I will use this as a very broad definition of what constitutes a venue.

- *Transducer*: a device that converts variations in a physical quantity, such as pressure or brightness, into an electrical signal, or vice versa. In this context typically microphones and loudspeakers, but also record player (or phonograph) cartridges.

- *Acoustic sound source*: the sound source that is (or can be) amplified eg a musical instrument, speaker or a singer. In other domains this is sometimes referred to as: primary source, direct source/sound, original or natural source/sound, real sound event.

- *Electric or Electronic sound source*: Electric and Electronic instruments as described in chapter two. Sources can include CD, record and tape players etc, but also electric guitars and synthesisers.

- *Amplified sound source*: the transducer (loudspeaker) that emits the amplified sound. In other domains common terms are: secondary source, amplified source, virtual source, phantom source (a common term in stereophonic reproduction).

The problem with the use of opposing pairs in this context (ie real/virtual) is that they suggest a hierarchy, ie if the 'acoustic sound' is real does that make the 'electronic sound' fake? This question will be addressed in the discussion of modality in chapter four.

- *Amplification level*: The level of the amplified sound in relation to the level of the sound source that is amplified. In the process of amplifying an acoustic source there is control over the level at which the loudspeaker reproduces that sound. That level can be very low (the acoustic source is still audible by itself) or very high (drowning out the acoustic source). Rather than a measurement based, technical level this is used to express the way amplification is used; different applications of electronic amplification can be organised along a continuum between low and high levels.

- *Sound system*: this comprises a system of loudspeakers and the acoustic space it is designed for or set up in. When a system's response is measured this is done in a venue; the whole of the output of the several or individual loudspeakers and the room's acoustic response are taken into account. More colloquially 'sound system' can refer to how it is used in the 'Dub' tradition in Jamaica (cf Husse 2003; Veal 2007, p. 85) which includes the agents involved, DJs, vocalists, producers and sound engineers.

- *Loudspeaker system*: A system of loudspeakers, their amplifiers and how they are 'driven' but excluding the acoustic space it is set up in. A system can be driven directly from a mixing desk or from 'processing' equipment for time alignment (digital delays), frequency response (crossovers, equalizers) and dynamics (limiters to protect against overload or compressors to decrease the overall dynamic range).

Sound Reinforcement versus Amplification

> *Sound-reinforcing systems are used to augment the sound output of a speaker, singer, or musical instrument. By means of sound-reinforcing systems, speech can be rendered intelligibly, where before it was either too weak to be heard above the general noise or too reverberant.* (Olson 1967, p. 275)

Increasingly the terms 'reinforcement' and 'amplification' are used to distinguish between different ways of using the technology that are ultimately related to the level of amplification. When making music louder is not a goal in itself (as it is at a rock concert) but a sound system is used to balance instruments and singers in an acoustic environment, this is often referred to as 'Sound Reinforcement'. That implies that the aim is that most of the audience will hear the sound as coming from the acoustic sources rather than from a loudspeaker. When all the sound appears to be coming from the loudspeaker and the individual acoustic sources on stage can no longer be heard, this is called 'Amplification'. Of course there is no clear demarcation between the two as they are related to the level of amplification: subtle reinforcement can turn into amplification when the level is increased. They are two ends of a spectrum and not a pair of binary opposites. The terminology will help to define with what purpose the aid of microphones, amplifiers, loudspeakers and sound engineers was called upon. I will use the term amplification in its most generic sense, contrasting it with the term reinforcement where needed.

Sound reinforcement and electroacoustics

Leo Beranek (1966), the 'don' of the field in concert hall acoustics, writes in the introduction of a journal article 'Sound Systems for Orchestra and Grand Opera':

> There can be no question that electroacoustically assisted sound will find many applications. Its use is demanded in halls that either must serve many purposes, or are large, or both, or where there are defects in the acoustics which need correction. As experience expands, the concept of assisted acoustics in our halls for music will probably be accepted as natural by musicians and critics and, eventually, we may expect during a concert to hear the "acoustics" of some halls electronically adjusted to best suit each style of music performed.

Theatres and venues for music performance with dry acoustics, that is to say, a (too) short reverb time can, where available, utilise variable acoustics to enhance room response for certain types of music. Conversely, making a hall with a long reverb time (concert hall, church) drier is much harder if not impossible unless there are ways to significantly decrease the internal volume of the room. The 'Espace de Projection' at the Institute de Recherche et Coordination Acoustique/Musique (IRCAM) in Paris (opened 1978) for instance, has a flexible ceiling in three segments allowing for a four to one change in internal volume. In addition the walls have triangular flexible panels with different finishes; absorbent, reflective or diffusing (cf Forsyth 1985, p. 316). Another example is the *Muziekgebouw aan het IJ* in Amsterdam (opened 2005) with a movable ceiling and flexible panels surrounding the stage. As an alternative to variable volume and reflective surfaces electroacoustic systems can be used that emulate acoustic reflections suggesting a more reverberant room response. In his paper Beranek (1966, p. 108) reviews several different sound systems:

> A number of loudspeakers located throughout the auditorium, some or all fed from time-delay devices or artificial reverberation chambers, or both, with several or many microphones located either near the stage or throughout the auditorium.

> The early sound is brought to the listeners' ears by the natural acoustics of the auditorium.

As an example Beranek mentions the Arts and Sciences Hall in The Hague (the since demolished 'Gebouw voor Kunst en Wetenschappen'), which had such a system, installed by Philips in the 1950s to improve the room's response for orchestral music. Another early example is the Royal Festival Hall (1950) in London where, what Beranek describes as an 'assisted resonance' (AR) system, was installed in 1964. The system, at the time favourably reviewed, increased the reverb time in the low-mid frequencies from approximately 1.5 sec to 2.5 (cf Forsyth 1985, p. 294). [27]

[27] Before a major overhaul conductor Simon Rattle said the acoustics made performers 'lose the will to live', *The Independent* 17 June 2007.

1 A Brief History of Amplified Sound

Introduction

The first chapter gives a brief history of amplified sound – the making louder of (musical) sound in more general terms, the chapter also serves as a literature review of what has been written historically about the technology related to music amplification. Starting, impressionistically, from the early ritual use of acoustically 'attractive' natural spaces such as caves that offered a different sonic experience and the theatres of the ancient Greeks, key developments in the late 19th and early 20th century are highlighted. A relatively large section looks at the work of loudspeaker pioneers Jensen and Pridham, mainly because Jensen's autobiography provides good insights into the developments at that time. Early examples of the use of electronic amplification at concerts are described from a perspective of technological and social developments. The historical overview ends with the opening in 1933 of the Radio City Music Hall in New York, the first purpose built electroacoustic auditorium.

1.1 Cultural Preparation

This history, rather than providing a timeline of key moments, aims to follow a suggestion made by Jonathan Sterne (2003, p. 27) as a way of interrogating the key ingredients to this thesis: sound, technology and culture. Sterne introduces what he calls 'the age of Ensoniment': 'a series of conjunctures among ideas, institutions, and practices' that rendered the audible in new ways and valorized new constructs of hearing and listening' (ibid, p.2). He suggests that age ended in roughly 1925 with the advent of electronic recording, but a point could be made for inclusion of the sound motion picture (circa 1927) and the breakthrough of the commercially available directional microphone in the early 1930s.

An important premise for this first chapter is that a practice such as the amplification of sound did not appear as a consequence of one single invention or event. André Millard (2004, p. 42), discussing the invention of the electric guitar talks about the 'heroic

inventor' who 'overcomes numerous obstacles to reach a goal that many think impossible'; in addition to Alexander Graham Bell and Thomas Alva Edison, Millard mentions King Gillette and Samuel Colt. In popular history the focus is often on single developments and individual inventors fitted to a timeline; the enormous impact of sound recording on our culture is often attributed to Edison and the year 1877 (or 1878 when his phonograph was patented). A closer look however, reveals that throughout the second half of the 19th century many more people were working on similar devices; Edison simply got there first. David Morton Jr. (2006, p. 1) in a recording history book traces a line of discovery and research into sound that goes back to the ancient Greeks. Similar observations can be made for telegraph, telephone and radio.

Dutch literary critic and Slavist Karel van het Reve (2004, p. 52), in a brief discussion of Pascal's comment: 'Cleopatra's nose, had it been shorter, the whole face of the world would have been changed', points out that sometimes isolated events or people may very well change history. His examples are the failed Von Stauffenberg attempt to kill Hitler in 1944 (which would have significantly altered the course of WWII) and his suggestion that without Lenin's energetic motivations the Bolsheviks would not have started the revolution of 1917.

In Louis Mumford's famous book *Technics and Civilisation* (1934) the notion of cultural preparation refers the foreshadowing of inventions in earlier (not necessarily technological) developments. That notion can be contrasted with a technical deterministic account that poses a 'conviction that the essence of something new originates from the sequence of technological innovations that produced it' (Crafton 1999, p. 23); or, 'the idea that tools, machines, and other artefacts of human invention have unavoidable, irresistible consequences for users and for society in general' in Mark Katz's (2004, p. 3) words.

With those different viewpoints in mind I would like to mention Peter Sloterdijk's (Schmidt-Wulffen 1991) suggestion that artists, together with politicians and entrepreneurs are 'on the order of surfers' riding the waves of opportunity and living on 'the genius of circumstance'; a fitting description for the famous inventors/entrepreneurs (ie Bell, Edison, Guglielmo Marconi, Werner von Siemens) of the 19th and 20th century. Edison was a great inventor/entrepreneur and involved in many of the new technologies

of the modern era; on the other hand at times he misjudged the impact and possibilities of his own inventions. He did not foresee the workings of a recording industry (see Chanan 1995, p.3) and later on, the inventor could not imagine the benefit of an extended frequency range, when electronic recording became available in the mid 1920s. In an article in the *Los Angeles Times* from 1926 he fulminates against radio as a music medium, announcing its doom (quoted in Lockheart 2003 p. 373).

Finally, as Jesse Klapholz (1988) writes in a short article about the history of live sound amplification, citing Alvin Toffler: 'change is exponential, not linear'. Considering electronic amplification, in the 1910s we can still look at individual developments and inventions; come 1930 after accelerating in the 1920s the number of technologies, products, patents, and ideas is overwhelming, making it more complicated to do justice to all the little steps and events in this history.

1.1.1 Decentralisation

While working on my Master's thesis, which looked at (usually amplified) Jazz concerts in the Amsterdam Concertgebouw, I started researching sources related to the history of sound amplification. My first Internet find was an English website called *History of PA*. The website relates the story of the Yaxley family in Norwich who had been, amongst other activities, in the public address business since 1922 (Yaxley 2005a). Since 2001 members of that family have been running a small museum and a website. The Yaxley story made me realise how decentralised the amplification, or public address, business is in comparison to recording and broadcasting industries. Instead of large centralised organisations, local agents (radio shops or electrical engineers) started (I imagine) amplifying the mayor's speech, the Friday dance and similar events. From that perspective an explanation for the lack of sources and systematic study might be that the development of sound amplification as an activity and an industry was very different from the development of the recording, cinema and radio industries. One reason for such a difference is strictly technological. Radio, cinema and recording industries, by the nature of their workings need a centralised enterprise: apart from a working radio station consumers need to have access to receiver sets; in order to play a record bought at the end of a distribution network the user needs to be able to buy or otherwise obtain a player that

plays back the same format as in which that record (disc or cylinder) was produced. Examples of sound engineers crossing over from the highly specialised technical cadre of (film) recording and radio to live sound are rare or undocumented; Elvis Presley's live mixer Bill Porter being a notable exception (discussed in the section on monitoring §2.12). In the earliest days, ie 1932, the technologies and the people at the forefront of these technologies came together incidentally, for instance at the Radio City Music Hall, and possibly later in the Cocoanut Groove in Los Angeles where Bing Crosby's voice was likely amplified at some stage. Both examples will be discussed in this and the next chapter.

With the advent of home recording in the past two or three decades we have witnessed a big change in that same recording industry. The shift from analogue to digital recording technology and the availability of affordable, powerful computers allows musicians to make complete productions in the 'home' environment, bypassing the need for professional studios, trained sound and balance engineers, and centralised business models. As a consequence of the changes in entertainment business models, attributed to the success of the Internet, corporate profit models and musicians' income have shifted towards live entertainment. Rather than organising concerts to support record sales, recordings aid in drawing people to the big stadium concerts (Carr 2008; Connolly & Krueger 2005).

In the past two decades 'Live Sound' has grown and professionalised with more companies creating more products specifically for amplification, marketed in a wider price range. A number of loudspeaker and mixing desk brands have global sales and support networks with other brands focussing on wireless microphone and in-ear monitoring technology. Sound hire companies have grown into operating globally and a growing number of tertiary education providers offer programs in live sound.[1] Although regulations around maximum amplification levels are fragmented and occasionally problematic (as I will discuss in chapter 3) different regulations have supported a continuing professionalisation: safety rules in and around theatres and venues, including

[1] Since June 2012 the HiFi rock and pop venues in Melbourne, Sydney and Brisbane offer two different, eight week courses in live sound engineering, hinting at the strong need for people specifically trained for this work. See www.thehifiacademy.com.au/ <viewed 6 March 2013>.

exposure to loud sound but also (for instance) maximum number of working hours in a day and in a week.[2]

1.1.2 Sources for this Chapter

This historical overview is limited to developments and experiments of transducing technologies that have been, or are in use for sound amplification, specifically for music. This concerns primarily microphones, loudspeakers and amplifiers and in extension to those, mixing desks. A history of microphones has been much better documented due to its synchronous development in radio and sound recording technology. From a perspective of 'amplification' this chapter brings together material from a variety of fields, including history of audio technology, acoustics and music. Additional material was found in articles from the first half of the twentieth century in particular from the journals of the Acoustic Society of America, and the Society of Motion Pictures (and Television) Engineers (SMPTE).

There are several sources with regard to attempts using air pressure for sound amplification, discussed later in this chapter. Some newspaper clippings from the turn of the century describe Short's 'Gouraudphone' (Joly 1901); there are more sources related to Parsons' 'Auxetophone', he was a well known engineer and his Auxetophone was, to some extent, commercially successful (Appleyard 1933; Parsons 1934; Stoney 1938; Scaife 2000).

Little literature with a systematic historic approach to the application (and development) of loudspeakers for reinforcement and amplification is available. One important source regarding early public address systems is I.W. Green and J.W. Maxfield's (1923) paper *Public Address Systems* reprinted in the Audio Engineering Society (AES) journal in 1977. Both this and an accompanying paper by W.H. Martin and A.B. Clarke (1923) detail the technical proceedings at Arlington on Armistice day 1921, one of the first large public address events. An early paper about the development of horn-less loudspeakers gives an overview of different transducing approaches until

[2] When I first started working as a live sound engineer in Holland it was not uncommon to work for more than twenty hours a day. Working with double crews on the long concert days was considered financially unviable for producers, and 'uncool' by the tough independent 'roadies'. A legal maximum of 12 hours per day for free-lancers came into effect in the late 1990s.

then (Rice & Kellogg 1925). A relative wealth of information was found in publications about early sound cinema. Amplified sound came to many venues (Vaudeville theatres for instance) with the loudspeakers that were needed for the talkies (but it took a bit longer for the necessary directional microphones to become widely available). A personal report by James G. Stewart (1980) who was involved in the roll-out of loudspeakers to the thousands of American cinemas in the late 1920s is very insightful and so is the collection of historical papers regarding the cinema by Raymond Fielding (1974). Emily Thompson's book *The Soundscape of modernity* (2002) is very detailed about the opening of Radio City Music Hall and 'Roxy' Rothafel its director. Regarding microphones, a paper from 1931 by W.C. Jones (1931) is very informative about the microphones used in the 1920s. Leo Beranek (1954), the don of concert hall acoustics, published a paper covering the years from 1915 until then. Frederick Hunt's *Electroacoustics* (1954/1982) presents a very broad historical context but focuses on the underlying physical properties rather than applications. Nevertheless, he begins his book with a wonderful revelation: 'Electro acoustics is as old and as familiar as thunder and lightning, but the knowledge that is the power to control such modes of energy conversion is still a fresh conquest of science not yet fully consolidated'. A paper mentioned before by Beranek (1966) called *Sound Systems for Orchestra and Grand Opera* discusses six halls using 'assisted acoustics'.

A chapter in a book about inventions in America (Pursell 1990) is dedicated to Peter Jensen and Edwin Pridham who created the 'Magnavox', arguably the first working electro dynamic loudspeaker. Jensen (1975) wrote an autobiography which was published after his death in 1974. The developments in Germany, particularly related to the rise of the Nazis are very well documented on a website from the 'media and cultural communication' program at the university of Cologne (Ehlert 2004b). Ralf Gerhard Ehlert's work is very well referenced, particularly providing German sources from the 1920s and 30s.

Jesse Klapholz (1988) presented a paper at the 6th international Audio Engineering Society (AES) conference giving a brief overview of the most important technical developments related to electronic amplification but unfortunately it is not very well referenced. More recent is a book by David Collison (2008) about the art of sound

design for theatre, with some valuable backgrounds on the advent of amplified music in the UK. His timeline gives an interesting mix of technological and applied developments. Collison is also known for *Stage Sound* (1976) one of the first sound reinforcement instruction books, after Burris-Meyer and Mallory's (1959) classic *Sound and the Theatre*, and to some extent Olson's (1967) *Music, Physics and Engineering.* An other classic instruction book is *The Sound Reinforcement Handbook* (Davis 1989), initially created as the manual for one of Yamaha's earliest large dedicated live sound mixing desks.

Although parallel developments took place on both the European and American continents, this history focuses primarily on the developments in the USA. The main reason for this bias is the historical relation of amplification to popular and theatrical music in the USA; the other is the relative lack of sources of similar developments in England and France. German developments have been very well documented by Ehlert, as mentioned before, but that research focussed on amplification of speech and the relation to Nazi propaganda, rather than musical use of technology.

1.2 Telecommunication

Technologies that allow humans to communicate over a distance could be said metaphorically to make voices reach farther and be heard by more people. Early long distance communication technologies, visual (semaphore, smoke/fire signals) or auditory (eg African drumming), have a long history. A system of fire relays was set off after the Greeks took Troy and systems of relay beacons alerted Westminster to the arrival of the Spanish Armada in 1588 (cf Konstam & Gerrard 2001, p. 26).[4] 2000 years, and many technologies later, brought the advent of electric telegraphy (first commercial system in place in 1839). Even though the telegraph did not relay sound directly, some receivers used sound to allow operators to decode the (binary) messages, which increased the interest in sound transducers (cf Sterne 2003). Bell's work on the 'harmonic' or multiplex telegraph that allowed multiple simultaneous transmissions on one single line by using

[4] A fire signal (lit at Troy) was seen at Lemnos, relayed to Athos, Macistus on Euboea, across the Euripus to Messapion, to Mount Cithaeron, Mount Aegiplanctus and finally to Mount Arachneus where it could be seen from Mycenae. It took the leaders of the Greek army a much longer route to get home (cf Homer's Odyssey).

different frequencies helped him in developing the telephone, Elisha Grey, Bell's competitor followed the same steps (Adams & Butler 1999, p. 34; Coe 1995). With the advent of telephony the two basic transduction principles for amplification were already in place: sound waves to an electric signal using a microphone, and vice versa using what we now know as a loudspeaker. All that was missing at that time was a device that could increase the power (amplify the amplitude) of the electronic sound waves. For a time many inventors and entrepreneurs worked at improving those transducers; the basic vacuum tube or valve that could actually amplify an electronic signal did not come into use before 1915 and was not commercially available until after WWI.

1.2.1 Transduction: Telephone

The principal technical dislocations of place (telephony) and time (recording) related to sound were major developments of the 19th century. Telephony is similar to amplification in that a sound is transduced into the electric domain and instantly reproduced by a second transducer. Not surprisingly, some of the first experiments with electronic public address were relaying speech through a telephone connection, as we will see later in this chapter. With what we know now it appears that the crude telephone built by German schoolteacher and inventor Johan Philipp Reiss (1834-1874) was the first working prototype.[6] Proof that his device actually worked is limited to a few contemporary reports, most of them not convincing (Coe 1995). In 2003 the BBC reported a 'cover up' of a successful test with an original Reiss' telephone in 1947. Standard Telephones and Cables (STC) engineers got an 1863 model working to reproduce speech of good quality (albeit with low efficiency). STC, a British firm, did not want to risk its relation with the owners of the telephony patent, the American Telephone and Telegraph Company (AT&T) and decided not to publish the discovery ('Bell did not invent telephone' 2003; Highfield 2003).[7] In 2002 the USA Congress acknowledged an Italian immigrant named Antonio Meucci (1808-1889) who also created a working telephone in the 1860s and filed a patent caveat in 1871 (Catania 2002). A bill (H.RES 269) was passed which:

[6] Allegedly a Professor Page of Massachusetts discovered the ticking created by making and breaking a current through a coil containing a needle in 1837-38. In 1854 telegraph engineer Charles Bourseul (1829-1912) formulated the possibility of transmitting speech using that make-and-break technology.
[7] The documents were uncovered in October 2003 at the London's Science Museum by John Liffen, the museum's Curator of Communications.

‘expresses the sense of the House of Representatives that the life and achievements of Antonio Meucci should be recognized, and his work in the invention of the telephone should be acknowledged’. Famously Elisha Grey missed out on patenting and being credited with the invention of the telephone to Bell (cf Adams & Butler 1999, p. 34; Coe 1995). As another sign of the times, in 1867 Grey and Edison simultaneously invented the automatic (self-adjusting) telegraph relay; a vital instrument for improved long distance connection. This being a much needed improvement (that decreased operational cost) explains why it was not a coincidence that they were working on it simultaneously. Regarding telephony the cultural preparation seemed to be less evolved; the business opportunity of telephony was not easily perceived while telegraphy was still making fortunes. In 1876 Grey’s financial backer convinced Grey to stop working on the telephone and focus his attention on the multiplex telegraph. Bell had received a similar advice from Western Union in 1875, advice he ignored (cf Adams & Butler 1999, p. 37).

1.2.2 Transduction: Recording

The earliest device (or method) that transduced and recorded sound was Frenchman Léon Scott’s ‘Phonautograph’, which was patented in 1857. Scott wanted to make a device that would transduce sound in order to study it through graphic representation; it is possible he did not even think about reproducing the recordings.[8] In 2008 scientists at the Lawrence Berkeley National Laboratory in California were able to transduce the depicted soundwaves into a playable digital sound file, in a way playing back the recording and making Scott’s the earliest sound recordings we know of (Rosen 2008).[9]

In the same year 1877 when Edison famously recorded (and played back) ‘Hello, hello, hello, Mary had a little lamb…’, Charles Cros, another French scientist submitted a paper to the Academy of Science in Paris describing a way of recording sound on a cylinder. And in October that year in a magazine called *La Semaine du Clergé* Cros’ invention called the ‘Parleóphon’ was referred to using the same name as Edison’s

[8] Scott in his turn borrowed from even older work by Jean Marie Duhamel who managed to capture the vibrations of a tuning fork with a pen. English physicist Thomas Young improved that idea by applying it to a rotating cylinder in 1806 (cf Morton 2006, p. 2).
[9] For a more detailed discussion see Sterne and Akiyama (2012).

device: 'Phonograph' (Morton 2006, p. 5).[10] Chanan (1995, p. 24) mentions a patent granted to British inventor Joseph B. Fenby using the name phonograph for an electro mechanic device that could record piano strokes onto paper tape.

In 1878 Edison left his work on the phonograph to concentrate on other work, most notably his electric lighting system. This made room for competition by Bell and his colleague Charles Sumner Tainter, but also Berliner, a German immigrant who had previously improved the microphone for Bell's telephone. Berliner looked at using a disc instead of a cylinder as early as 1888 because he thought discs were easier to mass-produce; also he assumed (correctly) that most consumers wanted to play back music, not actually record as Edison envisioned (cf Chanan 1995, p. 27).[11] In 1888 Berliner presented a paper at the Franklin Institute in Philadelphia , which predicted that the future of sound recording would be in inexpensive recordings for consumer entertainment (ibid p. 34). Edison may have been the one with the patent but he most certainly was not the (only) inventor of sound recording, let alone a viable recording industry.

With Edison's phonograph, Bell and Tainter's Graphophone and Berliner's Gramophone things did not get louder at first, but rather softer: one had to shout to record and the replayed sound was not very loud; it took a while before the procedure was optimised. The first commercial success of the different mechanical 'talking machines' came in 1889 with pay-per-listen coin-in-the-slot phonographs in public places with up to four (acoustic) headsets (Almind 2009; Morton 2006, p. 28).[12] An image of a *Sala del Fonografo* can be found in Forsyth (1985, p. 314), a drawing from an 1892 Milanese newspaper showing several people around a table listening to a recording through rubber tubes. With immense profits on the horizon both the telephone and the recording industries started off with vast, long lasting patent and format wars (Coe 1995; Read & Welch 1976; Koenigsberg 1990).

[10] Cros miraculously also 'missed out' on the patent to another great invention, namely colour photography in 1869.
[11] It would take a long time before the recording industry arrived at the 'standard' 33⅓ (RPM) per minute LP. The 'format war' lasted sixty years from 1888 until roughly 1948 (Welch 1976; Morton 2006).
[12] Coincidentally those crude, tubular headphones were white, looking not unlike the trademark iPod headset. Pay per listen price was a nickel, $0.05.

1.3 Amplified Sound: Beginnings

Like the telephone and sound recording, amplification did not arrive with a bang. If we include, for instance, the sound amplifying nature of reverberant caves the history of amplification, and its cultural preparation, can be traced back to our prehistory. Barry Blesser and Linda-Ruth Salter in their *Spaces Speak* (2006, p. 74) hint at the importance of enclosed acoustic spaces: 'Caverns were nature's bequest of concert hall acoustics to peoples who would otherwise have experienced only open-air acoustics.' They point to work done by acoustic archaeologist Steven J. Waller (1993) indicating a relation between cave paintings and the acoustic nature of a cave:

> …pictures of animals whose movements generated loud sounds were frequently placed in spaces having enhanced echoes, resonances, and reverberation. When such spaces are excited by sound, the animal portraits seem to come aurally alive. (cited in Blesser & Salter 2006, p. 75; cf Iégor Reznikoff (1995)

Reverberant spaces and echoic sounds may have been perceived as godly or spiritual voices. From that same perspective a personification of the echo phenomenon can be found in Greek mythology as described by Peter Doyle in his *Echo and Reverb* (2005, p. 40), the nymph Echo ended up only being allowed to speak when spoken to. Doyle adds that a similar story can be found in Australian Aboriginal mythology. In her book *In Search of Opera* Carolyn Abbate (2003, p. 24) discusses the use of echoes in operas, she argues that when a source previously identified as an echo produces something we have not heard before there is an instant suggestion of magic or otherworldliness. She presents examples from Claudio Monteverdi's *Orfeo* and Christoph W. Gluck's *Orfeo ed Euridice,* Wagner and Walt Disney's *Snow White* (1938):

> Echoes, however, also have a more strictly mechanical implication. They can "bring the beyond" downstage. Monteverdi's echo effects allude to noumenal singing but are also a representation of high volume, and a wholly different kind of magic in the form of a voice travels through great distances. Echo represents

> transmission and as such is a symbolic correlative to the very idea of monumental vocal power.

Abbate, but also Friedrich Kittler (1993) discuss the possibility of postulating operatic echo as a pre-technology of sound reproduction, with Abbate referring to Klaus Theweleit (1993, p. 156): 'These echoes dream of recording: "You may laugh, but … Orpheus is asking for Edison"'.

Raymond Murray Schafer (1977) mentions 'magical' spaces with very specific acoustic effects.[13] Doyle, like Blesser & Salter, points out that: 'The architecturally amplified voice must have held special connotations'. Perceived detachment of a sound from its source, as is the case in echoing and reverberant spaces or other natural environment (eg canyons) is very relevant to technically mediated sound. I will discus some of the different theoretical approaches to this phenomenon in the third chapter.

1.3.1 Greek Theatre

Clearly related to this thesis but subject to much debate, is the attribution of speech enhancement to the masks that actors used in ancient Greece, in the 6th century BC. Theatrical masks featured a conical megaphone mouthpiece that possibly amplified the voice. Declercq and Dekeyser (2007, p. 2011) mention this as one of the theories to explain the success of classical theatre. The masks: 'may have had a focusing effect on the generated sound', but they object: 'that does not explain why speakers with weak voices are also heard throughout the theater'. The specific role of the mask in ancient Greek theatre remains widely discussed, whether its goal was to amplify an actor's output, or to alter that actor's voice; for a discussion see Schaeffner (1968). One means of acoustic amplification in the classical amphitheatres that we know more about is the clever use of reflections. Bagenal and Wood (1931, p. 192) summarise:

[13] The cave of Hypogeum (Malta), a room in the Ali Qapu in Isphahan (Iran) and a mythical room in Babylon. Chinese legend talks of a black box that remembers and relays messages from a king, which as such could be a precursor to sound recording, as Doyle notices,

- The sound was intensified at the source by reflectors (back wall and orchestra floor).[14]
- The sound had a clear passage from speaker to listener, and owing to the ramp of seats, struck the listener at a wide angle.
- No sound was returned to the stage or front seats and there was no reverberation.

Later the authors remark on how the ancient Greeks managed to improve upon natural conditions: 'their hilly country gave them natural amphitheatres'. The first author we know of writing about architecture, Marcus Vitruvius Pollio (first century BC), could very well be meaning those natural features when he wrote: 'Therefore the ancient architects following nature's footsteps, traced the voice as it rose, and carried out the ascent of the theater seats.' (Quoted in Declercq & Dekeyser ibid p. 2011) Vitruvius continues:

> By the rules of mathematics and the method of music, they sought to make the voices from the stage rise more clearly and sweetly to the spectators' ears. For just as organs, which have bronze plates or horn sounding boards are brought to the clear sound of string instruments, so by the arrangement of theatres in accordance with the science of harmony, the ancients increased the power of the voice.
> M. Vitruvii Pollionis, *De Architectura,* book V, Public places, Chap. 3.

Declercq & Dekeyser (2007) discovered a different, possibly more important, reason why the amphitheatres (and particularly the famous 'Asclepieion' in Epidaurus where they did their measurements) were (and still are) acoustically so impressive. The steps that form the amphitheatre work like a filter, filtering out low frequency sound (they mention below 500hz), suppressing wind noise and the rustle of the more than 10,000 spectators.

[14] 'Orchestra' referred to the floor directly in front of the stage, which was presumably kept free to allow for acoustic reflections.

1.3.2 Ritual and Religion

> *I walk into the Cathedral of Notre Dame in Paris for the first time. Its emptiness and high arching dark interior are awesome, but it bespeaks certain monumentality. It is a ghostly reminder of a civilization long past, its muted walls echoing only the shuffle of countless tourist feet. Later I return, and a high mass is being sung: suddenly the mute walls echo and re-echo and the singing fills the cathedral. Its soul has momentarily returned, and the mute testimony of the past has once again returned to live in the moment of the ritual.* Don Ihde (1976, p. 50)

Schafer, Blesser & Salter and Doyle all articulate (in the words of the latter) an 'integral and enduring' relation between reverberant spaces and religious or spiritual practice. And Schafer (1977, p. 53) suggests that the vocal reinforcement as a consequence of reverberation was 'designed to make the deity listen'. From that point of view it is perhaps not surprising that in the 20th century one of the driving forces behind the professionalisation of the sound reinforcement branch are the enormous Christian churches in, mainly, the US.[15] Doyle (2005, p. 43), quoting Krautheimer's *Early Christian and Byzantine Architecture* (1965) notes that early Christian architecture had a direct influence on the acoustic properties of their churches: '…determining and shaping the practices conducted within, sonic and otherwise.' The relation between church acoustics and the development of Western European (church) music has been described by several authors (Bagenal & Wood 1931; Blaukopf 1992; Sabine 1922), but I will stay with Doyle who points out that not only did the (cathedral) acoustics amplify and add importance to the words of a priest, they served (and Schafer points this out as well) to suggest a connection to the deity in the tradition of the religious spaces mentioned above. The architecture serves as a musical instrument (Doyle after Bagenal & Wood) or an

[15] There is currently no research looking into this, but one clue is the appearance of dedicated 'Worship' sections in industry supported magazines ('trade rags'), and dedicated magazines: Church Production and Worship Facilities. Producers of amplification technology often target church communities directly in their marketing efforts.

acoustic machine (Schafer) supporting the theatrical representation of the Catholic hierarchy: God talked to the pope who talked to the priest who brought it to people (for as much as they understood Latin). Mark Katz (2004, p. 27) underlines the significance of disembodied sounds in a church or other religious reverberant spaces: 'The removal of visual cues, certainly no accident, separates body from sound, heightening the sense that the music comes not from humans but from heaven.' Bagenal & Wood looked at the relation between the reformation and changing church acoustics (p. 380). To allow sermons to be conducted in the vernacular the reverberation needed to be shorter (Blesser & Salter p. 65). As a consequence, a relatively drier acoustic response allowed faster and 'busier' music; Bagenal and Wood (1931, p. 369) use the example of Johann Sebastian Bach's Cantatas. The Thomaskirche in Leipzig, one of the churches where Bach worked had a relatively shorter reverberation after modifications related to the reformation. Michael Forsyth (1985, p. 9) writes that the drier acoustics: 'would have enabled the string parts to be more clearly heard and allowed brisker tempi and a faster rate of change of harmony than would have been possible in an original medieval church'.[16]

In Thompson's *The Soundscape of Modernity* (2002) a lively description can be found of Wallace Sabine's early experiments and the birth of room acoustics as a science. Both Thompson and Blesser & Salter point out that the science of acoustics and to a lesser extent the science of sound were slow to catch up with the other physical sciences. Before the late 19th century dedicated performance spaces were built according to rules that were 'at best folk sciences and at worst cultural myths'. Designs for 18th and 19th century concert halls were: '… mostly derived from tradition, crude experiments, visual aesthetics, and dogmatic beliefs in imaginary science, and whose acoustics ranged from magnificent to disastrous […]'(Blesser & Salter 2006, p. 78). Bagenal & Wood (p. 372), noticed that the first European purpose built rooms for music performances may have been designed with the acoustics of the Protestant churches in mind, although scientific knowledge on how to achieve such acoustics would have been minimal. This was to change after Sabine's involvement with the design for the Boston Symphony Hall (opened 1900).

[16] Forsyth mentions an estimated reverb time of 1.6 seconds, very short ('dry') for a church of that era.

1.3.3 Reverberation Time

Forsyth (1985, p. 3) begins his book *Buildings for Music* by referring to Hope Bagenal, who used to say that: 'all auditoria fall into two groups: those with the acoustics of the cave and those with the acoustics of the open air'. If that needs further explication: imagine the difference between singing in a tiled bathroom and in an empty field. The acoustic properties of a room can be expressed in a relation between the total volume and the total reflective surfaces in that room. That expression, also known as Sabine's law is measured in time, the reverberation time, expressing how long (usually in seconds) it takes for a sound triggered in that room, to die out.[17] Some examples of familiar room types that are often used for music:

- Churches & Cathedrals, very long reverb time (4-10 seconds.)
- Concert Halls, often modelled after the Gewandhaus in Leipzig or one of its descendants, Concertgebouw Amsterdam or the Boston Symphony Hall, medium reverb time (1.5-2.5 seconds)
- Theatre, short (1.0 – 1.5 seconds)
- Cinema, very short (less then 1.0 second)

The reflections of the sound emitted by a source (in an enclosed or partially enclosed space), build up to a steady state over a short time, before ultimately that sound's energy is dissipated.[19] Apart from the reverberation time, the initial time gap (in digitally simulated reverberation referred to as the pre-delay) is another important measure of evaluating reverberation.

1.3.4 Echo

Notwithstanding echo's mythological clarification given by Doyle earlier, an echo is a distinct acoustic phenomenon. When the time gap between a sound event and an audible

[17] Ken Woolley (2010, p. 52) gives a clear description of reverberation time: '…is the time it takes for a distinct sound in the mid frequency range to die down to an imperceptible level throughout the listening space. It is a function of the air volume of the room as modified by absorptive surfaces.' With the least reflective surface being an open window, the sound travels on, unhindered.

[19] That steady state occurs when the total energy absorbed by the walls equals the energy delivered by the sound source.

reflection becomes much larger, for instance in a very large building or in the great outdoors in a canyon, the reflection can be perceived as a separate sound event, which is referred to as an echo. As a rule of thumb the minimal time gap for an echo to occur is 50 milliseconds.[20] Echo and reverb are sometimes mixed up in the critical analyses of music performance or recordings even though they are different phenomena. The use of echo as a vocal effect on Elvis Presley recordings is a crucial defining factor for the Elvis 'sound' (cf Doyle 2005).

1.3.5 Music Rooms

Notwithstanding the limited knowledge of acoustics pre 20th century, a wide range of different room sizes and reverberation characteristics can be traced to different styles of musical performance and cultures across Europe. Alban Bassuet (2004) researching the subject for the design of the Constellation Centre at the Massachusetts Institute of Technology (MIT), identified and measured 200 historically significant performance venues. He presented a summarised list of seven room types found in different cultures and music genres, playing key roles in the development of music in Western Europe:

- Great Hall (shoebox) of the palaces, similar to the enclosed chancels of large churches,
- The first Anteroom in various Renaissance and Baroque palaces,
- The size of the Medieval Tennis Court, a size later often used for opera, theatre and music performance,
- Bach-style Organ Church,
- Basilica - various sizes from small to large
- Small household music room
- Baroque Opera House.

[20] Forsyth (1985, p. 262) tells the story of Gustave Lyon who was involved in designing the Salle Pleyel in Paris (1927). On mountaineering trips in the Alps he discovered that when the distance between him and one of two friends making sound with their ice axes was larger than 22 metres he could hear a gap between two simultaneous hits (22 meters equals roughly 66 milliseconds, 1/15 of a second).

Bassuet explains that the acoustic properties of the rooms under test (variation of reverberation frequency, room resonances and reflective or absorptive behaviour of the surface material) enhance instrumental timbres:

> .., the Organ churches have a gap of reverberation in the mid bass that complements the sound of the 17th century German organ sound and allows fast parallel melodies and clear music counterpoints. The Shoebox rooms create strong modal resonances that support the weak string instrument in the bass register. In the Baroque opera houses, the thin wooden walls absorb the mid bass and the thick stone structural walls enhance the lower bass of the music.

Forsyth (ibid) dedicates a chapter to what he calls the *Hi-Fi* concert hall describing the changes in 20th century concert hall design, largely as a consequence of the need to fit larger audiences. But the modern audience also, conditioned to music recording, radio and sound cinema had gradually changed its taste to a preference for drier acoustics. Another aspect, since not every community could (and can) afford the construction of dedicated concert halls, theatres and operas, is the development of multi-purpose performance halls as described by J. Christopher Jaffe (2010, p. 98). Commercial 20th century venues for music performance developed a much 'drier' type of acoustics for instance the Jazz club, Discotheque or 'black box' multi purpose theatre. The (circus) tent takes its own place in acoustic history, Bessie Smith toured with her own tent where she sang unamplified. The canvas tents had acoustic conditions that were very different from those of buildings because of the fabric's small mass in relation to surface size, resulting in good absorption for low frequency and increasing reflections for higher frequencies. The tents were much drier (compared to concert halls for instance) and as such very good for speech and blaring trumpets (Forsyth 1985, p. 349) and sharp whip cracks (Cremer & Müller 1982, p. 31).[21]

[21] Forsyth (1985, p. 290) brings up tents in relation to experiments with canvas used to improve acoustics of Carnegie Hall in the late 1950s. Canvas and plywood screens were used to increase the clarity of the music by reflecting sound directly toward the audience. To lower frequencies the screens were 'transparent'.

1.3.6 Louder Musical Instruments

The Baroque opera theatres of the 18th century did not have an orchestra pit; the orchestra was seated in front of the stage, level with the audience. The baroque instruments in use in that era would have been easy to balance with the singers on stage; in more modern opera theatres the orchestras reside in a pit. Not only did the repertoire demand larger orchestras, the individual instruments had improved so much that they became much louder than their baroque predecessors (Bassuet 2008). Musical instruments had developed slowly but one consequence of improvements in materials and construction methods was a louder and more full-range sound. With the industrial revolution came the steel frame for pianos in the 1820s, effectively allowing them to become louder instruments. Edwin Good (2002, p. 118) points out that the desire; or rather the demand for louder pianos preceded the stronger frames. Larger concert halls (as audiences grew) and higher pitched wind and string instruments required more volume. Other than that, romantic composers like Beethoven increasingly used a wide dynamic range as an expressive device, requiring more flexibility from instruments. For a discussion of the steel frame piano see also Théberge (1997).[22]

Loud musical instruments go back much longer in time, with different reasons why a loud sound was required. The Roman legions used horns to relay commands, and banged the flat of their swords on their shields to impress opponents (Goldsworthy 2010). For centuries Tibetan monks have used loud sounds for more peaceful purposes. The 'Dung Chen' is a trumpet like horn that can be as long as four meters and is documented as going back to 1040 AD. Brian Pertl (1992) who spent time in Tibet researching the instrument writes:

> From the day it was invented the dung chen has been known for its capacity to produce extremely loud notes. A Tibetan legend relates that the first blast of the dung chen was so loud and frightening that the villagers fled for their lives.

[22] Baroque violoncello's lack the steel endpin of modern instruments, the pin allows the player to use more force (and so playing louder) it also transmits some sound directly to the floor, which can be beneficial in some situations (cf Russel 1987).

The loud horn blasts of the instrument are intended to please the fiercer deities; softer horn instruments are in use to woo the peaceful gods.

1.4 Non-electronic Amplification

Before looking at electronic amplification I will briefly look into mechanical ways of amplifying sound, the megaphone to begin with. 'Das Rote Sprachrohr' ('the red speaking tube') was a Berlin communist agitprop group lead by Maxim Vallentin active from the 1920s until the rise of the Nazis in 1933. Composer Hans Eisler worked with the group as a composer, pianist and conductor and wrote their signature tune 'Wir sind das Rote Sprachrohr'. The iconic megaphone was not just claimed by the political activists, according to C.S. Lewis (1942, p. 83), metaphorically it was a holy instrument in its own right: 'God whispers to us in our pleasures, speaks in our conscience, but shouts in our pain: it is His megaphone to rouse a deaf world.'

Regardless of progress in electroacoustics in the 19th century, air was (and obviously still is) the primary medium for sound, as far as human perception is concerned. Attempts to make sounds louder looked at concentrating that air directionally (megaphone) or by modulating pressurised air (eg the 'Auxetophone' described later). One year before Edison played back his first recording, Richard Wagner took a small step towards the use of a form of amplification in opera by adding an external artefact to a specific sound source (cf Kittler 1993, p. 224). In his opera *Siegfried* (1876) the dragon 'Fafner', performed by a bass, sings through a 'powerful speaking trumpet'.[23]

Descriptions of speaking trumpets first appeared in the 17th century. English inventor Samuel Morland (1625-1695) claimed he invented the speaking trumpet or *Tuba Stentorophonica* in 1671. Morland was a famous hydraulic engineer who was hired by Louis XIV to advise on the fountains in Versailles. His megaphone, made by a trumpet-making firm in London, was advertised in France. Before Morland a similar device had been described by Athanasius Kircher (1601-1680), in his *Musurgia Universalis* 1650). In 1672 Kirchner reaffirms his invention in a book called *Phonurgia Nova*: 'A new method of sound production' (cf Tronchin 2008). The invention also appears in the writings of Emanuel Maignan (1601-1676) whose work is described by P. Whitmore

[23] Cf Wagner's *Siegfried* p. 156 in the 1900 Schott & Sohne edition.

(1967, p. 170). Twenty-five years before Morland's announcement, Maignan had been to the Vatican library with Kirchner finding a reference in an ancient book ('in pervetusto codice') to Alexander the Great using a speaking trumpet that was given to him by Aristotle. Maignan adds a biblical reference; what other than a megaphone could St. John have been referring to in the Apocalypse:

> Fui in Spiritu in Dominica die, et audivi post me vocem magnam tamquam tubæ…
> I was in the Spirit on the Lord's Day, and I heard behind me a great voice, like that of a trumpet…

Anthropologist Peter Buck (1877-1951) has suggested that the wooden Maori instrument called a 'Puutoorino' could have been used as a speaking trumpet for singing or reciting (McLean 1996).

Megaphones used in music are mentioned from the early 1920s, perhaps they were common earlier, but there are few sources. It is not impossible that singers in the 1910s used megaphones, as these were common at sporting events in the USA. 'Player announcers'[24] used megaphones in football stadiums in the USA. A 1910 description of Edison's 1878 improved megaphone by Martin & Dyler (1910 chapter ix) mentions old and new applications:

> The modern megaphone, now used universally in making announcements to large crowds, particularly at sporting events, is also due to this period as a perfection by Edison of many antecedent devices going back, perhaps, much further than the legendary funnels through which Alexander the Great is said to have sent commands to his outlying forces.

[24] Or PA, interestingly the same abbreviation as Public Address, now common to refer to a loudspeaker system for amplification (usually regardless whether used for speech or for music).

1.4.1 Stethoscope

A key aspect of Sterne's book *The Audible Past* (2003, p. 99) is the significance of the stethoscope: 'one of the most enduring symbols of modern medicine', as it marks the 'articulation of hearing to reason'. Zooming in on, amplifying, bodily sounds developed a listening technique of investigation and diagnostics: 'mediate auscultation'. Sterne traces its usage and development back to 1817. Currently it is still a vital tool: four students from Melbourne University competed in the international 'Imagine Cup' in 2012, with a digital stethoscope that can be connected to a smartphone with the actual diagnostics running on a network based application (ie cloud computing). The device is intended to support diagnostics in areas that are devoid of medical services (Barlass 2012).

Another listening device that amplifies sound is the hearing or ear trumpet that has been in use as a hearing aid. Concentrating and funnelling the sound into the ear may have been attempted using animal horns for ages, however the first description can be found in 1624 by Jean Leurechon (pseudonym for Henrik van Etten) before Kircher described it in 1650.

1.4.2 Sound Increasing Devices[25]

Similar to the electroacoustic inventions of the 19th century, at least three people outlined and worked on a way of modulating pressurised air in order to make a sound source louder. Edison proposed his 'Aerophone' in 1878; it worked with a steam engine or compressed air. It looks like he never actually built a working prototype: according to one of his assistants Francis Jehl (1936, p. 182) the Aerophone was still embryonic in 1878, and after that year the device disappeared from the Edison literature. It did end up getting a fair description in the US *Popular Science Monthly*:

> The arephone (sic), an invention of Mr. Edison's, for amplifying sound, has already attracted considerable attention, though as yet it has not been perfected. Its object is to increase the loudness of spoken words, without impairing the distinctness of the articulation (Prescott 1878).

[25] Coincidentally, at the time of writing a book chapter about Parsons' and Short's inventions was announced by Kolkowski and Rabinovici (2012).

Horace Short, brother of ballooning and aeroplane pioneers the Short brothers Eustace and Oswald, invented a device that used air pressure to increase sound level (Driver 1997). Short was granted a British patent in 1898 and an American patent in 1901:

> ... the words or other sounds are uttered into the telephone (mouthpiece) … being reproduced, very greatly magnified and strengthened, and capable of being heard at a great distance by the more ore less complete closing at very rapid intervals of the apertures or grating through which the air is forced (Short 1901).

Short found a sponsor in American entrepreneur George Gouraud (aka Colonel Gouraud) who had moved to England to represent the Pullman train car company. From 1879 to 1890 he represented Edison in the UK and as such he was marketing Edison's telephony system, electric lighting and other inventions. His 'all electric' house in was called 'Little Menlo' (after 'Menlo Park' Edison's industrial research lab in New Jersey). Edison sent Gouraud an 'improved' or 'perfected' phonograph in 1888 which Gouraud used for demonstrations. Allegedly he made the first sound recording in the UK, possibly the first 'live' recording of music ever.[26] That recording took place in July 1888 of a performance of Handel's *Israel in Egypt* at the Crystal Palace.

1.4.3 Devil's Dyke

In a footnote in *From tinfoil to stereo* (Read & Welch 1976, p. 186) we can read that in 1900 Gouraud announced a new sound transmitter: the 'Gouraudphone', attributing the invention to Short. An article from 1900 details the first public demonstration near the 'Devil's Dyke' in the vicinity of Brighton. ('A Shouting Phonograph' 1900) 'A combination of megaphone and phonograph that is called in some of the papers a "howling terror" has been invented by Horace L. Short, of Brighton, England.' The article then refers to an item in the London Mail:

[26] Mechanical, acoustic (ie with a horn driving the stylus) recordings of concerts are very rare as a consequence of the distance to the source. It became more viable after the introduction of electronic recording in the 1920s.

> A phonograph that shouts so loudly that every word can be heard at a distance of ten miles has been tested at Brighton. You can whisper a sentence into the machine's small funnel-shaped mouthpiece and it will repeat it in tones that are more deafening than the shrieks of a liner's steam siren. Yet every word is perfectly articulated, and a shorthand writer ten miles away can take down the message as easily as if you were dictating to him in a small room. In appearance, it [the machine] is merely an ordinary phonograph, with a large trumpet measuring 4 feet in length. Inside this trumpet there is a small and delicate piece of mechanism that looks something like a whistle. This is the tongue of the machine. Instead of the "records" being taken on wax in the usual manner, a sapphire needle is made to cut the dots representing the sound vibrations on a silver cylinder, and when the needle travels over the metal a second time, the vibrations cause the whistle to produce a series of air-waves, and the machine thus becomes a talking siren which transforms the human voice into a deafening roar. The experiments were made near the Devil's Dyke, Brighton, were the inventor has his workshops. The instrument was placed on the roof of the laboratory, and was made to repeat a number of sentences. At a distance of ten miles the sounds were plainly heard by a large number of people, every word being perfectly distinct, and at a second trial with a favorable wind it was found that an unknown message could be taken down in shorthand at a distance of twelve miles…

In the same year the Gouraudphone was demonstrated at the World Fair in Paris in 1900 and there is a rumour of the device being used on the Eiffel tower (Appleyard 1933).[27] In a syndicated newspaper article appearing in several New Zealand and Australian newspapers the demonstration was reported and the experiment on the Eiffel tower announced. [28]

[27] No other mention of a successful demonstration on the Eiffel tower was found. I think, if such an event really occurred more reports would have appeared. In personal communication Alison Rabinovici suggests that, while there may be nothing in the Parisian newspapers mentioning the event, it could still have occurred but it just did not work, no one heard it.

[28] 'The Gouraudphone'. *The Star* (Christchurch NZ , Issue 6965, 1 December 1900, Page 1)

> Mr Short, has, at great expense, perfected the apparatus; the experimental stage is over and the public demonstration of its power has become possible. Perhaps, mercifully for the audience, today the occurrence of some damage in transit to certain parts of the instrument prevented a complete demonstration of its capabilities, for when fully equipped it transmits the human voice many times magnified in volume over enormous distance, several 'tens of kilometres,' according to Colonel Gouraud. It makes itself heard equally well in fog, and will also carry against a very strong wind. Its value in many ways, if these promises are realised, and especially in connection with vessels at sea, or in distress, can easily be imagined, and its usefulness is increased by the fact that no receiver is required at what may be termed the other end, to capture the sound or to make it intelligible.[…] Later, that is to say at about the end of September, he will fix his machine on the uppermost platform of the Eiffel Tower, and from there will discourse through it without raising his voice, but his words will be heard all over Paris…

From a French article about the Gouraudphone (Joly 1901) we learn a bit more about Short who oversaw a gold and silver mine in Mexico. There he was introduced to the phonograph and apparently so impressed that he decided to build one himself. The article mentions that although unbeknownst to Short, Edison had previously noted the possibility of using pressurised air to increase sound pressure level (ie Edison's Aerophone). Some unsuccessful experimentation in Berlin is mentioned unfortunately without further detail. Short explains the working of his device in analogy to the human voice, calling the key-part a 'metallic larynx'. Gouraud and Short set up an acoustics laboratory in Hove, Sussex (on the second floor of which the two other Short brothers were making balloons) but the facility was closed after the Gouraudphone proved unsuccessful in 1903 (no working exemplars are known to remain) and Gouraud pulled out while Horace Short went on to work for Charles Parsons.

1.4.4 Auxetophone

Not content with the sound quality and volume of the gramophones and phonographs at the start of the 20th century Charles Parsons set out to improve sound reproduction with the use of air. Parsons was a famous British engineer credited with the invention of the steam turbine, still in use now, to generate electricity. Parsons thought of transducing the record grooves to sound more directly, like the action of an organ pipe:

> The essential feature of his idea was to form the sound by causing the needle of the gramophone to operate a valve, which should control the emission of the air in exact accordance with the grooves of the record. The valve would thus be the mechanical equivalent of the vocal chords in the human throat. (Stoney 1938)

Parsons, like Short, claims to be unaware of Edison's Aerophone. According to two sources Parsons did not know of Short's work (and patent) and the Gouraudphone (Appleyard 1933; Stoney 1938). After notices in the papers about Parsons' device he received a letter from Short in 1903. Subsequently Parsons purchased Short's patent and engaged the latter to further develop their device at Heaton Works where Parsons built his turbines. In a letter to Ambrose Flemming (one of the separate contributors to the invention of the vacuum tube) in 1921 Parsons also mentions the mysterious event at which Short demonstrated a Gouraudphone on the Eiffel tower (Appleyard 1933, p. 204; Scaife 2000, p. 471). In that same letter to Flemming Parsons writes that Professor Johnston Stoney, suggested the name 'Auxetophone' in 1904 (Scaife 2000). Professor Stoney's son Gerald Stoney (1938) suggests that the working Auxetophone in 1903 reproduced sound with a quality and volume equal to radios and gramophones of 1938.

The patent was sold soon after to the Gramophone Company (parent to His Master's Voice Co), which marketed the product in the UK. Deutsche Grammophon promoted several models in Germany and Victor (who produced them until 1918) in the USA. The Auxetophones were heavy and expensive and also needed a lot of maintenance (Appleyard 1933, p. 214). An additional problem was the electric pump providing the pressurised air, which would have been very noisy.

Parsons moved on to apply the concept to the amplification of musical instruments and he successfully did so for larger string instruments, although actually documented examples are limited to the double bass. According to the patent the sounding board of the instrument was removed and a valve attached to the bridge. [29] It was used for a season of promenade concerts in the Queen's Hall in 1906 (a concert hall in London, destroyed by German bombs in 1941). A notice on the hall's door explained that the two huge trumpets were not a new ventilation system but the Auxetophone:

> … a pneumatic device for increasing the volume and richness of tone of stringed instruments, and is worked by air supplied by a blower in the basement of the building. The Auxetophone consists of a small comb-like valve made of aluminium, which is connected to the front wood of the instrument near the "bridge", and vibrates in response to the tones produced by the player. This valve controls the air from the blower into a large spiral-shaped trumpet which emits sound-waves identical in quality and intonation but richer in tone and larger in volume than those produced by the instrument itself unaided by the Auxetophone. (Appleyard 1933, p. 203)

The experiment took place under patronage of conductor Sir Henry Wood, who (after his death in 1944) gave his name to the 'Henry Wood Promenade Concerts', better known as the 'Proms'. None of the sources tell us how this cooperation was initiated, but Wood was 'perennially curious about new music trends'. For example, Wood was present at the first UK demonstration of Leon Theremin's electronic instrument in London in 1927 (Glinsky 2000, p. 64). In a letter dated 22 October 1906 Wood reports having tested the system with 'all classes of music' and being delighted with its practical value: '…as a new voice in the orchestra, also that it reinforces a most important and up to now weak section of modern orchestra, viz. the Double Basses.' (Appleyard 1933, p. 213)

One week later in another letter Wood requested the use of the Auxetophone for eight symphonic concerts in the winter of 1906/07. Wood stresses the value of the Auxetophone Double Bass for some big 'Wagner items'. Wagner was also subject of a

[29] UK patent: 10,468/1903, US Patent No. 816,180, applied for April 12, 1904, granted March 27, 1906

later inquiry by Wood in 1909; for a performance of *Siegfried* Wood proposes to have the role of the dragon Fafner performed by a 'very big bass tuba' utilizing an Auxetophone. Parsons' answer is not included but it is unlikely that the Auxetophone could work with a Tuba. Wood ended up having the tuba player play his instrument through a large megaphone that he had specially made (ibid p. 215). Wood and Parsons' experiments were ultimately stopped by the 'Music Fraternity', Parsons wrote in a letter to Ambrose Flemming in 1921 (ibid p. 204), who objected to the work of five string players being done by one player. A letter from Wood to Parsons dated 22nd October, 1906 suggests that the latter paid the salary of the bass player who was not playing as a consequence of the experiment. Wood had big plans for an orchestra with an amplified string section, two violins, viola, cello and bass, to 'combat' the entire woodwind and brass of the Wagnerian orchestra. In a small town only five string players would have to be engaged (ibid 216).

In a collection of Parsons' publications (Parsons 1934) an appendix is dedicated to the Auxetophone, written by A.Q. Carnegie who worked with Parsons. It mentions a recital at the same hall by cellist Auguste van Biene using an Auxetophone 'a few years later when playing as a soloist in a concert conducted by Sir Landon Ronald.' Scaife (2000, p. 475) mentions Biene in relation to Parsons' efforts to attract more attention to his invention. In 1909 the cellist was to play a number of recitals at different venues. It is unclear whether these were separate events, a soloist at a concert with a conductor suggests a cello concerto, a recital hints at chamber music repertoire. Both Scaife and Carnegie mention unsuccessful attempts to amplify harps and pianos. The latter writes:

> He also applied it experimentally to the piano and the harp, but these instruments have sound-boards of large area and it was found impossible to select any part of the sound-board which would respond to the vibrations of all the strings. The vibrations appeared to take place in local zones which moved about according to the strings which were sounded. One "Errard" harp was fitted with four or five separate Auxetophone valves, but the results were discouraging. (Parsons 1934, p. 245)

Several other inventors worked on the same principle of amplifying sound with air, which I will briefly detail in the following paragraphs.

1.4.5 Auxtephone

Kellogg (1967, p. 291) mentions under 'Siren type of Amplifier' that German sound film pioneer Oskar Messter patented an amplifier using pressurised air in 1903/4. This device appears to have been named 'Auxtephone' (confusingly and suspiciously similar to the name of Parsons' device). Kellogg most likely bases his information on Theisen (1941, p. 422) who writes:

> … Oscar Messter was granted several German patents on methods of synchronizing phonographs and projectors. One claim granted to him in an English patent dated October 19,1903, specifies a synchronizing mark to serve as a starting guide. Messter's system, known as the auxtephone, utilized compressed air in the speaker for amplifying the sound. It is said that by means of air-compression amplifiers, Messter surmounted one of the chief difficulties of the sound picture pioneers, namely, sufficient volume. It would seem, however, that Gaumont had sufficient volume in his sound pictures, because, in 1913, he is said to have successfully shown talking pictures for a time at the Gaumont Palace, previously the Hippodrome, to audiences of 4,000 persons.

1.4.6 Elgephone

Rick Altman (2004, p. 158) writes about both Messter's and Gaumont's work. Leon Gaumont worked on a way of syncing recorded sound and image and he demonstrated his 'Chronochrome' in 1902 (chrono as in synchronous). From 1905/6 the device that amplifies the sound is dubbed the 'Elgephone' (after his initials), which is described in detail in a chapter in Raymond Fielding's *A Technological History of Motion Pictures and Television* (Gaumont 1967) based on a paper found after Gaumont's death in 1946. It is again similar to Parsons' device in using compressed air, but the transducer worked in

a different way.[30] Gaumont writes 'This method of amplification was more satisfactory than any known at that time' (ibid). Scot Eymann (1980, p. 27) quotes inventor and cameraman Arthur Kingston: 'The sound amplification was terrific, it was marvellous.' A later version of the device from 1910 can be seen at the Conservatoire National des Arts et Metiers in Paris. It has two turntables and two horns using a similar if not the same principle. At first sight the two turntables make it look like a contemporary DJ set-up but the reason for the dual playback was to allow switching from disk to disk while the movie kept playing.

1.4.7 Stentorphone

In the first three decades of the 20th century several other companies made pressurised air record players using air pressure. One of the more famous ones is the Stentorphone developed by H.A. Gaydon. It sported a huge horn (like Parsons earliest Auxetophones) and was installed in places like the Crystal Palace to play back music.[31] During WWI they were used to accompany silent movies and in an article in 'Popular Mechanic' (May 1921) they are seen installed in a London Tube station playing back (presumably) pre-recorded messages and the chimes of Big Ben. The Daily Mail operated a truck with a Stentorphone in the 1920s. The Stentorphone is mentioned in the seminal Rice & Kellogg (1925) paper as:

> A siren […] Instead of moving a diaphragm to set up airwaves, the voice currents are made to operate a delicate throttle valve which controlled the amount of air issuing from a jet. This principle is employed in the 'Creed Stentorphone' evolved by Mr Gaydon and manufactured by Mr Creed of Croydon, England.

1.4.8 Hot Air

With Parsons' Auxetophone possibly the first working sound increasing device for a musical instrument, one important social consequence appeared very soon: the threat this

[30] Some sources suggest it used flammable gas instead of air. In the context of this thesis I have not looked into verifying that.
[31] One Stentorphone was installed in the Crystal Palace from 1910-1914. It appeared for auction at Christies in 1994.

technology imposes on the number of musicians' jobs (cf Fleischer 2006; Kraft 2003). Whereas previously demands for louder music were met by improving instruments and at the same time adding musicians to ensembles, from that moment in time it would seem that louder sound could be achieved by a dedicated technology, potentially allowing for smaller musical ensembles.

The deliberate approach of first Edison and later Short and Parsons to use air pressure as a means of sound amplification can hardly be called serendipitous, unlike some of the episodes in the development of the 'electro dynamic' loudspeaker. Jensen and Pridham (often mentioned as the first researchers to amplify sound) were looking to improve the telephone transmitter, creating the first loudspeaker instead, as detailed in the next section. The early attempts to amplify sound do suggest that a cultural preparation was in motion with the desire to make sounds louder for the first time appearing in the 'Zeitgeist'. Effective electronic amplification had to wait for the vacuum tube to be perfected and for WWI to be over before it became available to non-military (radio) application.

1.5 Loudspeakers: the 19th Century

The contraption that Philipp Reiss used for transduction in his early telephone (initially consisting of a violin top and a knitting needle) was a precursor to the most common principle of transduction into air, what is known now as the electro dynamic loudspeaker.[33] After Reiss' telephone and the receivers in the different (Bell, Grey, Meucci) telephones, the next known occurrence of a working transducer is Werner von Siemens' electro dynamic loudspeaker of 1887 (Trendelenburg 1975). A UK patent[34] was filed in December 1887 while some two weeks earlier Charles Cuttriss and Jerome Redding filed a patent in Boston, describing an improvement to the telephone, using a moving conductor transducer.[35] According to Beyer (1998, p. 179) the Siemens patent became the dominant one. Siemens' 'Elektroakustischen Wandler' (converter) was

[33] A coil was wound around an iron knitting needle attached to the f-hole of a violin top. An applied current causes the needle to shrink (magnetostriction) producing an audible sound. Although the different components were there, this is not quite the same as the electro dynamic loudspeaker envisaged and created later.
[34] German patent 2355 granted 30 July 1878. British patent granted 30 April 1878
[35] U.S. patent 242,816, granted 14 June 1878.

intended as both microphone and loudspeaker as part of a telephone system. In England Oliver J. Lodge filed a patent in 1898 for a similar device, this time specifying a major improvement, the use of non-magnetic spacers in the air-gap between the magnet's poles (Beranek 1954; Beyer 1998, p. 57; Hunt 1982, p. 59).[37] Lodge's improved model can be considered the 'Urtype' for all later electro dynamic loudspeakers. Hunt mentions a photo of it in *Wireless World* (nr. 21, 807 December 1927). This transducer can still be seen in the Science Museum in South Kensington, London as reported by Collison (2008).

1.5.1 Key Players in the US

Two parallel lines in US corporate history can be roughly traced back to the holders of the initial electroacoustic patents, Edison and Bell: Edison General Electric merged in 1896 with General Electric (GE), and in 1899 AT&T acquired the American Bell Telephony Company. AT&T had previously bought Western Electric (WE) from Western Union in 1881. The latter company had made a fortune with the first transcontinental (east-west) telegraph connection. The WE and AT&T research departments were reorganised and renamed Bell Telephony Labs in 1925.

The Radio Corporation of America (RCA) was established in 1919 to market the radio patents that were acquired by the US government and military before and during WWI. The company was jointly owned by GE, light bulb and radio manufacturer Westinghouse and, surprisingly, the United Fruit Company.[38] The national radio system that was organised by the War and Navy Departments went into the hands of RCA on the provision that the latter would buy out Marconi Company who marketed a competing radio technology. After WWI the only non-military source for radio service was the Marconi Wireless Company of America, which was controlled by British interests (Burns 2004, p. 247). Essentially the radio monopoly was granted to RCA while at the same time AT&T received the telephony monopoly; it would take until 1926 for the dispute to settle and the 'natural' monopolies were established. Through the Broadcasting Corporation of America (BCA) AT&T was involved in radio experiments most notably through station

[37] U.K. patent 9712, granted 13 January 1899.
[38] According to Chanan (1995, p. 61) the United Fruit Company was using radio to 'link its agricultural empire in Latin America.

WEAF[39] that was sold to RCA in 1925 (something that was provided for in the 1919 deal around RCA). By the same agreement AT&T was committed to open their long distance telephony lines to the transmission of (RCA) radio programs (cf Adams & Butler 1999, p. 110/11).

1.5.2 Vacuum Tube, the Missing Link

In 1873 Frederick Guthrie had already described the principle of the vacuum tube (or valve in the UK). Ten years later Edison was awarded a patent describing this essential step towards electronic amplification known as the 'Edison Effect'. But it was not until 1904 that John Ambrose Flemming discovered the rectifying working of a vacuum tube while experimenting with Edison light bulbs. This 'Flemming' valve or diode tube could be used in radio circuits but not yet for amplification. In 1907 Lee de Forest added an extra electrode to his 'Audion', a diode similar to Flemming's, creating a triode valve. This 'Triode' could be used for amplification but was patented by De Forest for use in wireless telegraph, or 'Space Telegraphy'.[40]

Harold D. Arnold, a researcher at the WE engineering department witnessed a demonstration of De Forest's triode Audion in 1913 and was convinced that a better (or stronger) vacuum in the tube would improve performance (Collison 2008; Nesper 1928). After successful experiments AT&T bought the rights to the De Forest patent and in 1913 the Audion was used in telephone repeaters between New York and San Francisco and in 1915 across the Pacific (Adams & Butler 1999, p. 1; Burns 2004, p. 423). How AT&T acquired the rights is somewhat controversial, as related by Susan Douglas (1989, p. 243). In the same year (21 October 1915) AT&T established a short wireless transatlantic radio conversation from Arlington in Virginia to the top of the Eiffel tower in Paris. The technology developed by Arnold would soon be used for the amplification of sound.

Arnold stayed on at WE later becoming the director of research at the Bell Telephone Labs (BTL) and in the 1930s he worked with Leopold Stokowski to improve the quality of the transmission of music from concert halls (cf Stokowski 1932). In April

[39] This was AT&T's (Western Electric) experimental broadcast station. The letters did not stand for anything, but staff were 'fond of pointing out the four classic elements of matter depicted in a mural above the studio doors: Water, Earth, Air, Fire (cf Jaker, Sulek & Kanze 2008).
[40] It was granted US Patent 879,532 in February 1908.

1933 Stokowski oversaw the live transmission of a performance at the Academy of Music in Philadelphia to the Constitution Hall in Washington, captured by three microphones and transmitted via three telephone lines. Three loudspeakers, controlled by Stokowski, reproduced the signals to the audience.[41]

It took until 1919 before the triode could be used commercially as a consequence of a standoff in the conflict between Flemming's and De Forest's patent:

> A court ruling in 1916 held that de Forest's Audion infringed on Fleming's valve, owned by Marconi, while the grid introduced by de Forest was protected by his own patents, which he had just sold to AT&T. The two companies were stymied. Neither could proceed without permission of the other. (Klapholz 1988)

As part of the 1919 dealings around the creation of RCA the Marconi and AT&T Tube patents were brought together in the same hands and became available commercially. The tubes were readily available immediately because the WE factories had invested in production capacity during WWI (Adams & Butler 1999, p. 107) and other a government moratorium forced companies to share the patent (Douglas 1989, p. 278). With the ability to increase the amplitude of electronic sound waves the doors swung open to the electroacoustic era in the 1920s. This included radio (from 1920 in the USA), electronic recording (1921-4) sound motion picture (1926/7) and amplification of public address from as early as 1919.[43] Each of these technologies had been researched and to an extent proven in the decades before, but ultimately the vacuum tube paved the way for mass application and commercial success.

1.5.3 Magna Vox: Jensen & Pridham

Peter Jensen's autobiography (1975) is very anecdotal when it comes to his and Edwin Pridham's loudspeaker experiments and commercial ventures. Jensen had moved to the USA in 1909 representing the Danish engineer Valdemar Poulsen, and to supervise the installation of radio equipment in California. Poulsen demonstrated and patented his

[41] A photo of the maestro at the controls can be found on http://www.stokowski.org/Harvey_Fletcher_and_Bell_Labs_Stereo.htm <viewed 8 August 2012>
[43] In 1919 radio broadcast restrictions imposed during the war were lifted.

‘Telegraphone’ a magnetic wire recorder in 1898 without commercial result; more successful was Poulsen’s 1904 arc transmitter (known as the ‘Poulsen Arc’). This radio transmitter used an electric arc to convert direct current electricity into high frequency alternating current that could be used for radio transmission. The system was in use mainly in the USA, most notably by the US Navy until circa 1920 when vacuum tube technology took over. Pridham started working for the American Poulsen Company at the same time as Jensen and they became close colleagues. In 1909/10 the duo was involved in the construction of radiotelephony stations in Sacramento and San Francisco using Poulsen’s patent. Instead of going back to Denmark later in 1910, when Poulsen’s assets were sold to the Federal Telegraph Company, Jensen decided to stay in California. In 1911 he and Pridham obtained financial backing and started the Commercial Wireless and Development Company. They set up shop in Napa (a town close to San Francisco), with the aim of carrying out experiments, and possibly claiming patents for new developments. Inspired by another Poulsen device, a photographic recorder that translated telegraph signals into dots and dashes, they suspended a wire between two poles of a magnet. In the centre of the wire they glued a match that was connected to a diaphragm. A signal through the wire (in the magnet’s field) made the wire ‘jump’, following the incoming signal. In the words of Jensen:

> We then hooked up an ordinary telephone circuit, and spoke through a microphone, but instead of using a telephone receiver, we substituted the string of wire in our apparatus. To our surprise, we heard speech coming out of our device with exceptional strength and clarity. (ibid)

1.5.4 Moving Coil Patent

They had actually discovered a moving conductor (a wire or a coil) transducer that had already been patented by Werner von Siemens in 1877, as mentioned before.[44] Hunt (1982, p. 59) comments that Siemens had: ‘no more articulate signals in mind than those of a bell or telegraph sounder’. Even though Siemens had pointed out that the coil could

[44] It appears both Siemens and Jensen & Pridham were inspired by the ‘Einthoven’ Galvanometer a sensitive device that measures current and displays it by moving a pointer attached to a coil in a magnetic field.

also be used for causing audible signals (ibid). Siemens may have stopped his experiments when he heard of Alexander Graham Bell's successful telephone patent bid in 1876. Bell's telephone used a moving electro (non permanent) magnet as a transducer rather than a moving conductor. Jensen and Pridham may or may not have been aware of the existing patents, but they tried to patent their discovery soon after they tried it in 1914, but it was turned down a few months later. Jensen insists that their device was based on an 'imposing array of old masters' (ibid p. 63) but none of them perfected the principle into a viable product and none of the prototypes had appeared outside of a laboratory. Not being granted the patent of the moving conductor principle, Jensen and Pridham travelled to New York in 1914, to try to sell their invention (still too bulky to be used in a telephone) to AT&T. While their apparatus was under test by engineers at WE the two stayed in town. During those six weeks they visited Lee de Forest who at that time was in the process of selling his three element vacuum tube to AT&T. Jensen remarks that at that point in time in the phone company's laboratory the 'fundamental requisites' (ibid p. 82) for sound amplification and many other applications of vacuum tube amplification and electro dynamic loudspeaker were present, without anyone realising the potential. Unfortunately for Jensen and Pridham AT&T was not interested and returned their invention without comments. According to Cowan (1931, p. 8) AT&T, ie WE experimented with their own system in 1916, possibly unbeknown to Jensen and Pridham.

1.5.5 Player Announcement

Carroll Pursell (1990), in a series of monographs on American inventors and their inventions calls it a serendipitous event when Jensen and Pridham followed a suggestion made by a visitor. After returning to Napa, an uncle of Jensen's wife thought the inventors should try to use their device at the ballpark so people could actually hear what was being said. Here the uncle referred to 'Foghorn Murphy' a public or player's announcer in San Francisco who used a megaphone to be heard. Uncle Ray made the suggestion to connect a horn like a megaphone to Jensen and Pridham's device, and hinted at the commercial potential of having a number of them in a baseball park. The next day they connected a large gooseneck horn from an (old) Edison cylinder

phonograph to their dynamic telephone (Douglas 1995). Six 'heavy duty' powerful microphones that the two had bought in Berlin in 1910, were clustered and connected to a common (telephone) mouthpiece, fed by a twelve Volt battery.[46] As soon as they connected the source to the 'loud speaking telephone' they observed the (possibly) first very loud electro acoustic feedback loop ever. Feedback was a common phenomenon in early day telephony, it occurred when the mouthpiece was accidentally held too close to the transmitter. But with a sound system of, according to Jensen, 10 to 25 Watts the feedback was much louder than what they could have heard ever before. Moving the mouthpiece away from the speaker easily solved that problem. Jensen goes on to describe how, after installing the speaker on the roof, they ran out into the field and kept going for a mile, still hearing the speaker. In his autobiography Jensen does not mention the exact date but it was at the very beginning of the year 1915.

1.5.6 Magnavox

Before the current terminology became commonplace, with the rise of the talking pictures in the late 1920s, names for the different transducers came from telephone technology: 'transmitter' for what is now called the microphone and 'receiver' for the loudspeaker. The term 'loud speaking telephone' was first coined by Edison to market his 'Motograph', an efficient receiver for his telephone system, which was in competition with Bell's. Jensen and Pridham first called their device that, but also 'dynamic loud-speaking telephone'; Jensen goes so far as to say that he was not responsible for the word loudspeaker as he found it an ugly sounding word (Jensen, p. 87). After discussing names like 'Stentor' or 'Telemegaphone' Jensen and Pridham decided on 'Magnavox', Latin for 'great voice'. Through 1915 they worked on improving the Magnavox, Jensen mentions using four, American, *Button* (Carbon) microphones instead of the six German ones. Another development was a 'pick-up' (Jensen was not sure whether they originated that term in relation to record players), that allowed them to hook up a phonograph to their device (for which they filed a patent in 1916).[47] They often entertained the village of Napa with music played back through the Magnavox in the early evening (also

[46] Unfortunately it remains unclear which brand and type of microphones they used.
[47] Sound Magnifying Phonograph, U.S. Patent number: 1,329,928. Filing date: 3 July 1916 granted date: 3 February 1920.

mentioned by Beranek 1954, p. 14). The first official public demonstration took place at the end of that year. On December 10, 1915 Jensen and Pridham played back records and amplified a local attorney reading Lincoln's *Gettysburg Address,* and a piano. Jensen copied an article reporting the event from the *San Francisco Bulletin* of the next day (Gleason 1915) into his autobiography. The demonstration was repeated in front of a much larger crowd (75,000 – 100,000) at a Christmas celebration outdoors at the San Francisco Civic Centre (24 December 1915). On the 30th of that same month they set up their equipment at the same venue but now indoors, at the Civic Auditorium. This time the distinguished speaker, Hiram Johnson the then Governor of California was bedridden and the two engineers were asked to connect the Governors' home, two miles away, with the Auditorium. They connected to an existing wire along Van Ness Avenue that connected both places, and by using the ground for the return signal they were able to connect a microphone in the Governor's house to their loudspeakers at the venue. Another speaker was John Galen Howard the architect of the Auditorium that was opened that night. While holding the microphone in his hand he pointed at different features of the building and thus moving the microphone away from his mouth, to Jensen's agony. For the Governor's remote speech Jensen found his loudspeaker blocked by a choir that had appeared directly in front of it; he tried to create a clear path for the sound by moving the choir but was not successful.[48]

The demonstrations may have proved the feasibility of sound amplification but Jensen and Pridham could not attract enough capital to manufacture sound systems (Jensen, p. 110). Possibly this was a consequence of the looming war or perhaps, without an actual electronic amplifier their system was just too cumbersome. In 1917 their company merged with the Sonora Phonograph Co, a successful phonograph producer. The new company was called the Magnavox Company with Sonora's Frank Steer as president and Jensen and Pridham as Chief Engineers.

[48] Speakers moving away from microphones or swinging them around and unforeseen obstacles (such as choirs) blocking loudspeakers are still regular challenges in the live sound profession.

1.5.7 World War I

Once the USA started their WWI effort in 1917 Jensen and Pridham, devoted their research to military applications. They successfully developed an in-flight headset microphone that cancelled out the noise of the aircraft, allowing a plane's crew to talk to each other whilst airborne. They also developed an on-board telephone system for the US Navy. After WWI Magnavox was involved in several more big rallies, including the first amplified address by an American president. On 19 September 1919 President Wilson spoke to 50,000 people in a stadium in San Diego. But from then on they focused on loudspeakers for radio receivers like the R3 in 1921/2. Magnavox steered away from the amplification market but later they jumped on the bandwagon of sound motion picture, presenting a high-efficiency cinema loudspeaker in 1928 (Gleason 1915, p. 15). A horn loudspeaker shaped Magnavox monument can be found in Napa, California.

1.6 Other Early Events

Kellogg (1967, p. 179) in his 'History of Sound Motion Pictures' relates of developments by WE in the loudspeaker field:

> The company had considerable experience and had developed units for public address work. The public address installations had afforded experience with auditoriums and requirements for intelligibility, while experience in acoustics for sound pick up had been gained in radio broadcasting.

L. Cowan (1931) in an early book about motion picture sound mentions a WE experiment in 1916 setting up an 18-loudspeaker public address system capable of addressing 12,000 people. Unfortunately WE's Green and Maxfield (1923) do not mention that event in their seminal 1923 paper describing some early systems, nor does Adams and Butler's (1999) history of WE. Cowan also refers to the 1920 Republican Party convention in Chicago, presumably the first successful indoor PA system, with the same system used for the Democratic Convention in San Francisco (Eargle 2003, p. 413; Thrasher 1946, p. 24). Early amplification systems were referred to as using loud speaking telephones, in part because the transducers used were still very similar to the ones in telephones and

partly because the source of these addresses came to the gathered audience by phone. In a book about the invention of the telephone Lewis Coe (1995, p. 177) mentions a 1913 address of the governor of Oklahoma talking to a crowd of 300 in Tulsa, 122 miles away using a telephone line. As with Jensen and Pridham's early experiment the electric energy (3 Ampere according to Coe) for the amplification came entirely from a special, water-cooled, microphone.[49] The Armistice Day event in 1921 is very well documented in comparison to the other early events. President Harding's speech was transmitted by telephone from Arlington in West Virginia to Madison Square Garden and to the Civic Auditorium in San Francisco. Two early papers describe the technology used at those events: Green and Maxfield (1923) outline the PA system and Martin and Clark (1923) detail the telephony system. Green and Maxfield also refer to President Harding's March 1921 inaugural address for a crowd of 125,000 people: 'every one of whom was able to clearly and distinctly hear all of the words spoken…' This event is also described in William Peck Banning's *WEAF Experiment* (Banning 1946, p. 113). These installations used Henry Eggerton's 'balanced armature' loudspeaker that he patented in 1918 for WE (Beranek 1954, p. 14). The balanced armature was an improvement on the original transducer patented by Thomas Watson in 1882, the famous Mr Watson who received the first ever telephone call from Bell: 'Mr Watson, come here I want you'.

1.7 Europe

In Europe important (and well documented) developments took place in Germany. A particular boost to the application of electroacoustic technologies (abbreviated to ELA in German) was given by the Nazis, and their understanding of the importance of mass media such as radio broadcast, recorded speeches and PA systems at political rallies.[50] An interesting difference from the USA in the early days of radio is that after WWI German military personnel with radio training were allowed to take their equipment home, instantaneously creating an audience for radio broadcasts. The rapid spread of the technology in the interbellum was partly due to the large number of such trained

[49] No other sources were found for this event in 1913.
[50] Another electroacoustic mass medium was the use of loudspeaker trucks riding around cities. For a discussion of how Nazi propaganda took over the German soundscape in the 1930s see Carolyn Birdsall's (2012) *Nazi Soundscapes: Sound, Technology and Urban Space in Germany, 1933-1945.*.

operators; Friedrich Kittler (1999, p. 96) mentions a figure of 190,000 soldiers, referring to a book about the beginnings of German radio by Lerg and Steininger (1975, p. 188).

Ehlert (2004b) refers to the announcement by WE of the commercial export to Europe of PA systems in 1920. In England the earliest mention of a PA-system is a public address system developed by Henry Round who worked as a consultant for the Marconi Company. He built an improved loudspeaker, which prompted the Marconi Company to begin a PA department developing their Sound Projectors SPG types 1 and 2, becoming available in 1925. The first large event was the opening of the 1924 (April 23) British Empire Exhibition at the London Wembley stadium (Ehlert 2004e). Marconi used technology supplied by WE who were relying on their experiences from the 1921 Armistice Day system. WE used a number of very large horns that were even bigger than the ones used in 1921. Two of these were taken to the European continent afterwards with one ending up in Prague on the roof of the 'Radiojournal' and another on the Frankfurter 'Herbstmesse'.

In Germany in the same period, an important step was made by Siemens ELA engineer Erwin Gerlach (1924) and Professor Walter Schottki, who together developed and built prototypes of ribbon microphones and loudspeakers (which were still too expensive to develop commercially; Ehlert (2004c) mentions 1,100 golden Marks for the loudspeakers). Another development at Siemens & Halske was the 'Blathallter' loudspeaker a large planar electrodynamic loudspeaker that was capable of producing high SPLs. The 'Blathallter' was in use in different sizes until the early 1930s, the only reference to an application of the ribbon loudspeakers and microphones is at the 1925 opening of the German Museum in München (Ehlert 2004a).

In Germany research was done by amongst others, Siemens & Halske and AEG. In 1932 all the electroacoustic research and development was transferred to Siemens affiliate Telefunken, a radiotelephony company that had been around since 1903. Ehlert (2004b) quotes an interview with a Telefunken manager who explains that all the political parties in the early 1930s used amplification systems but that they had decided not to supply the communist party with the technology, hinting at the political significance of the technology.

In the UK a company by the name of Tulsemere Manufacturing Company was formed in 1926. In 1932 the company trademarked the brand name Tannoy after 'tantalum alloy' (a metal often found in electronic components). The brand was so successful in the PA and paging markets in the UK that a paging announcement can still be referred to as a 'Tannoy' (for instance in subtitles for UK television).

1.8 Roxy Rothafel

On 19 November 1922 WEAF, WE's experimental radio station started broadcasting from the Capitol Theatre in New York. That theatre was at the time the largest motion picture theatre in the world under the direction of Samuel L. Rothafel, better known as 'Roxy'. In his book about the history of WEAF, William P. Banning (Banning 1946, p. 113) describes how Rothafel directed the elaborate floorshows that were common in larger cinemas in those days. WE engineers working at the Capitol suggested that Rothafel tried using a microphone, amplifier and a loudspeaker to address the performers on stage (whilst himself seated in the auditorium):

> Its usefulness was, of course, apparent at the first demonstration, and the delighted director gave the engineers permission to utilise an off-stage dressing-room for their testing equipment, and to install microphones at various places on the theatre's great proscenium arch to pick up the music … (ibid p. 114).

A few years later Rothafel himself expressed his enthusiasm in an architectural magazine:

> … acoustics no longer present a problem since the amplification system, with which we are now experimenting, will carry the voice and will send it perfectly almost any distance within reason, and certainly a distance greater than could be found in any theater. We have now installed a system in the Capitol Theater which permits the director to sit in a chair and speak in a natural tone of voice, even in a whisper, so that he can be heard in any corner of the theater -the booth, more than 200 feet away from him, and in any corner of the stage by the conductor and all those concerned. The orchestra of tomorrow will be quite

> different from those of today. They will be smaller for theater work, with many new instruments; but each instrument will be so amplified that the orchestra will probably exceed in "color" and volume of tone an orchestra many times its size today. (Rothafel 1925)

Rothafel, who according to Ben Hall (1961) used a megaphone before to direct the stage shows, was very pleased with this 'Voice of God', a term still in use, often with very strict rules: only the director is allowed to use the system and halt a rehearsal. On film sets directors traded in their megaphones for PA systems in order to address large crowds at mass scenes. Thompson (2002, p. 242) and Scott Eyman (1980) mention *The Hunchback of Notre Dame* (1923) and both write that such installations became commonplace after 1922. Hall, Donald Crafton (1999) and Thompson (ibid p. 615) write that from 1922 Western Electric started installing PA systems in larger theatres and WE PA systems became commercially available from the same year. Referenced by Thompson is a sales bulletin from the AT&T archives as a source for this information.[51]

1.8.1 Talkies: You Ain't Heard Nottin' Yet!

The success of the sound motion picture after the release of *The Jazz Singer* was phenomenal, in synchrony with the economic growth and optimism of the years before the Wall Street crash of 1929.[52] The four Warner brothers had joined forces with WE in 1925 to produce sound movies. *Don Juan* in 1926 had no spoken word but recorded music and sound effects. Emily Thompson writes in *Dead Rooms and Live Wires* (Thompson 1997, p. 616):

> The success of *The Jazz Singer* was such that, by 1928, virtually all the major studios had tooled up for sound production. Within a year, the motion picture

[51] Sales Bulletins T125-T790, AT&T archive

[52] Much has been written about 'the coming of sound', the transition from the silent era to the 'Talkies' (cf Fielding 1974; Evans-Cameron 1980; Gomery 1985; Chanan 1995; Abel & Altman 2001; Thompson 2004).

> industry had invested $50 million in the transformation to sound, and by 1932, 98 per cent of the motion picture theaters in America were wired for sound.[53]

James Stewart (1980) started working for 'Photophone' (the sound motion picture division of RCA) at the theatre installation and maintenance department. He lists a number of problems in relation to the conversion of all the silent movie theatres to sound picture cinema. Prior to the talkies there were no acoustic (reverberation) or noise problems for the theatres. A bit of reverberation supported the musicians accompanying the movies. Vaudeville houses were less of a problem as a consequence of the upholstered seats and drapes. But in many cinemas the combination of the low quality of the recorded sound and the poor acoustics led to very poor intelligibility. Robert Altman (1992, p. 27) writes about this problem: '… even intimate scenes recorded to give the impression of small, private spaces sounded as if they were set in cavernous public halls.' WE's results were less troubled by this problem because they used a horn loudspeaker that directed the sound more towards the audience than at the reflecting surfaces. The result was better than the 12" cone loudspeakers mounted on baffles that RCA deployed, which was, Stewart writes, 'at the borderline of acceptance for speech reproduction' (p. 40). Stewart was involved in a Westinghouse, GE and RCA study to find ways to improve the directional characteristics of the loudspeakers.

> Nothing was particularly successful until J.D. of Westinghouse went to the plant in East Pittsburgh and returned with what came to be known as a directional baffle. It was simply an exponential horn of square cross sections five feet long, mounted on a fully encased cone-type speaker. (ibid p. 41)

According to Edward Kellogg (1967 p. 184) this was in 1929, also referring to the 'directional baffles' for the GE/RCA cone-type speaker. Their primary function was to 'confine radiation within a limited angle'. He adds: 'in spite of the benefits of directive

[53] Fielding (1980, p. 20) mentions a total of 8,741 cinemas with one of 234 different types of theatre sound equipment in use; some of them based on discs that ran in sync with the movie and others based on optical sound tracks printed on the actual film. A document apparently authored at the Warner Brothers Studios in 1930 lists a total of 1,046 cinemas equipped with the Vitaphone (sound on disc) system in December 1928. See www.georgegroves.org.uk/downloads_files/History_of_Sound.pdf <viewed 6 March 2013>

baffles, in many motion picture theatres satisfactory speech reproduction was not achieved until absorption had been applied to reduce reverberation.' (ibid) (cf Olson 1932). The WE loudspeakers used for the premiere of *Don Juan* (1926) were using an improved moving coil 'receiver' named the WE555 (developed by Wente and Thuras of that company) which was attached to a huge coiled exponential horn made by Victrola (who were very experienced in building horns for phonographs). Beranek (1954 p. 16) comments:

> This horn driver unit, when used with a 10 to 15 foot long exponential horn, was so efficient that, with 2½ Watts of available audio power, a fairly creditable job was done even in large theatres in the frequency range of 100-5000 cps. I am told that the WE company received a large part of the motion picture business between 1927 and 1933 because of this unit.

The combination of this WE555 transducer and certain large wooden WE/Victrola horns survived and is still popular, particularly when used with a matching tweeter for treble frequencies. They are highly valuable items on the second hand market and replicas of both the WE555 driver and the horns are on offer on the Internet.

Loudspeaker directionality proved to be an essential element in the rapid success of the sound picture. WE, through Electrical Research Products Incorporated (ERPI) a subsidiary that focussed on the cinematic market, was initially very successful, possibly because of the head start they had using directional horns for their loudspeakers. But in the 1930s they rapidly lost ground to the competition from RCA, abandoning the movie theatre business in 1937 (Adams & Butler 1999).[54] For an analyses of the work of ERPI and its impact, see Thompson's (2004) 'Wiring the World'.

1.8.2 Radio City Music Hall

'Roxy' Rothafel had developed himself to a household name in cinema management and the production of stage shows and radio broadcast at movie houses. He was approached

[54] In addition to WE and RCA's efforts, Fox Films marketed the 'Movietone' system with technology developed by physicist Theodore Case, discussed for instance in Gomery (1985, p. 15). This system used WE transducers (cf Fielding 1967, p. 179).

by the Rockefellers to help design and manage the new entertainment facilities that were to be part of the Rockefeller centre (which was initially going to house the new Metropolitan Opera House, an idea that fell through after the 1929 Wall street crash). Roxy did not want to add sound films to his stage shows because he thought that it 'struck a discord with the musical portion of the program' (Melnick 2003, Jewell 2012, p. 58). The new Rockefeller entertainment centre was to have two venues, one for the stage shows and one cinema, which became the Radio City Music Hall (RCMH capacity 6,200) and the Radio Keith Orpheum (RKO) Roxy Theatre (capacity 3,700). Rothafel envisaged the venue to be not just for entertainment and stage shows but also 'serious' music, symphonies and opera, ultimately competing with the Metropolitan opera (ibid). Unfortunately for Rothafel, from the very beginning the stage shows were unsuccessful, as Jewell (ibid p. 59) reports: 'It quickly became obvious that the Music Hall was not going to work at all; indeed, it became a disaster unprecedented in show business history.' After a few weeks the stage shows were stopped and the venue became a regular, if very large, cinema. From the perspective of this thesis this was a very unfortunate development as the amplification technology installed at the Music Hall was the first of its kind, a giant leap in terms both of the technology and its application.

The RCMH was the first purpose built venue for electronically amplified sound and it was (actually is) as such very successful. Thompson (2002) dedicates an entire chapter to the RCMH and she starts by pointing out that because of the gradual deployment of electroacoustic technology into the soundscape of the 1920s the 'electrically generated sound in Radio City Music Hall was unremarkable' (p. 233). In a later publication Thompson (2004, p. 191) refers to this gradual process as becoming 'sound conscious'. Audiences had already accustomed themselves to telephone, radio, recording and sound motion picture. She adds that the new sound technology was applied satisfactorily because it had been 'deployed in tandem with that more traditional tool of acoustical control, sound absorbing building materials.' (ibid)[55] Ten years before the opening of the RCMH Green and Maxfield (1923) pointed out that, in order to successfully amplify sound; the acoustics of the space would have to be 'dry', ie with

[55] Carolyn Birdsall (2012, p. 182) in her book about the Nazi soundscape suggests a comparable sentiment in a footnote: 'sound technologies such as the telephone provided a specifically modern training ground for the auditory generation of subjectivity.'

minimal reverberation. In an earlier chapter of Thompson's book she looked into the development of building materials for acoustic treatment and the upcoming science and profession of acoustics.

Thompson reminds us that Americans would have first come across acoustically optimised spaces (ie made drier to accommodate electroacoustic sound) in the refurbished cinemas after 1927: 'the evolution of acoustical technologies in theatres and studios demonstrates how architectural acoustics and electroacoustics gradually merged.' (ibid p. 234)

At the RCMH the novel directional microphones (the special PB-31 ribbon microphones mentioned earlier) and the newly improved directional loudspeakers developed for the cinema theatres, came together. The directional microphones were developed specifically for the production of sound motion pictures (see Olson 1931) and the directional loudspeakers in cinemas for the reproduction of such pictures. The transducers were now used in one and the same process, sound amplification of the stage show at the RCMH. The fact that separate loudspeaker systems were in use for the reproduction of film sound and for amplification underlines that these are very different applications of electroacoustic technology. In a paper for the Society of Motion Picture Engineers (SMPE, later SMPTE with T for Television), Barton Kreuzer (1933) from the development section, Engineering Department at RCA Photophone, presented a detailed overview of the (state of the art by any means) sound technology in use at the RCMH. The film sound system consisted of three RCA drivers with 10' directional baffles and three with 5' baffles. The PA and sound reinforcement system was as follows:

> The public address and sound reinforcing system utilizes ribbon microphones, AC operated 80-watt amplifiers, and a mixer console and remote control panels, both of which are unusually flexible. The system is used, of course, to reinforce sound emanating from the stage or as a public address system that can be used, for instance, by an unseen person making announcements to the audience, and for other similar purposes. Six of the 3-foot directional baffles are used for loud speakers. These are concealed behind lighting grilles above and on either side of the proscenium arch. There are 54 microphone positions on or above the stage,

> including those on the choral stairs. The most notable of these, perhaps, are eleven positions built into the disappearing footlights and eight positions in metal boxes whose tops are grilles made flush with the floor of the orchestra elevator. There are eight positions on the light bridges above the stage.

In addition to the film and the PA system a rehearsal system was installed with three removable 3' baffle loudspeakers directed toward the stage, allowing a director (Roxy for instance) to address performers and crew. Behind the cyclorama (a theatrical semi-circular back drop) an effects system, presumably the first sub woofers[56], was installed:

> The output of the "effect" amplifier supplies two gigantic directional baffles located in a separate room behind the cyclorama at the rear of the stage. Each of these baffles has a mouth opening of 19½ by 12 feet, and is 20 feet long. The baffles terminate in four throats, each of which is supplied with sound energy by an electrodynamic cone unit. These loud speakers reproduce frequencies as low as 30 cycles per second.

As Thompson notes the reason why this venue is so important in the history of stage entertainment (and radio broadcasts) is that it was designed and built as an electroacoustic venue. Not only was it realised as a venue where sounds from stage or orchestra pit could be amplified, music could be 'piped' in from one of the adjacent radio studios.[57] The RCMH seems excessive, obsessive and over the top when seen from a perspective of the young live sound tradition. With just one new venue the practice of music amplification grew from perhaps one microphone adding a little volume to a singer (which I'll address in the next chapter) to an enormous, dedicated electroacoustic church with 54 microphone inputs, four different sound systems and perhaps foremostly, a dry acoustically treated room.

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[56] Sub woofers are a special type of large loudspeaker for the reproduction of the lowest audible frequencies, they are vital for rock, pop and dance music but also in cinemas to create explosions and low, suspense creating, drone sounds.

[57] An interesting thought in line with Wagner's orchestra hidden under the stage (for balance and dramatic reasons) but also looking ahead toward the musical 'Cats' in which the orchestra (or band) play in a room outside the theatre.

It is unlikely that this technological leap at the RCMH came from out of nowhere. Thompson (2002 p. 242) refers to an article from an AT&T in-house journal called *Erpigram* (after ERPI) in which all AT&T's motion picture efforts were brought together in the late 1920s). From a chapter called: 'Public Address, one of ERPI's Functions' Thompson quotes:

> By 1929 Roxy was using the system to manipulate the balance between the string sections of his orchestra during the performance, as well as to enhance reception by the audience throughout the vast auditorium of the Roxy theatre.

Thirty years on, Beranek writes about the RCMH in his 'Sound Systems for Opera' (Beranek 1966) paper: 'The Music Hall sound system has been successful, in part because it has been improved continually in the 33 years since the hall opened'. He then describes the 1966 system, which in approach was much the same with 58 microphones in semipermanent positions. A webpage dedicated to the RCA Photophone PB31 microphone writes (unreferenced) that they were in use for fifty years until they were discarded in the 1980s.[58]

1.9 Microphones

Because microphones for amplification technology share, for the larger part, their history with the well-researched and published history of recording, radio and telephony (Chanan 1995; Eargle 2001; Ballou & Lubin 2009; Borwick 2010) I will only briefly look at the technical development of this transducer. In particular I will look at the early 1930s when electronic amplification of music became viable, from a perspective of microphone technology. One important difference with microphones for recording or broadcast is that for public address or sound reinforcement applications microphones that are directional are (much) more suitable. Before more or less directional microphones became commercially available in 1931, in order to ensure sufficient amplification gain there

[58] http://www.coutant.org/pb31/index.html <viewed 20 March 2012>

would have to be adequate acoustical isolation from the microphone to the loudspeakers, to prevent feedback (the loud howling sound that Jensen and Pridham encountered when they first hooked up a microphone to their loudspeaker). Green and Maxfield (1923, p. 347) note on the subject:

> In the specific cases where the sound is reproduced in the same space or room in which it originates, another effect is encountered, which has generally been termed "singing," and is evidenced sufficiently great by the emission of a continuous note from the equipment.

As a consequence of the co-presence of both transducers in the same space at the same time, amplification creates a feedback loop: the sound that is picked up by a microphone leaves the loudspeaker and enters the microphone again (Blesser & Salter 2006, p. 199). At a sufficiently high amplification level (or with a more sensitive microphone) the loop can start to oscillate and cause the not unfamiliar 'ringing' or 'squealing' at a certain, often unpleasantly high, frequency.[59]

The intuitive analogy between a microphone and the human ear is not very precise; Olson in his patent for the ribbon microphone calls the device an: 'Apparatus for converting sound vibrations into electrical variations'.[61] There may be some similarity with the air in its primary function of transducing soundwaves in air into a different medium, but that is where comparison ends. a microphone lacks the ability to discriminate between sounds and sound sources, something our hearing does very well. The way (I should say ways) our ears are connected to our cognitive system are much more complex; different bioacoustic and psychoacoustic processes deal with pitch, location and loudness. For a (comprehensible) overview see for instance Dan Levitin's (2007, p. 89) *This is Your Brain On Music:*

> When I hear a car horn, air molecules impinging on my eardrum cause electrical signals to be sent to my auditory cortex. […] First, neurons in the auditory cortex

[59] The frequencies at which feedback occurs are amongst other things related to the dimensions of the space the system is in.
[61] USA Patent number: 1885001, Filing date: Mar 31, 1931, Issue date: Oct 25, 1932

> process the pitch of the sound so that I can distinguish the car horn […] A different group of neurons is activated to determine the location from which the sound came. These and other processes invoke a visual orienting response—I turn toward the sound to see what made it […]

Levitin then goes on to discuss the neurological complexities of listening to music.[62]

Before looking into the history of microphones for amplification I will briefly give some essential backgrounds on the notion of pitch and on how frequencies are used to describe sound in technical domains.

1.9.1 Pitch and Frequency

The soundwaves that humans are able to hear oscillate with a certain *periodicity*, swinging up and down once each 'period'; not unlike waves in the ocean, which is why we call them *waveforms*.[64] Pitch is what we psychoacoustically assign to periodic sounds, and pitch is dependent on a *frequency* that is strongly present in that sound, much more so in musical sound than in other sounds. Frequency refers to how often something happens, in this case the number of periods, of single vibrations that occur in one second.[65] Pitch is a phenomenon of our perception and as such less objective than frequency; for instance, some people are better at determining pitch relations than others. By way of example, recent work by Diana Deutsch (Deutsch et al. 2009), looking at the rare condition of 'perfect pitch' or 'absolute pitch', the ability to name or produce a musical note of particular pitch without the aid of a reference note, showed a correlation between languages being tone or nonetone, and the number of people with that ability.[67]

Pitch also refers to the abstractions we use in music notation. A black dot in the centre of the five well-known horizontal lines of music notation represents the note 'A' (in the common G-clef). In contemporary practice that note 'A' on an instrument is tuned

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[62] Chion (1994, p. 93) discusses the difference between the roles of the camera and microphones in cinema; where the camera is an 'active character' the microphone is excluded even 'from the spectator's *mental representation*'.
[64] Oscillations occur for instance in tensioned strings, they are triggered and keep vibrating until dying out.
[65] See also Tagg's (2013, p. 275) discussion of 'tone', ie a sound with discernable pitch.
[67] Tone languages are for instance the Eastern-Asian languages; English and most Western-European languages are nontone.

to 440 Hz. The abbreviation Hz stands for Hertz named after the German physicist Heinrich Hertz and it denominates cycles (ie periods) per second. The sounds that we can hear have a certain periodicity ranging from 50 milliseconds (mS) to 0.05mS or 20Hz to 20,000Hz (or 20 kilo Hertz: kHz):

> 20 Hz vibrates 20 times each second: 20 times 50mS equals one second.
> 20 kHz vibrates 20,000 times each second: 20,000 times 0.05mS equals one second.

Depending on the waveform, sounds that vibrate less than 20 times a second become audible as a rattle rather than as a continuous sound.[68] Sounds above 20kHz are inaudible to humans but certain animals can perceive much higher pitches.[69]

Soundwaves travel through air at a certain speed (usually 343 meters per second, but depending on environmental conditions), which means there is a relation between the frequency and the size or wavelength of a soundwave. As can be found in the table below the difference in wavelength between the lowest and highest frequencies is very big!

Frequency (*f*)	Periodicity (1/*f*)	Wavelength
20Hz	50ms	17.15 m
1kHz	10ms	0.343 m
20kHz	.05ms	0.017 mm

Table 3 Frequency and wavelengths

[68] These 'infra' or 'subsonic' sounds, with frequencies lower than 20Hz, can be, when loud enough, perceived bodily, rather than auditory. In a paper called 'Physiological effects of low frequency noise', Takahashi et al (2007) explain that due to the large size of the wavelength relative to the human body (6.8 metres or more for 50Hz), the perception is generated by the difference in atmospheric pressures between the inside and the outside of the body.

[69] 20Hz to 20kHz are figures that are often used to express the frequency 'spectrum' of our hearing, perhaps because they are easy to remember. 16Hz is a better number for the lower threshold and 15kHz for the upper. With age we lose the ability to perceive the top end of the range. The high-pitched tone that we associate with older TV-sets has a frequency of 15.7kHz young people can easily hear it, few older people can.

Pitch, frequency, periods and cycles are all abstractions that refer to the periodicity of (audible) waveforms. There are however also many sounds in which we cannot discern any pitch, these sounds have no dominant frequency. Like the waves in the ocean there is never just the one wave going up and down, there are many waves with different periodicities moving simultaneously.[70] Waveforms are complex; they are the sum of many vibrations occurring at the same time, the relations between those vibrations are essential for perceiving pitch and recognising the *timbre* of sounds.

Sounds never just appear or disappear; they have a perceivable onset or attack (a drum being struck has a very different onset than blowing a horn). This attack is part of an 'envelope' that is shaped by what causes a sound and the way it is defeated. The shape of this envelope (ie the duration of each element) is crucial for the identification of sounds.[71] A percussive sound has a very short and hard onset, a wind instrument a slow and gradual onset (see Howard & Angus 1996, p. 152).

1.9.2 Pressure and Velocity

There are many different types of microphones all differing in the way the mechanical energy (from a soundwave) is transduced to the electronic domain (carbon, condenser, dynamic, piezoelectric, ribbon etc). There are however only two ways of expressing the relation between the soundwave and the electrical response: measuring pressure and measuring velocity. The output of a pressure microphone corresponds to air-pressure variations in a soundwave; it transduces minute changes in air pressure at the diaphragm (the back of the diaphragm is isolated from the environment). The output of ribbon microphones corresponds to minute differences in the (particle) velocity resulting from a soundwave propagating in air (cf Olson 1967, p. 325). These fundamentally different methods result in different polar diagrams, of directional sensitivity with respect to frequency response; they can be omnidirectional (pressure), bidirectional (velocity or pressure gradient) or unidirectional (the two principles combined).

With regard to the 1920s many sources (Banning 1946; Beranek 1954; Klapholz 1988; Eargle 2003; Collison 2008) mention the WE 'Stretched Diaphragm Double

[70] That is why we hear the ocean as 'noise'.
[71] In sound synthesis this envelope is described as ADSR, Attack, ,Decay, Sustain and Release. See for instance Tagg (2012, p. 277).

Button' carbon microphone playing an important part for radio broadcasting, particularly for speech[72]. Those microphones were introduced in 1921 and W.C. Jones (1954) mentions that one such microphone was used for president Harding's address in Arlington that year (and in London's Wembley stadium in 1924). In their 1923 public address paper Green and Maxfield discuss the comparison between a condenser microphone (very linear frequency response but very low output, needing an amplifier very close to the diaphragm) and the carbon double button microphone (limited frequency response but a much higher output, able to drive long cables); these types were still omnidirectional.

As mentioned before in Germany Gerlach (1924) and Schottki had laid the foundation for the ribbon microphone, a very thin (two micron) metal foil suspended between the poles of a magnet. The moving air (ie by the sound waves) makes the foil interact with the magnetic field of the magnet, inducing a tiny voltage in the ribbon. As a consequence of the 'pressure gradient' the microphone is sensitive to sound arriving on both sides of the foil whereas it is insensitive to sounds arriving from the sides of the foil creating a bidirectional polar pattern. This 'figure-of-8' directional sensitivity allows for more control over which sounds are transduced and which are excluded, making them useful for amplification (but primarily for motion picture sound recording since they could be used facing away from a noise source such as the film camera).

Harry Olson at RCA improved on the work of the Germans and realised the first commercially viable ribbon microphone in 1931. He describes his work in a paper (Olson 1931, 1933) that features an image of an RCA *Photophone* PB-17A. The next model the PB-31 was specially produced in a limited edition for the Radio City Music Hall.[73] The first ribbon mike introduced commercially was the RCA model 44A, late in 1931. Olson also developed the first cardioid microphone; at this stage essentially a ribbon microphone with the ribbon split in two; one half operating as a normal ribbon and the other half, by isolating the rear of the ribbon working as a pressure microphone.[74] Combining the bi-directional ribbon and omnidirectional pressure components result in a

[72] And where long microphone cables were necessary, the carbon microphone had a much larger output than the condensers

[73] coutant.org http://www.coutant.org/pb31/index.html <viewed 8 August 2012>

[74] It was isolated by an acoustic network or 'labyrinth' approximating the impedance of an infinitely long tube (RCA 1936).

‘cardioid’ unidirectional polar pattern. This RCA model 77A was released commercially in 1936, however the sales brochure mentions the microphone being realised earlier, but considered too expensive. Both the 77 and 44 models are famous from many photographs of singers like Bing Crosby and Elvis Presley; and from television, sitting prominently (but unused) on the desks of talk show hosts such as David Letterman.

The German firm Neumann introduced the CMV-3 in 1928, a tube amplifier that looked like a bottle to which different capsules could be connected. An improved model CMV-3a and the M7 cardioid and M8 figure of eight capsules were introduced in 1932, later models of that M7 membrane became legendary such as the Neumann U47 (sometimes referred to as Telefunken U47); at the time of writing still a much sought after microphone for rock and pop recordings.

The Western Electric 618 microphone introduced in 1931 was the first dynamic (ie moving coil) microphone, which was somewhat directional at higher frequencies (Jones & Giles 1931). It was developed by Wente and Thuras at Bell Telephone Labs (BTL) from 1929-1931 (Beranek 1954; Burns 2000, p. 109).

In the late 1930s Shure introduced the Unidyne cardioid dynamic (moving coil) microphones, predecessors to the legendary Shure SM57 and 58 still ubiquitous in rock and pop amplification.

1.9.3 Recording and Microphones

The mechanical recording process was gradually improving over time; Edison introduced a better and stronger cylinder, the ‘Blue Amberol’, in 1908. It was arguably the best recording medium at that time, one of the reasons being the constant surface speed in comparison to the disc records of that era (Welch 1994, p 112). Morton (2006, p. 60) mentions the introduction of Edison’s ‘Diamond Disc’, five years later; the better quality cylinder is why Edison’s company was the last to abandon cylinders in favour of discs, which were easier to mass-produce. To demonstrate the improvement of the new discs, so called ‘tone tests’ were organised at which an audience in a Music Hall was presented with both a recording and the artist in person singing from behind a screen: ‘the audience could sometimes tell and sometimes it could not, and Edison’s team cheated a little by carefully selecting artists who could mimic the sound of their recordings’ (ibid; see also

Welch 1994, p. 105; Thompson 2002, p. 237; Blesser & Salter 2006, p 112). Sterne (2003, p. 215) also writes about these comparisons, and the way they were used as a marketing tool.

WE first developed a means of electronic recording, which allowed for the use of microphones in the recording process instead of the mechanical horn. Amplification (using AT&T's improved tubes) of the signal from the microphone allowed it to be transferred to disc mechanically (cf Olson 1967, p. 361). Using microphones (that could be mixed together) meant that musicians no longer had to gather around the recording horn. Morton (ibid p. 66) notes that: '…the radio industry had leapt ahead … much of what was needed to create the new electrical recording studios had already been pioneered in radio'. In the early 1920s the recording industry started losing ground to radio, accelerated by improvements in the latter medium, for instance by better loudspeakers (Chanan 1995, p. 39). The introduction of the microphone to the recording process allowed the recording industry to catch up with radio in terms of sound quality. The new recordings could still be played on older record players but the better sound could only be reproduced on new players with a larger horn that was able to reproduce the extended frequency range. Victor dubbed their new system 'Ortophonic' and introduced players with the same name from 1926. The players were still driven mechanically, usually by a wind-up motor, but electric models were available. It would take until the 1930s before most American households were connected to the electric grid (ibid). Electric record players that transduced the stylus' movement into an electronic signal that could be electronically amplified, or plugged into a radio receiver (using its amplifier and loudspeaker) were available soon enough but did not replace the horn phonograph until the late 1930s (Morton 2006, p. 66). The 33⅓ RPM 12" LP we still know was introduced post WWII with stereo playback becoming available in the late 1950s.

1.10 Mixing Desks

In the UK, the standard term for the device used to collect and blend or balance audio signals, either for recording, broadcast or live sound reproduction, is a

> *mixing desk or mixer. The person who operates this equipment is either a balance engineer, recording engineer or a sound operator. In the USA the device is known as a mix(ing) board or console. To add to the confusion, the operator is often known as the mixer.* (Leonard 2001, p. 66)

Mixing desk technology advanced with sound recording for the cinema, when more microphones were used simultaneously. John L. Cass (quoted in (Klapholz 1988) a RCA sound recordist mentions working with five or six microphones simultaneously from the late 1920s.[75] One very early example of a control unit for PA systems was presented in a paper about lapel microphones, developed by Jones and Bell of Bell Telephone Systems (Jones & Bell 1932). In addition to the lapel (or clip-on microphone) a control cabinet for up to five microphones is explained, now we would say a total of five input channels. This device was more a switchbox than a mixer, in making sure that only one microphone was connected to amplifier and loudspeaker at a time; no volume control was available. The control panel installed at the Radio City Music Hall in the same year, with 54 inputs channels, each with a number of controls, must have looked truly Jules-Vernian; an image of the desk can be found in Burris-Meyer and Cole (1975, p. 292).

For a long time sound engineers either adapted mixing desks for recording or developed and built their own. From the 1970s companies like Midas (ca 1970), Yamaha (ca 1972), Soundcraft (ca 1975) and Cadac (ca 1987) started developing mixing desks for the live sound branch especially. Yamaha was very early in the move to digital technology, in 1986 with the DMP-7 and ten years later with the O2R, which was meant to be a recording console (hence the 'R') but it found widespread use in live sound, particularly in theatre where 'cues' are much the same for every performance, and the ability to store and automate aspects of balance and routing was (and is) very valuable.

In theatrical lighting technology (usually found side by side with sound amplification) the introduction of a low bandwidth control standard, Digital Multiplex for 512 channels (DMX512) parameter control standard allowed for digital control of

[75] Also George Grove, who recorded the sound for the *Jazz Singer*, mentions using mixers as early as 1928. He has a website dedicated to him, which include some recorded interviews. www.georgegroves.org.uk <viewed 10 March 2013>

lighting since the mid 1980s.[76] Digital technology for live sound took a lot longer to become widely accepted, until the first decade of this century. One reason is the amount of computing power needed for high quality digital sound, and another reason is the popularity and availability of large analogue consoles that offer a familiar interface with direct control over all parameters (analogue sound mixing desks have thousands of dials, switches and buttons). One important aspect of the digital desks is that they can be smaller than the occasionally huge (and heavy) analogue desks, simply needing a smaller footprint in a venue, allowing for more tickets to be sold. The contemporary digital sound desks are somewhat smaller than the older battle ships but still nowhere near as small as the desks used for the control of theatrical lights.

The application of digital technology in live sound allows for amazing transformations and almost futuristic developments (live control over vocalists' pitch for instance), which will be discussed in chapter four.

1.11 Column Loudspeakers and Line Arrays

> *Line arrays of loudspeakers are used by sound system designers to obtain a narrow directivity response, generally in the vertical plane. This narrow response provides increased gain that is useful in venues requiring long throw or improved direct/reverberant ratios*. (Ureda 2001)

At this moment in time so called Line Array loudspeakers are close to ubiquitous in music amplification, following a steady growth since the early 1990s. The big difference over conventional loudspeakers for amplification (often horn-loaded, going back to developments of the 1920s and 30s) is that they allow for a certain amount of directivity control at higher output levels. As described earlier in this chapter directionality of loudspeakers is important to ensure sound arrives in the audience areas while minimizing acoustic reflections of walls and ceilings. Harry Olson published a paper in 1940

[76] In theatrical lighting the number of channels denotes the number of units (dimmers or related parameters) that can be controlled; on a mixing desk, apart from the number of input channels (microphones and electronic sources) the number of output channels denotes how many separate mixes can be created, for different loudspeaker systems, monitoring for performers etcetera.

outlining the theory of how a number of sound sources in a line can be combined to create a wavefront with increased directionality.[77] That theory was first applied in so called column loudspeakers that from the late 1950s were introduced in for instance churches (and can still be found in many churches), in airport lobbies and railway stations. Those early column loudspeakers, although working well for speech in reverberant acoustics, did not have the power needed to work well in music amplification. However Shure introduced their 'Vocal Master' columns in 1967 and they were rather popular for small-scale band amplification. From the late 1980s a renewed interest in the theory resulted in an approach to line source loudspeakers that were more powerful and from the 2000s nearly every pro audio brand has introduced its own take on the concept. For amplification of music in reverberant acoustics (such as classical concert halls) the technology has been very important, allowing for better results in amplified music.

1.12 To Review: History of Amplified Sound

The long acoustic history that began in reverberant caves, cathedrals and concert halls sped up in the twentieth century: from the crude early experiments of Jensen and Pridham to the electroacoustic architecture of the RCMH electronic sound amplification has borrowed (serendipitously or not) from developments in telephony, recording, radio and cinema (both sound recording and playback in cinema theatres). The extent to which knowledge and experience crossed over from sound and music recording (including film) and radio broadcast to live sound practises is an aspect that will need further study.

In order to keep this history brief I have chosen to limit it, but for a few points, to 1933 when the crucial technologies (directional microphones, amplifiers, directional loudspeakers and a certain amount of control over room acoustics) were in place. There is still a rich technological history to discover, in relation to music, in relation to the practice of concert production and the very slow (in comparison to other industries) coming of age of the live sound profession and related industries. For this thesis an

[77] Earlier work was done by Wolff and Malter (1930). But Olson's publication is usually referred to as the seminal text. For an overview see Ureda (2004).

introduction of the important technologies suffices, allowing to us to look at how the technology was and is used for music in the next chapter.

Be it on a different scale than telephony, radio and recording, amplification played a role in the reshuffling of what is public and what is private. The possibility of amplifying an intimate, close voice in a public realm, allows informal communication to operate on a different, possibly a very large scale. Franklin Roosevelt's 'Fireside chat' radio speeches are often mentioned in this context. Roosevelt started working with radio as a medium in 1929 when still governor of New York state. Chanan (1995, p. 109) remarks on the striking contrast between these radio broadcast and those of Hitler and Mussolini. Roosevelt's talks were meant to be perceived as if delivered by someone nearby, in the private sphere. David Michael Ryfe (1999) writes in a paper looking at the eight historic talks:

> Roosevelt's fireside chats were structured in both form and content by the new mode of publicness initiated by the culture industries in the 20th century. Roosevelt employed the idioms of mass culture to close the perceptual gap between him and his mass audience.

An interesting aspect is that instead of 'chats' the programs were highly scripted, crafted speeches, the novelty was the use of an intimate radio voice, an element of what is referred to as 'social distance' that will be discussed in chapters three and four.[78] Arnheim (1936, p. 76) tells of a gentlemen talking in a similar fashion, weekly on a Berlin radio station, about law and politics:

> The world became a cosy parlour where he sat and spoke at the microphone. Simple people think of the Heavenly Father rather like that: unseen yet entirely earthly, mighty in colloquialism, benevolent but with none of the overpowering sympathy of a near relative, familiar with law, omniscient and consequently rather

[78] In the USA, since the formation of the National Broadcasting Corporation (NBC) in 1926, strict rules for radio broadcast (almost always live until the mid 1930s) came in place. Adlibbing was forbidden and all content was scripted.

> ironic, unceremonious and yet commanding respect, ready with free information about the law and yet to be consulted only by roundabout means.'

Sterne (2003) coined the term 'the age of ensoniment' that brought new ways of hearing and listening, in communication and in music, resulting in what Thompson (2004) referred to as 'sound consciousness'. Similar to mechanical reproduction questions of authenticity, or perhaps a Benjaminian 'aura' arise when a local source is electronically amplified; different from radio, recording or photography the original, 'authentic' source is still present, with the causality of the sound displaced. This issue will be further analysed in chapter three.

Already Parsons' work with the Auxetophone foreshadowed the tension between new technology and the size of a workforce, a tension that had already changed the relation between work and worker since the industrial revolution and that has redefined, and keeps redefining, the performance of music. Not long ago in a pub in the Blue Mountains, I witnessed a single guitar player/singer accompanied by a laptop producing drum, bass and keyboard parts, in addition to providing lyrics to sing and the chords to play. I could not distinguish whether we were entertained by a recording or a 'live' performance, if it were not for his announcements.

2 Sources for amplification

So what did you play?

Guitar.

I mean, what kind of music.

Oh, I dunno. All kinds, I spose. Anything you could play on a verandah.

You know without electricity. Dirt Music.

As in ... soil?

Yeah. Land. Home. Country

Tim Winton *Dirt Music*

Abstract

In this second chapter I abandon the chronological and technological approach and will look at amplification from a perspective of possible sources or combinations of sources: musical instruments, electronic sources and the singing voice. The chapter also serves as a literature review of what has been written historically about the practice of music amplification. It is intended as a further introduction to this thesis, exploring amplification practices. Like the first, this chapter is focussed very much on developments in the USA, acknowledging international influence where possible. I will start by describing musical instruments that are commonly amplified, electronically or mechanically. I will then offer a brief discussion of electric, electronic instruments and music. In an analysis of 'mixed music' I will tease out some of the problems that arise with the multiplicity of sources. This is followed by a discussion of changes in vocal styles before and after the availability of electronic amplification, also covering the Broadway musical, an important practice when it comes to 'microphone singing'

2.1 Sources for this Chapter

In addition to the historical sources from the previous chapter, this chapter incorporates literature from a variety of disciplines, here brought together from the perspective of amplification. The departure point for this chapter is the difference between possible sources for amplification ie musical instruments and the human vocal apparatuses. I will use a systemic approach to instruments from Bert Bongers (2006) in a discussion of electric and electronic instruments, borrowing from the history of the electric guitar and the Stroh violin. I will also discuss electronic music based on amongst others Olson (1967) and Chadabe (1997) and additionally Glinksy's (2000) book about the Theremin which is a good resource. Emmerson's writings (2000; 2007) and a paper by Lalitte (2006) are used as a background for a discussion of practices mixing acoustic and electronic sources. The discussion of amplified voice use draws on Broadway history (Grant 2006) and a history of 'crooning' though autobiographies and biographies of Rudy Vallee and Bing Crosby, and 'classics' such as Pleasants *The Great American Singers* and Engel's *The American Musical Theatre.* John Potter's writings (1998; 2000; 2012) have been very valuable for all aspects of singing. And Bruce Johnson's (2000) *The Inaudible Music* has an excellent discussion of early microphone singing, including the emergence of amplification in Australia.

2.2 Musical Instruments as Sources for Amplification

With regard to musical instruments I will rely on the categorisation proposed by Bert Bongers (2006, p. 50; 2007). As he argues, even though the Hornborstel-Sachs organology (that looks at the way instruments actually produce sound, ie idiophones, membranophones, aerophones etcetera), was extended with the term 'electrophones' it does not adequately distinguish between electric and electronic instruments, let alone instruments utilising digital technology. Digital instruments are ultimately electronic as a consequence of the digital to analogue conversion needed to make any digitally stored sound or digital processes audible; Bongers calls those 'digital electronic'. His divisions are made according to technological stages: objects (drums); passive mechanical (reeds, horns, stringed instruments); active mechanical (church organ); electric (electric guitars and pianos); analogue electronic (Theremin, Moog Synths) and digital electronic

(Samplers, digital synthesiser such as the Yamaha DX-7). Generally, electronic technology differs from electric technology in that an electronic device can exert change on an electric signal; an electric device (dynamo, guitar pick-up, light bulb) can (merely) induce or transport a current.[1] An additional computer stage can be added; computers can run many music technology processes (recording, analysing, synthesising, spectral and dynamic processing) but again they are dependent on electronic technology to be heard.[2] The important difference between a computer and other digital technology is that it can be programmed to perform different tasks as specified in that program (the software). A contemporary example is what is known as 'live coding' where a performer writes a computer program live on stage (the code is often displayed on an overhead display and often with additionally generated visual displays); that program is executed and amended on the spot, giving the performing musician freedom to 'instantly compose', improvise and show off virtuosity in coding skills.

Most instruments combine (successive) technologies, as Bongers explains looking at the electric guitar: it is a passive mechanical instrument and the coil that picks up the vibrations of the string is electric (or mechanoelectric as coined by Olson (1967, p. 188)) and the amplifier is electronic; an external analogue or digital effects processor can be connected to further enhance (or distort) the guitar sound to the performer's taste. The reason for introducing Bongers' system is to be able to accurately distinguish between the different acoustic and electric/electronic instruments in later discussions in this thesis. From a perspective of electronic amplification a simpler division can be made identifying three types of sources:

- Acoustic sources that need a microphone to transduce its sound into an electric signal;
- Electric instruments that use electro-magnetic induction or capacitance to transduce vibrations in a (metal) sounding string or body and that can be 'directly

[1] Although not strictly musical instruments, one class could be added to include Short's and Parsons' devices that use pressurised air.
[2] Bongers does justice to the Italian futurists by not forgetting the 'Intonarumori' which he classifies as electro-mechanical.

injected' (DI, not needing a microphone) into an instrument amplifier or sound system;

- Playback and sound synthesis devices that output an electronic signal rather than mechanical vibrations and therefore do not need a transducer at all. To be sure, digital sound equipment ultimately outputs electronic signals.

2.3 Instruments Using Mechanical Amplification

There is one additional category of mechanical amplification that I will briefly discuss. Apart from Charles Parsons' Auxeto-instruments there are a few examples of instruments adding phonograph-like horns to direct the sound towards the listener. The most famous and long-lived instrumental application of a 'magnifying' horn is the Stroh violin. The history of this (and similar) instruments has been researched in detail by Alison Rabinovici (2005) and has been the subject of a paper by Julian Pilling (1975). John Matthias Augustus Stroh was a German watch and clock maker who moved to London in 1851 where he worked for Charles Wheatstone (the inventor who is often credited with coming up with the word 'Microphone'). For the Postal Telegraph Department he built a phonograph after Edison's plans in 1878, according to both Pilling and Rabinovici a possible source for his interest in recording technology. At a closer look Rabinovici suggests however that Stroh may have been working on the mechanically amplified violin before working with the phonograph (ibid 104), ie not with music recording in mind at all. In 1899 he filed a patent for his instrument, which as we can read in Pilling: 'was conceived as a means to increase the amplitude of sound of the violin for the purpose of acoustical recording...' The Stroh was successful, not just for recording but also for performance:

> Later the instruments came to be widely used during the 1920s and 30s in pier bands and dance orchestras as a last valiant effort to prevent the saxophone from usurping from the fiddle the position of leader of the general dance. (ibid)

As pointed out by Rabinovici (ibid p. 101) but also in a book about the history of the Rickenbacker guitar brand (Smith 1987, p. 2) the Stroh particularly influenced George

Beauchamp, a violinist and guitarist who was looking to create a louder guitar. He approached a violin repairman by the name of John Dopyera and together they developed the Tri-cone guitar with three layers of resonating aluminium sheeting. A very early prototype of a guitar with a phonograph horn was a failure:

> It sat on a stand and had a wild-looking walnut body with a Victrola horn attached to the bottom. According to one report, Beauchamp played this instrument in vaudeville for a short period, although it was a disappointing failure.[4] (ibid p. 2)

The aluminium resonators mechanically amplified the sound from the guitar's bridge not unlike the small mica disc reproducing the vibration of the needle in a Victrola phonograph. Beauchamp would move on to developing electric guitars (most notably the 'Frying Pan' electric guitar with Rickenbacker) and violins, Dopyera would become famous for the so-called 'Dobro' guitars (cf Waksman p. 284).[6] Several more references to mechanically amplified instruments can be found: singer Rudy Vallee (1975) mentioned using megaphone horns on saxophones and acoustic guitars. It is possible he was referring to a Tri-con or Dobro guitar with a mechanical resonator. There is a record of Bill Rank playing trombone with the aid of a megaphone on a Paul Whiteman recording from 1928.[7] Howard Weiner (2009) in a book about historic brass tradition mentions the existence of two megaphones at the 'Spiegle' Willcox Archive at SUNY Cortland. Newell Lynn Willcox was a trombone player with the Jean Goldkette orchestra:

> I learned that from Sammy Lewis, one of Whiteman's trombone players, while I was working at the Rendezvous nightclub in New York with the Collegians. After our job, we'd go over to hear them play and he had a megaphone rigged to a birdcage holder and it seemed to improve his sound. I put together the same rig, but it was too much to carry around. I still have that old megaphone ... even

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[4] 'Victrola' was the name branded by the Victor Talking Machine Company for phonograph players with an internal horn. Victrolas were sold from 1905. The horn instead of facing up was folded down into the cabinet with a door that allowed for volume control.

[6] Dobro stood for Dopyera Brothers, also meaning 'good' in their native Slovak language.

[7] 'Oh! You Have No Idea', (Ponce-Dougherty. arr: Challis), 78 RPM May 23, 1928 Columbia W146327-2 Paul Whiteman and his Orchestra, solos: Rank, tb-with megaphone.

> though it's got holes in it now. Eventually I just balanced it on my toes to keep it up off the floor. I didn't blow into it directly, into the small end. I'd just put a little piece of the bell up there and I'd get the most marvellous, big sound! But it was cumbersome (Tarby 1998, pp. 9-11).

According to Weiner, Spiegle played with the Collegians from 1923-25, suggesting an era for this episode. Johnson (2000, p. 90) describes an advertisement in the *Australian Music Maker & Dance Band Magazine* (November 1933) for a megaphone dedicated to be used with a clarinet, called the 'claritone'; the same magazine features an account of using a megaphone to support trombone solos.

2.4 Acoustic Instruments

The amplification of acoustic sources with the aid of transducers and amplifiers lies at the heart of this thesis. In this overview one key work, or rather the interpretation of that work is discussed. Performer, and later in live composer, David Tudor performed many of John Cage's works (cf Collins 2004, Pritchett 2004). About his interpretation (or realisation) of Cage's *Variations II* (1961)[8] Pritchett (ibid) states: 'As Tudor indicates in his notes regarding the realization, the amplified piano is not just a piano that happens to be amplified…' Tudor conceives the amplified piano as an electronic instrument, greater than the sum of the parts (piano and electroacoustic amplification). Tudor used a number of different transducers to amplify the piano: microphones, contact microphones (discussed in the next section) and 'phonograph cartridges'; the latter, normally used to transduce the inscriptions in a record's grooves to an electronic signal were a recurring element of Cage's imaginative instrumentarium.[9] Pritchett (ibid) continues:

> These cartridges could be used both as amplification devices and as ways to activate the instrument: Tudor moved them among and along the strings of the

[8] Cage's *Variations II* (1961), parts to be prepared from the score, for any number of players, using any sound-producing means. For a discussion of the – fascinating – multi dimensional graphic score see Pritchett (2004).

[9] Cage's *Cartridge Music* (1960), for amplified small sounds; also amplified piano or cymbal; any number of players and loudspeakers; parts to be prepared from score by performers.

> piano, sometimes letting them just sit on top of the strings, vibrating freely with them. The signals from these various microphones were mixed together, amplified, and played through speakers in the same space as the piano.

With the piano's sustain pedal forced down, the strings are allowed to resonate freely, along with ('sympathetic' to) the vibrations coming from the loudspeakers and the amplified sounds feeding back into the loudspeakers, the instrument (piano and amplification) now comprises a number of feedback loops. Those loops extend the instrument even further, incorporating the acoustic conditions of the performance space, but also making the instrument '… so complex that its behavior can never be totally predicted: the amplification of the piano made it, to some degree, an uncontrollable instrument' (ibid).

2.5 Electric Instruments

The history of electric and electronic instruments pre-dates the electronic amplification of traditional instruments, with the directional microphone only becoming available in the 1930s. It has been suggested that microphones were being used to amplify guitars, which is where I will start this discussion. But first, the electric guitar, and its several famous inventors; most notably Rickenbacker (with Beauchamp), Leo Fender and Les Paul. André Millard (2004, p. 41) points out that the origin of the history is clouded, but that it represents an important marketing tool for brands such as Gibson (Les Paul), Fender and Rickenbacker. In the history of the Rickenbacker brand (Smith 1987, p. 9) we can read that Beauchamp experimented with amplifying guitars as early as 1925, putting together a small PA system (unfortunately unspecified), and used a microphone first in front of the guitar and later with the carbon mounted on the guitar, anticipating the piezoelectric pick up I will discuss later. Besides Beauchamp (a vaudeville musician) there are several examples of musicians experimenting with amplifying their guitars; the acoustic guitars were not loud enough for the modern jazz bands, let alone to position it as a 'lead' instrument, writes Steve Waksman (2003, p. 284). Eddie Durham originally played trombone in Jimmie Lunceford's band and guitar for a hobby. He experimented with resonators and amplification: 'Lunceford would move a microphone close to the sound

hole on the guitar to amplify the effect of the resonator' (cf Savage 1983, p. 48). Waksman (ibid p. 285) mentions the Gibson 1936 ES-150 model, which was taken up by two prominent musicians: the same Eddie Durham (who had moved on from Lunceford's to Count Basie's band) and jazz guitarist Charlie Christian. These two players brought the electric guitar to 'public prominence' (ibid). Before acquiring an electric guitar Christian used to play with a microphone between his knees (Boyd 1998, p. 202) or, in 1936, strapped to his guitar with elastic bands (Govenar 2008, p. 79) allowing him to project using a venue's PA system. The early models were electrified versions of acoustic guitars, Waksman (ibid p. 285) comments:

> … in the minds of their designers these earliest electric instruments fulfilled a predominantly pragmatic function, which was to make the guitar louder and thus more audible in the changing circumstances of professional performance.

Semi-acoustic guitars are still in use often by jazz guitarists; acoustic guitars with steel strings (as opposed to classic or Spanish guitars with nylon strings)[10] often have a transducer built in, ready to 'plug in' even when playing 'unplugged'. In the early 1940s, Les Paul and Paul Bigsby, a luthier from California, started working on a 'solid body' guitar, essentially a plank of wood with six strings and an electric pick up.[12] Commercial development had to wait until after WWII; in 1950 Fender introduced the 'Broadcaster' (later the 'Telecaster') and in 1952 Gibson introduced the *Les Paul* model. But the use of the guitar, the way guitarists individualised their sound proved more important for the development of 20th century guitar playing than the design and material of the instrument. As demonstrated by Jack White (of 'The White Stripes' fame) in the opening scene of the documentary film *It Might Get Loud* (Guggenheim 2008) a metal string on a plank, tensioned by an empty bottle (a Coca Cola cameo) and an electric guitar element suffice; bringing to mind Pythagoras' earliest harmonic experiments on a monochord.

As pointed out earlier, even though electric guitars (and electric pianos) usually contain (some) electronic circuitry, the way the sounds are transduced from mechanical

[10] Nylon strings began replacing the traditional gut-strings after WWII (cf Turnbull 1992, p. 79).
[12] Harald Bode (1984), citing an interview he had with the luthier, writes that Les Paul started working on a solid body model as early as 1927.

vibrations to the electric domain is what differentiates them.[13] Different from electronic synthesizers that generate (synthesised) sounds 'from scratch'; an electric guitar like its acoustic counterparts, actually creates mechanical vibrations when played. Those vibrations are transduced in a pick-up or element that resides close to the bridge of the guitar, but are also audible, albeit very quiet due to the lack of a resonating sounding box. The same goes for the several electric keyboard instruments, such as the Wurlitzer piano (famous from the Supertramp-sound),[14] Fender Rhodes piano,[15] Hohner Clavinet (made famous by Stevie Wonder's funky licks and riffs)[16] and Yamaha CP60/70/80 pianos. Those last instruments actually have (short) strings instead of solid rods and reeds. All these instruments have traditional keyboards, but the mechanical differences have a big influence on the relation between playing action and timbre. In terms of amplification these instruments usually rely on their own amplifier or combination of amplifier and loudspeaker in the same box, usually referred to as a guitar amplifier (even when used for an electric piano). In addition the signal can be 'Direct Injected' into a recording or amplification system, which implies the sound of the instrument (the 'dry' sound) is picked up before it reaches the guitar amplifier.

2.5.1 Pick Up Elements, Contact Microphones

One distinctly different category of transducers does not transduce vibrations in air but vibrations in solid materials to electric signals. Phonograph cartridges were mentioned earlier, for a discussion see for instance Olson (1967, p 360). Contact or piezoelectric microphones are attached to the body of a musical instrument or other sound generator. Piezoelectricity is the ability of specific materials to produce a voltage when pressurised, converting vibrations to electricity. These materials are often crystals; hence the older name crystal microphones that were in use in the vacuum tube era as a cheap

[13] Olson (1967, p 187) describes two transduction principles for electric pianos, electromagnetic (Fender Rhodes) and capacitive (Wurlitzer) using an electrostatic transducer: the electrical charge across the reed and the fixed electrode is constant; a change in the distance between reed and electrode changes the capacitance producing an alternating voltage.
[14] The introduction of for instance 'Breakfast in America' (1979).
[15] Prominent on for instance Chick Corea's *Crystal Silence* (1972).
[16] For instance the song 'Superstitious' (1973), which has many layers of clavinet (and guitar) riffs creating the groove.

microphone. Piezoelectric pick up elements are very common for the amplification of double basses (usually with their own dedicated amp).

2.5.2 Distortion; Intentional Colouration

In some styles the feedback loop that can be created between the instrument and the amplifier (at specific levels, when the guitar is held close to the amplifier the sound waves from the amplifier will feed back into the vibrating strings) is crucial, featuring prominently in Jimi Hendrix's work.[17] The majestic weeping and howling of the thus extended guitar sound endows, according to Andrew Blake (quoted in Chanan 1994, p. 257), the guitarist with a feeling of power: 'heavy metal fans will describe their feelings of identification with this demonstration of musical power'.

By saturating the input of the guitar amplifier the guitar sound can be distorted, making the timbre of the guitar tone very dissonant.[18] A famous early example can be heard on the Beatles' song 'Revolution' the B-side to the single 'Hey Jude', and again in Jimi Hendrix's sound. It has since become an essential and expressive sonic modification for rock guitar; and is not limited to the guitar. The players of the Kronos string quartet distort the sounds of their instruments on a recording of Jimi Hendrix's classic 'Purple Haze' (1985); Gavin Bryars' music for '2', a La La La Human Steps performance,[20] was written for two amplified and distorted harpsichords (bringing to mind Tori Amos' usage of distorted harpsichord on her album *Boys for Pele* (1996).

For guitarists the choice of amplifier (brand, age, using tubes or transistor components, and in and output settings) is essential and an important part of individualisation of the guitar sound. Antoine Hennion (1997, p. 427) writes in a discussion of the performativity of rock: 'The amp is part of the electric guitar; over-load is a common language.' Early guitar amplifiers were relatively sensitive and would often produce distortion; Waksman (2003) mentions trying to play louder (overcoming noisy

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[17] Feedback, 're-injection' was first described by the Danish researcher Abalson Larsen in 1871, it is sometimes called the Larsen effect. See (Augoyard & Torgue 2005, p. 46 and 65).

[18] Augoyard and Torgue (2005, p. 39) write in *Sonic Experience*: "Distortion manifests itself as an electroacoustic effect, either in an involuntary manner in the electrophonic chain, when saturation is produced during amplification, or as a specific additive intended to voluntarily transform the sound of an instrument such as an electric guitar."

[20] Bryars, Gavin, 1995, "2" for Dance performance, choreographer Edouard Lock/ La La La Human Steps. Instrumentation: 2 amplified harpsichords. First Performance: Theatre de la Ville, Paris April 29th 1995.

clubs) and recording with damaged amplifiers (one way of creating a distorted, aggressive sound) as early examples of individualising a performer's sound. English amplifier legend Jim Marshall (1923-2012) was credited with being the 'Father of Loud' developing amps for the likes of Pete Townshend and Eric Clapton (Hickling 2012). Stacks of Marshall cabinets are still a prerequisite in the backline of any serious rock band.

In addition to choosing (combinations of) amplifiers, electric guitarists can add effect processors to their setup (often in the form of foot pedals) to further blend, distort, enhance, echo or compress their 'own sound'. The significance of these additions is very well demonstrated by guitarist 'The Edge' of Irish rock band 'U2' in the documentary *It Might Get Loud*. He is filmed playing a riff of one of the band's hits; first using all the effects processing that 'makes' the sound and arrangement for the song and then playing that same riff 'dry', sounding nothing like the foundation of a best selling rock hit at all.

Similar to the electronic effects processors guitarists use to individualise and extend their sonic expressiveness, the output of electric pianos can be modified; a good example is the use of ring modulators and 'wah-wah' pedals in the early Miles Davis jazz rock records with keyboardists such as Keith Jarrett, Herbie Hancock, Chick Corea and Joe Zawinul.[22] For more contemporary examples players such as John Medewski and the late Esbjörn Svensson come to mind. Similar variations were realised using the (electric) output of Hammond Organs or the electronic combo organs such as the Farfisa or the Gibson G101.[23] Besides the option of using a 'dry sound' often in recording and amplification it is common to pick up the sound using a microphone in front of the guitar amplifier to ensure that possible effects and the musician's personal preferences in terms of timbre and processing are included. With bass guitars this is no different but usually the microphone signal is used in conjunction with a 'dry' signal because the (usually directional) microphone's frequency response is inadequate to pick up the crucial lowest sounds.

[22] A wah-wah pedal filters the output in relation to position of the user's foot on a pedal not unlike the gas pedal found in a car (cf Bode 1984). A pumping action creates the wah-wah sound, which can be found on many James Brown' records; hence his guitarist's nickname: Wah-Wah Watson.
[23] Notably in The Doors' 'Light my fire'.

Given all the different options that individual guitarists (and other instrumentalists) have, Windsor (2000, p. 29) comments: 'Although electronic transformation is very much a part of its identity and playing styles differ considerably, it is generally an easily identifiable instrument.' Theodore Gracyk (1996, p. 120) writes in his *Rhythm and Noise* that (again for electric guitarists): 'The process of amplification is essential to their expressive manipulation'. But a choice in terms of colouration and other external processes (reverberation, echo) comes to all electric performers these days, a violinist playing on an electric violin or an acoustic instrument with a pick-up has the same choices and options of 'sonic personalisation' as any guitarist. An interesting aspect from a perspective of amplified sound is that in these cases control over many of the sonic parameters is in the hands of the performer, and much less so in the hands of the person at the mixing desk.

There is another aspect of control to the use of guitar amplifiers (whether for a guitar or a piano or a violin); to achieve a certain 'sound' some guitarists insist on using their guitar amp set to the maximum level.[24] With the amplifier on stage aimed at the audience and the mixing desk, in smaller venues this is often the minimal level of amplification, meaning that everything else has to be amplified in balance with that one guitar amplifier. Towards the sides of the venue and out of range of the guitar amp (often rather directional for the mid and treble frequencies so prominent in an electric guitar sound) will as a consequence appear to be out of balance. Better practice has the guitar amp on an angle directed at the guitar player (who will consequently think the better of running it at the maximum level) away from the audience. Other options are using a remote guitar amp not audible on stage (the truck is often a good place), the signal picked up by a microphone can be fed into the guitarist's monitoring system creating a much more balanced sound both on stage and in the venue.[25]

[24] This is why in the faux 'rockumentary' *This is Spinal Tap* (Reiner 1984) an amp is presented that can be set to a maximum volume of 11 instead of 10.

[25] Rumour has it that some legendary rock bands, with large stacks of guitar amps on stage use this approach; the amplifier used remotely does not even have to be of the same brand as the ones featured prominently on stage.

2.6 Electronic Instruments

From electric musical instruments I will move on to electronic instruments that use electronic components to generate sound. For the subject of this thesis the important difference is that, because of the electronic output no microphone or other transduction is needed. Apart from Thadeus Cahill's famous 'Telharmonium' or 'Dynamophone' (1897-1906),[26] usually considered the first electronic instrument, Michael Chanan (1994, p. 254/5) in a chapter called *Musica Practica Electrified* lists an impressive number of early electronic instruments: Aetherophon, Couplex Organ, Electrochord, Electronde, Emicon, Hellertion, Klaviatur Sphaerophone, Magnetton, Ondes Martenot, Ondes Musicales, Orgatron, Phototone, Pianotron, Radio-Synthetic Organ, Rangertone, Superpiano, Theremin and Wave Organ. Most of these impressive sounding devices remain in museums, but for instance the Ondes Martenot and the Theremin are still used in musical performances. Lev (Leon) Sergeyevich Termen's instrument the Theremin (or Termenvox, first realised in 1920) was famously used in some post WWII science fiction movies and numerous pop records.[27] Musician Maurice Martenot created the Ondes Martenot (1928), which synthesised sound in a similar same way as the Theremin.[28] Composers such as Olivier Messiaen, Arthur Honegger and Darius Milhaud wrote works for the instrument cementing its place in the repertoire.

The electric and electronic instruments of the first thirty years of the 20th century explored different ways of sound generation. For instance Cahill's Telharmonium used mechanically driven dynamos; Laurens Hammond's 1934 organ used the same principle with metal tone wheels rotating in front of magnetic pick-ups that induce the electric sound wave (see Bode 1984), in Bongers' system both would be classified as electric instruments. Theremin's and Martenot's devices used vacuum tube oscillators to generate

[26] The spelling of Telharmonium varies with one or two l's.

[27] Bernard Hermann's work is a good example, in particular *The Day the Earth Stood Still* (1951) directed by Robert Wise. The song 'Good Vibrations' *from* The Beach Boys' album *Pet Sounds* (1966) is often mentioned in relation to Theremin use. However, the electronic instrument used for the intro of that song is a similar sounding instrument called the Electro-Theremin or Tannerin, after trombonist Bob Tanner. See www.electrotheremin.com/ <viewed 8 March 2013>

[28] Although the interfaces of the instruments are very different, the electronic principle used to synthesise sound in both devices was based on the principle of 'Beat Frequency' or 'Heterodyning'. This technology, invented by Canadian radio-pioneer Robert Fessenden in the early 19th century, mixes the outputs of a fixed and a variable oscillator (the frequency of which is controlled by the interface) to synthesise the desired sound (cf Salter 2010, p. 186).

sound. Lee De Forest had worked on that principle as early as 1915 proposing an instrument called the 'Audion Piano' but that never became a commercial product (Glinsky 2000, p. 80). Important in this context is that in order for the sound of Theremins and Ondes Martenot to be heard they had to be connected to a loudspeaker. The simple fact that no microphone was needed to amplify these electronic instruments made them much more likely candidates than the human voice or an acoustic instrument to perform –amplified electronically, at concerts in the 1920s (as I argued in the previous chapter the directional microphone became available only in the 1930s). Theremin demonstrated his instrument on numerous occasions in Germany, France and England but predominantly in the US from 1927 until well into the thirties.[29] He left the USA in 1938 in suspicious circumstances, adding allegations of espionage to commercial debts, related in detail by Albert Glinsky (2000) in his Theremin biography *Ether Music and Espionage*. The Theremin demonstrations ranged from small gatherings featuring the instrument with piano accompaniment to full concerts at Carnegie hall. The loudspeakers Theremin used proved up to the task of filling a concert hall, and even more, judging from two outdoor concerts in 1928. The first one took place at the Stadium on Coney Island. It was organised with socialist propaganda in mind, which kept it out of the big New York newspapers (ibid p. 88). A second big concert took place at the Lewisohn's Stadium (an amphitheatre) also in New York, with the New York Philharmonic Orchestra.[30] Theremin completed a quartet of electronic instruments 'approximating the ranges of violin, viola, cello and double bass.' (ibid p. 89). They performed classical and romantic symphonic repertoire before an audience of 12,000. The *New York Times* reported: 'The loud, full tones, with a radio sound similar to a movie theatre Vitaphone, easily overwhelmed the orchestra at times'. Already several years before Theremin performed with the Leningrad Philharmonic[31]; Glinsky (ibid p. 35) writes: 'With the evolution of the loudspeaker, Lev (sic) was able to unleash limitless dynamic range.' The Theremin features briefly elsewhere in the amplified music narrative when early in

[29] In the US Theremin was confronted by a patent claim from one Frank Miller. Glinsky (ibid p. 78) mentions a newspaper article that refers to Theremin's work as 'Bootleg' music.
[30] August 27, 1928, New York Philharmonic Orchestra conducted by Van Hoogstraten; Rachmaninoff's 'Vocalise', Mozart's 'Ave Verum', Saint-Saen's 'Swan' and Handel's largo from the opera *Xerxes.*
[31] May 2, 1924, Leningrad Philharmonic conducted by V. Dranischnikov; the first original work 'A Symphony Mystery' for 'Thereminvox' by A. Filippovich Pashchenko, with the inventor (who was also a talented cellist) as soloist.

January 1930 Theremin player and ambassador Lennington Heppe Shewell performed with radio 'crooner' Rudy Vallee in a broadcast from the 'Villa Vallee' (ibid p. 113).

The conductor Leopold Stokowski was, like his British colleague Henry Wood, 'perennially curious about new music trends' and a great driving force behind raising the bar for the quality of recorded and broadcast music (cf Stokowski 1932).[32] A reaction quoted by Glinsky (ibid p. 125) of contemporary critic and composer Nicolas Slonimsky to a performance that used the extra low notes on the Theremin: 'the infrasonic vibrations were so powerful that they hit the stomach physically, causing near-nausea in the double bass section.'[34]

Theremin's loudspeakers were of a particular design that Glinsky refers to as triangular but often in images they look like a diamond shape, standing on a two legged stand, each leg attached to a side of the diamond. A very interesting feature of Theremin's approach is that on occasions several of his instruments were performed in an ensemble. Each of the instruments was made audible with its own loudspeaker, which is different from what usually happens in contemporary practice where all sources are combined (mixed) to the same loudspeaker (system). At a concert in Carnegie Hall on April 1st, 1932, as many as sixteen performers billed as 'The Theremin Electrical Symphony Orchestra' played in different formations. The instrumentarium was now extended with a keyboard Theremin with vastly more possibilities regarding timbre and envelope (ibid p. 145; Holmes 2008, p. 22). [36]

Martenot's 'Ondes Martenot' could be perceived as an competitor to the Theremin; it was first presented to the public in 1928 five months after Theremin demonstrated his instrument in Paris. [38] On December 16th Stokowski conducted the Philadelphia orchestra at Carnegie Hall featuring the Ondes Martenot in works by Buxtehude, Mozart and a dedicated work by Dimitri Levidis.[39] Edgar Varèse, in 1929 for

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[32] Stokowski worked with the Theremin fingerboard (cello) instrument a variation off the instrument using a different interface but the same synthesis principle. For a description see for instance Holmes (2008, p. 23).

[34] Slonimsky attracted some cult fame later in life for naming his cat 'Grody-to-the-max' a phrase he learned from Moon Unit Zappa, daughter of Frank Zappa with whom he became friends later in life.

[36] Glinsky (p. 145) provides us with some data considering the loudspeakers for the keyboard instrument: 100 Watts playing through six 12-inch speakers.

[38] The two inventors had met each other in 1923; both were talented cellists and both worked in technical roles in WWI, Martenot in telegraphy and Theremin in radio and early TV research.

[39] *Poème Symphonique* the first work written for the Ondes Martenot in 1928.

a work called *Amériques* changed the part initially conceived for a mechanical siren to a part for Ondes Martenot. In 1934, in New York a work *Ecuatorial* by Varèse with two specially built Theremin models was performed in the New York Town Hall conducted by Slonimsky. When the score was published later however the composer opted to prescribe two Ondes Martinots instead (ibid p. 157).

Not unlike the iconic diamond loudspeakers that Theremin designed, the Ondes Martenot came with an 'ensemble' of diffusers or loudspeakers that was extended over time:

> …a principal diffuser (a traditional loudspeaker), a *résonance* diffuser (two possibilities : one originally named *palme* which is a loudspeaker in the shape of a flame, whose tuned strings, placed on a resonance chamber allow the sound to go on, vibrating by sympathy; and another one, more recent, named *résonance* which is composed of springs and whose effect is the same but louder) and the *metallique* (a gong set in vibration by an engine, the metal replacing the membrane of the loudspeaker, which creates a metal sound halo at a precise pitch). (cf Bloch 2008)

The prominent design of Theremin's and Martenot's loudspeakers emphasises how the loudspeakers became important as artefact, as an object of interest by themselves in addition to their function of sound generator. The act of making music received new visual elements, not just in new musical instruments with new shapes, but also the loudspeaker that has now become ubiquitous.

2.6.1 Electronic Music, Post WWII

Research and experimentation with electronic music gained a renewed interest after WWII, which, similar to WWI, brought huge leaps in science and technological development. Interestingly enough Friedrich Kittler (1999, p. 96) writes that the West Deutsche Rundfunk (WDR)[40] electronic music studio (from 1952) was equipped with generators and filters made from discarded US army equipment: 'The entertainment

[40] In Cologne, called NWDR with the'N' for North, until a reorganisation in 1955.

industry is, in any conceivable sense of the word, an abuse of army equipment'. An overview of post-war electronic music practice is given in Joel Chadabe's (1997) *Electric sound*. Apart from the developments in Paris (Pierre Schaeffer ao), Cologne (Werner Meyer-Eppler, Stockhausen ao), Tokyo (Toru Takemitsu ao) and Milan (Luciano Berio and Bruno Maderna ao), he refers to several occasions in New York in the 1950s (ibid p. 44), where electronic music played an important role. In the different cities distinctly different approaches took shape, still traceable in electronic music today. Not always mentioned in this context is the work of Daphne Oram, who worked at the BBC's 'Radiophonic' workshop (1958-98 famous for their work on BBC TV series *Dr. Who*) during its first two years. Oram left the BBC and continued experimenting with electronic sound synthesis, creating the 'Oramics' that allowed her to 'draw sounds' on optical 35mm film (cf Niebur 2010; Oram 1972; Worby 2008).

Olson in his 1967 book *Music, Physics and Engineering* starts his chapter about sound synthesis by explaining that there are an infinite number of ways to generate electronic sounds, also referring to the different geographical hot spots. He mentions 'Musique concrete' (France) Electronic Music (Germany, Holland, Italy, Japan) and Tape-Music at Columbia University: 'The difference in the various schools exists in the specific approach that is employed to carry out the process.' (ibid p. 411). Olson goes on to describe the RCA Electronic Music Synthesizer from 1952/5 that he developed with Herbert Belar (Olson & Belar 1955). The mark II version of that machine was installed at the newly founded Columbia-Princeton Electronic Music Center in 1959.

Bob Moog (a great admirer of Theremin, he tells us in the introduction to Glinsky's Theremin biography) started off selling Theremins and do-it-yourself Theremin kits from his student pad to pay for his studies in the 1960s. He came in touch with Herbert Deutsch, a music professor and jazz musician who had bought one of his kits and from 1964 they worked together on ideas for the first Moog synthesizer. An early version of Moog's very successful synths was used in a performance by Cage and Merce Cunningham, 'Variations no. V', at the Lincoln Center in 1965. Later in the 1960s rock and pop bands quickly adapted the Moog and other synthesisers (Donald Buchla presented what was to become his '100' modular synthesiser in 1963). With early examples being 'Reflections' by Diana Ross & the Supremes (July 1967); The Doors

album *Strange Days* (September 1967); *Pisces, Aquarius, Capricorn, & Jones, Ltd*. by The Monkees, (November 1967); and *Their Satanic Majesties Reques*t by The Rolling Stones (December 1967). And in 1968 Wendy Carlos' rendition of J.S. Bach's works on his famous album *Switched on Bach* saw the light of day, bringing horror to the classical music lover, which over time (hopefully) morphed into amusement (and perhaps reflection).

2.6.2 Digital Instruments

Because it was programmable the Olson-Belar synthesiser pre-echoes the later computer systems, even though it used analogue electronic sound generation. Rather than what we envisage now when talking about synthesisers (ie a Yamaha DX-7 or a Roland Juno-60) it had no music keyboard but a punch card reader that served as an input device. A dataset (in a way a score) was created using a punched paper record containing pitch and timbre data. It was 'fed' into the system and the work was recorded on multi track tape recorders that ran in sync with the system. In 1957 Max Matthews at Bell Labs created the first computer synthesis program 'MUSIC' that generated sound, and allowed for composition in the digital domain (relying on an electronic analogue to digital (AD) converter to create audible sound) (Matthews 1961).[41] Whereas the early computers that ran composition and sound generation software would spend a whole night crunching numbers for a few bars of music, today we can choose from a wide range of sound applications that allow us to organise, generate, process and record sound on our personal computers, laptops, tablets or smartphones. A contemporary example of such an application is called Max/MSP (the first part of its name referring to Max Matthews), which is a commercial product; a similar tool named Pure Date (or PD) is available in the public domain.

The modular synthesisers, the physical boxes that used to fill up a studio and the compact units with built in keyboard are still revered very highly by fans of classic analogue technology, along the lines of the popularity of tube amplifiers. Many such users choose to mix analogue and digital sources, often attributing specific authentic

[41] In Melbourne from as early as 1951 a computer used its 'hooter' loudspeaker (to signal when a task was done or an alarm) to play simple melodies (cf Doornbusch 2004).

qualities older 'classic' analogue gear. Other users are less bothered with working entirely in the digital domain and access the same devices as emulations, provided as 'plug-ins' to Digital Audio Workstation (DAW) software such as Pro Tools, Logic or Live.

Glinsky (ibid p. 297) mentions an event in the summer of 1969 at the Museum of Modern Art in New York with live synthesiser music, organised by synthesiser pioneer Robert (Bob) Moog. A group led by Chris Swanson with John McLaughlin, Hank Jones and others 'went into the free-form stuff' and as remembered by Herb Deutsch: 'they were in the middle of some wild free-form thing, and somebody kicked out the plug which was the main power…. suddenly there was dead silence.' The question: "what happens when the power fails?" is obviously an important one when looking at electronically amplified sound sources. The sources (instruments and singers) that need a microphone for transduction may still be audible, but electronic instruments and playback devices will stop working all together. In the next paragraph I will discuss practices of music that mix electronic sources with acoustic sources, using microphones to amplify the latter, or not.

2.7 Mixed Music

Combining electronic sources, whether pre-recorded or actuated in real time, with acoustic instruments is often referred to as 'Mixed Music'. A very early example of the use of pre-recorded material is mentioned by Roland Gelatt (1965, p. 234): a 1924 symphonic poem by composer Ottorino Resphigi called *Pines of Rome.*[42] It needed a nightingale, and conductor Arturo Toscanini had one recorded and played back against harps and strings; Chadabe (1997, p. 23) refers to it as the sweetest of 'found sound'. Unfortunately none of the sources mention how the bird's song was recorded, mechanically or electronically.

Playback of pre-recorded material is commonly electronic but there are examples from the 1920s of what Katz (2004, p. 117) refers to as 'Grammophonmusik' in which mechanical record players were used. In 1926 Hansjoerg Dammert issued a call for a new

[42] *Pini di* Roma together with *Fontane di Roma* and *Feste Romane*, loosely referred to as Respighi's 'Roman trilogy'. Each part was inspired by pine trees in different locations in Rome.

type of concert music 'the concerto for phonograph with the accompaniment of 'real' instruments'. Katz (ibid p. 116) quotes musicologist H.H. Stuckenschmidt who in 1927 wrote an essay for the American journal *Modern Music*:

> The artist is no longer content merely to express what is instrumentally feasible ... "the composer can make use of any tone-color he chooses, even those non-existent in our modern orchestras. He can call for fantastic tempi and dynamics as well as the most complicated combinations of rhythm and not fear a poor performance. The composer becomes his own interpreter.

Katz (p. 122) writes in detail about Grammophonmusik by Paul Hindemith and Ernst Toch performed in Berlin in 1930, with a young John Cage in the audience. Cage later referred to Toch's Grammophonmusik in relation to his 'Imaginary Landscape No. 1' (1939), for muted piano, large Chinese cymbal, and two variable-speed turntables.[43] Emmerson (2007, p. 104) writing about mixed music emphasises different choices with regard to the terminology, stemming from the broad international legacy:

> In English the term 'live electronic music' has often meant *both* music produced and performed through real-time electroacoustic activity of some kind *and* music which combined live performers and fixed electroacoustic sound ('tape').

He goes on to describe (ibid p. 105/8) two ways of approaching mixed-music:

- Extending the acousmatic into the instrumental;
- Extending the instrumental into the acousmatic.

[43] The works-list on johncage.org mentions for the instrumentation of this work: For two variable-speed phono turntables, frequency recordings, muted piano and cymbal; to be performed as a recording or broadcast. In the commentary Respighi's Pini di Roma (1924) is mentioned as one of the earliest electroacoustic works. http://johncage.org/pp/John-Cage-Works.cfm <viewed 11 March 2013>.

In an earlier book chapter Emmerson (2000, p. 194) considers: 'mixed' electroacoustic music (instruments and tape), 'live' electronic music (processing of sound produced by a performer) and 'real-time' computer music. 'Mixed music' goes back to the French post-war tradition of Pierre Schaeffer and the (from 1958) Groupe de Recherches Musicales (GRM) combining live performers with music on tape (support-based or *sur support* in French) in *Musique Mixte*.[44] In a broader definition this can include any mix of electronic and acoustic sources including, for example, the works mentioned earlier for orchestra and Theremin or Ondes Martenot. More modern examples that fit some definitions: karaoke or a band at a pub with guitar, keyboards and vocals amplified but not the drum kit as it is usually loud enough (depending on the drummer of course), and as such decisive when it comes to the balance between the acoustic and electric sources. Scott McLaughlin (2012) for the scope of a recent article excludes different pop musics from the mixed music category: 'For the purposes of this article, mixed-music is loosely defined as being any electronic music – excluding popular music genres – that includes a performance element on an instrument/ voice that may be acoustic or amplified.' The main question that concerns Emmerson and McLaughlin is one of 'liveness', how does what is seen on stage relate to what we hear as a consequence. For this thesis a discussion of mixed music can be used to look at the question of differences between acoustic (possibly amplified) and electronic sources (or more straightforwardly, what remains when the power fails).

Philippe Lalitte (2006) in a paper called 'Towards a semiotic model of mixed music analysis' focuses on 20th century composed electroacoustic music. As early examples of concert works using 'support-based', tape-recorded music he mentions the interpolations in Varèse's *Deserts* (1954) although in that work the acoustic and electronic alternate, they are not heard together, and works by Bruno Maderna and Iannis Xenakis. Stockhausen's *Gesang der Jüngelinge* (1956, the first major work made at the WDR studio) is a tape-composition or 'Elektronische Musik' recorded originally on five-track tape.[45] It has no performers on stage but the sound projectionist or director,

[44] If we include mechanically recorded or otherwise stored music the category can be extended to include player pianos, for instance in Antheil's *Ballet* Mècanique, or music boxes and carillons.
[45] *Gesang der Jüngelinge* brought together pre-recorded material and electronically generated and filtered noise, sine waves and impulses.

balancing the channels from a position in the centre of the hall. Stockhausen's *Kontakte* (1959-60) is often quoted as the first work that fully realised the potential of the mixed sources, the contact or the confrontation between the acoustic instruments and the electronic sounds coming from a loudspeaker. In the words of Lalitte (p. 93):

> The confrontation of the instrumental and the electroacoustic universes revealed traps inherent in the nature of these media. The instrumental is 'played', and thus visible, flexible and malleable, however limited by its timbric (sic) and spatial potential, while the electroacoustic is 'projected', and thus invisible, rich in unprecedented resources, however rigid in its timing.

Kontakte was written for four-track 'Elektronische Musik', two performers and a sound projectionist. Each of the four tape tracks is assigned to a loudspeaker in one of the corners of the room (surrounding the audience; *Gesang* initially, had a fifth loudspeaker channel overhead).[46] Sounds can be located in one of the corners or, sounds of long enough duration can 'take off' in one of the loudspeakers and then gradually fade out and in to another loudspeaker at the other side of the room suggesting movement and emphasising spatiality. The spatial set-up of the multi-channel loudspeaker system allowed Stockhausen, as he did in *Gesang der Jüngelinge*, to use space as a compositional or musical parameter. Stockhausen (quoted in Chadabe ibid p. 40) stated: '… I attempted to form the direction and movement of sound in space, and to make them accessible as a new dimension for musical experience.'[47] The use of space in music composition in a more literal way can be traced back to the renaissance, the Venetian multi and split choral works by Adrian Willaert, Giovanni Gabrielli and Claudio Monteverdi and the multi choir works in the San Marco. The relation between the acoustics of the Venetian renaissance buildings and spatial music saw some interesting research in recent years. One presents a computer reconstruction of church interiors during festivities, which may have had a big impact on what the works sounded like,

[46] Emmerson (2007, p. 156) discusses whether Stockhausen may have borrowed the overhead loudspeaker from the *Pupitre d'Espace* constructed in Schaeffer's Paris studio.
[47] Stockhausen discusses the movement of sound using loudspeakers rather than moving musicians, in Robin Maconie's (1981) documentary *Tuning In* at 11'50".

compared to the current 'bare' state of the buildings (cf Boren & Longair 2011). And another book combines research in architecture, acoustics and music to look at the question whether architects intentionally worked with acoustics to accommodate music (see Howard & Moretti 2009).

2.7.1 Doppler Effect

Here we need to briefly step aside from the subject at hand. There is an important difference between a moving sound source and a sound that sounds like it is moving between two or more loudspeakers. This is best demonstrated by the 'Doppler' effect.[48] When we hear a moving sound source (a train or a motor bike travelling at a constant speed) the pitch as perceived by the observer in one single spot, goes up when the source comes near and down when moving away. Because of the speed of the moving source relative to the speed of sound, the periodicity of the sound (and thus the frequency) is slightly compressed when moving closer and expanded when moving away.[49] The effect is often subtle but it is very important for localising moving sound sources (cf Rosenblum, Carello & Pastore 1987; Augoyard & Torgue 2005 p. 39). This Doppler effect does not occur when a sound is panned between different loudspeakers: the sources stay were they are, and only change the relative level (and possibly phase shift) of the moving sound; making the illusion of 'moving sound' hard to create convincingly. One solution in the creation of electronic music is the use of Wave Field Synthesis (WFS). For a discussion see (Emmerson 2007, p. 165; Ahrens & Spors 2008).

2.7.2 Loudspeaker Orchestras

One additional category, or rather an approach to the spatial projection of electronic music can be observed, although these systems are not often used for the amplification of acoustic sources. Luigi Russolo's Intonarumori: the 'noise intoners' were part of a 'Futurist Orchestra' that performed as an ensemble of noise machines, occasionally combined with acoustic musical instruments. A more literal example is the 'Orchestre de

[48] After Johann Christian Doppler (1803–53), an Austrian physicist, who in 1842 discovered what we now call the Doppler effect.
[49] This is an overly simplified explanation; in addition there is a relation between the intensity of the sound and the perceived pitch. See for more detail McBeath and Neuhoff (2002).

Haut-Parleurs' that originated in France, for instance the Gmebaphone conceived by Christian Clozier and the Acousmonium (1974) created by François Bayle, at GRM (cf Chadabe 1997, p. 68). Different approaches towards the source of such an orchestra are possible. For each of the channels in the orchestra a dedicated tape track could be used, or sounds from a much smaller number of tracks (or even from only one track) could be divided over the loudspeakers by frequency, spatially, or by other sonic parameters (cf Emmerson 2007, p 152).

2.7.3 Seven Stages

Lalitte proposes seven historical stages and gives relevant examples of mixed music development in the 20th century, to which I have added some examples and a number of related stages:

1. From the 1920s ensemble or orchestral pieces with at least one electronic instrument (eg Theremin, Ondes Martenot);
2. First use of pre-recorded music (record/tape) Pierre Schaeffer *Orphéo 51,* but also Henk Badings *Capriccio for violin and two sound tracks* from 1959. After Katz I would add the 'Grammophonmusic' and later in the 20th century current examples of DJs performing with Jazz bands (the Dutch band SFEQ comes to mind), or string quartets (the Dutch Matangi quartet performing with DJ Kypski in the 2010s);
3. What is referred to as 'Live Electronic Music' in which the sound of the acoustic instruments is transduced and transformed by electronic means, Tudor's version of Cage's *Variations* II was discussed earlier. Other early works often prescribe a ring modulator:[50] Mauricio Kagel's *Transicion II* (1958/9), Stockhausen's *Mixtur* (1964) and *Mantra* (1970). To this stage I would add the use of radio receivers eg in John Cage's *Credo in Us* (1942)

[50] A ring modulator (named after a ring of diodes) multiplies a signal with a carrier wave (often a sine wave), the process results in the signal modulated to a frequency plus the carrier's frequency *and* similar, minus the carrier's frequency (cf Bode, 1984). This is not unlike the way the Theremin and the Ondes Martenot generate sound, a process referred to as 'heterodyning'.

with one performer operating a radio receiver, 'Imaginary Landscape #4' (1951) for 12 radios or Stockhausen's *Kurzwellen* (1968).[51]

4. Magnetic tape combined with Live electronics: Brian Ferneyhough *Time and motion study II* (1973-76);
5. From the 1980s MIDI keyboards could, in addition to synthesisers, control and trigger samplers or sounds stored on a computer's hard disk; Boulez's *Réponse*;
6. Computers playing back files from a hard drive together with live processing and in addition looking after the synchronisation;
7. Any of the above in combination with Gestural interfaces: Cage 'Variations no. V' (1965) used photoelectric devices that triggered Moog's electronic percussion devices; Tod Machover, *Begin Again Again* (1991). When it comes to gestural input Michael Waisvizs' 'The Hands', Wart Wamsteker's 'SonoGlove' or Laetitia Sonami' s 'Ladies Glove' should not be omitted (cf Bongers 2006, pp. 57-64);

This seventh stage contains the first gestural interfaces that relate the cause or modification of electronic sounds back to a performer's movement, enabling a stronger visual relationship to what is heard.

8. I propose an additional stage describing 'hyperinstruments' such as researched at MIT by Tod Machover (1992); and 'hybrid instruments' as designed and built by Bongers, for instance Jonathan Impett's (1994) Meta-Trumpet and Frances-Marie Uitti's 'Cello++' (see Bongers 2006, p. 65). The traditional, acoustic instruments are extended with sensing technology that informs a digital system with performance data; that data can be used to create or modify electronic sounds or interact with the acoustic sound of the instrument

[51] For a good overview of Live Electronics see Salter (2010, p. 194/211).

(brought into the system by a microphone). Other examples are Hillary Jeffrey's 'Tromboscillator' and Cesar Villavicencio's 'E-recorder';[52]

9. Networked music: data gathered from the aforementioned hyperinstruments can be shared over a network using protocols such as MIDI or OSC (cf Harris 2004).[53] Networks can be local or world-wide: 'The advent of the Internet extends this still further; now we can have apparently 'live' music in a virtual space performed by composer/performers to an audience neither of which has physical boundaries. Indeed the distinction of composer, performer and audience may cease' (Emmerson 2000, p. 194). For an overview of see Mills (2010).

2.7.4 Mixed Music – Contradictions

In his analysis of the dichotomy in mixed music Lalitte utilises what is called a semiotic square (a method that goes back to Aristotle's *Organon*). Aspects of mixed music (acoustic, amplified, pre-recorded, live electronic) are organised as opposing corners of a square. Lalitte refers to McAdams (1984) who makes a distinction between real and virtual sounds looking at it from how an 'Auditory Image' is cognitively constructed from the signals from both ears and the auditory cortex:

> … the auditory image is a psychological representation of a sound entity exhibiting a coherence in its acoustic behaviour. The notion of coherence is necessary, if rather general at this point.

In relation to the acoustic behaviour he defines a real sound as when the auditory image coincides with the gesture that causes it (a hand strumming a guitar). When that coincidence is not there the source is virtual. As we can see from Lalitte's stages, but also

[52] For descriptions see Jeffrey's website: www.hiljef.com/news/trom/tromboscillator/ and Villavicencio's at www.cevill.com/en/erecorder.html, both viewed 3 March, 2013.

[53] MIDI for Music Instrument Digital Interface has been around since 1982. It is a clever low bandwidth protocol that allows transmission of musical data (eg pitch, duration and dynamics) from digital keyboards and computers to and from (for instance) samplers and computers. OSC for Open Sound Control can be used for the same purpose (and many things more) but at a much higher data rate, using computer network style addressing.

from Emmerson's and McLaughlin's writings on the subject, the gestural interaction in relation to (live) electronic music becomes more important towards the last quarter of the 20th century and it is a subject that frequently appears in the contemporary (computer) music discourse. One development that underlines the significance of the causal gesture is what is known as playing 'air-guitar'; pretending to play a guitar moving one's hands and arms in the air, miming to a recording (cf Gracyk 1996, p. 107; Thompson 2005, p. 197). This not uncommon way of enjoying a musical experience has grown into a movement of national and international competitions with contestants demonstrating their routine to a recording of choice in front of an audience.

John Croft (2007) discusses the notion that a loudspeaker can produce any sound whereas on a musical instrument almost all sounds are impossible: 'and of those that are possible, some are more difficult to produce than others, and this difficulty is patent in the act of performance'. He notices composers choosing different roads in their approach to their conceptualisation of music, some in idealised acousmatic conditions and some reasserting 'the central importance of the performing body'. To aid the mixing or the contact of the electronic music with the acoustic instruments (piano and a large percussion set-up) the scores of (for example) *Kontakte* and *Hymnen Region III* prescribe electronic amplification of the instruments through the same or an extra set of loudspeakers (adjacent to the acoustic instruments).

Rather than being opposing or contradicting pairs (as in Lalitte's analysis) I would argue that the use of amplification offers a continuum of integrating acoustic and the electronic sounds. From unamplified, acoustic, to maximally amplified; from no dislocation to maximum dislocation, this is one of the foremost consequences of electronic amplification. With such dislocation questions of authenticity may arise: which sound, the acoustic or the amplified, is the real sound? I will address that discussion in the following chapters.

2.7.5 Portability

Both Lalitte and Emmerson refer to the problem of bringing electronic music created in the studio into a performance space of much larger dimensions and acoustics, mixing it with acoustic instruments. In a recent paper Pierre Alexandre Tremblay and Scott

McLaughlin (2009) analyse the problem and propose a solution. They identify three problems:

- The non-portability of stereo material created in the studio to a larger concert hall. (The 'sweet-spot' problem);
- The positions and types of loudspeakers and the palliative use of amplification of the instrument as sound reinforcement;
- The need for foldback monitoring to cope with the problems created by the sound reinforcement.

The first problem is, apart from a matter of acoustics (from a very dry studio to a much larger possibly reverberant performance venue) also a matter of distances. The carefully balanced stereo effects that were created in a triangle (of composer and two loudspeakers) two to three meters in size is reproduced in a triangle ten to fifteen meters in size). Running time and level differences only work in a small 'sweet spot' equidistant from the two loudspeakers. This problem is well explained by Bob McCarthy (1998) in his *The emperors new mix* aka *Unveiling the stereo myth on live sound*. In some circumstances better result can be obtained as we can read in Jim Brown's (2002) *Systems for Stereo Sound Reinforcement*. The second problem has two aspects, both are fundamental; in many concert halls it is not feasible to position multiple loudspeakers surrounding an audience in such a way that there is a large number of 'good' seats within the coverage area of all the loudspeakers, without anyone being 'deafened' by being seated too close to one of the loudspeakers. The other aspect is the difference in acoustic dispersion between a loudspeaker (that is optimised to be directional) and musical instruments, very well put by Tremblay and McLaughlin (ibid p. 380): the acoustic instrument is 'native to the room', and later more technically:

> Traditional axial-firing loudspeakers project sound along an axis, while instruments are, more often than not, radiating sound sources whose energy is emitted in many directions and patterns (ibid p. 381).

Unamplified acoustic instruments are perceived in their own 'normal' relation to the acoustics of the performance space, which is a very dynamic relation, directivity of musical instruments being dynamic and frequency dependent (cf Caussé, Brescian & Warusfel 1992; Meyer 1972 and other publications by that author). This is a very different relation compared to the electronic sounds that have a loudspeaker as a cause which has a much more static relation (in terms of directivity and frequency response). In the (common) situation where the acoustic instrument is amplified, resulting in that instrument's sound coming from both the instrument and the loudspeaker, another problem occurs as outlined by Emmerson (2000, p. 207):

> Ironically, the causal link which the listener may have – instrumental gesture to sound – may be broken; the extraordinary sounds created from our 'familiar' instrument may not seem to come from it. The instrument aspires to the condition of the acousmatic. But this is the nub of the problem; the instrumental sound remains in practice anchored to the instrument. It is impossible to diffuse the amplified instrumental sound in the same manner as the electroacoustic sounds.

Tremblay and McLaughlin's set of 'In the box' proposals include using a simulation of the acoustic response of the (or a) performance hall in creating the electronic part and using loudspeakers that are less directional, behaving more like acoustic instruments in their relation to the performance room, ultimately overcoming the need to amplify the instruments.

2.7.6 Keeping Time

The third problem listed by Tremblay and McLaughlin considers monitoring, which was briefly discussed in the previous chapter. Related to monitoring, the problem of keeping time (mentioned in stage six) the synchronization of pre-recorded or other electronic material with live performers can be very complex. Often a 'click track' (very common in studio recording) is used: in pop and rock often to keep the tempo accurate and to sync with pre-recorded material or synthesiser arrangements that are played back from MIDI data; often it suffices if the drummer hears the click track using headphones. In other

occasions a pre-created drum track can function as the click track being audible in the mix (and the drummer plays along). With a classical ensemble or orchestra a conductor or leader usually needs her ears making it impossible to use a click track. There are systems with timers (the conductor watches a clock in sync with the tape playback (or a video monitor showing the signal of a camera *looking* at the timer display of a playback device eg a CD-player). Most successful systems are those where the composer thought of the synchronization issue when he or she started composing. In the third region of Stockhausen's *Hymnen* for four track tape and amplified orchestra, the conductor hears the tape on a small monitor near his or her desk. That system has several problems, the four-channel tape is very dynamic (as is the orchestra) so the conductor needs to be able to control the volume while conducting. The cues on the tape are very complicated and irregular, making it vital for the conductor to hear (and know) the material very well. In very acoustic rooms or if the conductor turns up the volume too much there is a lot of 'bleed' into the auditorium, creating an additional sound source, distorting the balance between the four loudspeakers directed at the audience (auditoriums are usually designed to favour sounds from the stage going towards the audience). Paul Jeukendrup (pers. Communication 28 June 2012) at a 2010 performance of the work with the Cologne based ensemble 'MusikFabrik' solved this problem very elegantly by using a video monitor displaying the waveform of the four tracks as they were being played back, creating a dynamic addition to the paper score. The conductor used the visual 'monitor' in addition to the conductor's monitor loudspeaker, which could consequently be run at a lower level, creating less bleed. The conductor on that occasion was composer Peter Eötvös who had performed the work numerous times and has become very familiar with the tape; for a long time he was the only conductor familiar enough with the work to execute it. Eötvös provided the *Klangregie* (sound projection/direction) for the first performances of the work while Stockhausen himself conducted.

2.8 Voice Amplification

When the speaking voice is extended into song it becomes the supreme articulator of human desires, emotions and aspirations; almost every individual (or group of

individuals) has potential to use this resource in whatever way is appropriate. (Potter 1998, p. 1)

Parallel to the discussion about mixed music I will argue that there is not simply amplified singing and unamplified singing. There is a whole tradition of vocal production that is dependent on the microphone, for recording and performance. Classical approaches to singing can equally be amplified and as such lean on a whole reservoir of expressive resources related to technical transduction and manipulation; in addition to making a voice louder so a larger audience can hear it. Performances of (vocal) classical music outside of the concert hall and opera theatre often make use of amplification, for instance when performing outdoors or in stadiums, where the classically trained voice is not supported by the acoustics.

Needless to say we can distinguish between amplified speech and amplified singing as they utilise significantly different means of communication. Many people enjoy opera in Italian or German without understanding or even discerning the words; not unlike the different vocal musics that have been brought together under the debatable label 'World Music'. Jazz singing, where a clear presentation of lyrics is usually very important, is often extended with 'scatting' or 'scat singing': vocal improvisations using percussive sounds with word-like qualities, but without semantic content.[55] Amplified speech occurs at a public address where an amplification system is used to ensure that all of the audience can hear the words that are spoken; similar to old-fashioned copper line telephony the faithful, or high fidelity, reproduction of someone's voice is not crucial, intelligibility is what counts.[56] Of course many examples of overlap can be found in poetry (Filippo Marinetti's sound poems come to mind), rap and other presentations of spoken word, and, again, we should not understand speech and singing in binary opposition.

In order to position the discussion of amplified singing I will briefly look into amplified speech. R.M. Schafer (1977, p. 215) reminds us that Plato suggested a

[55] Made famous by Ella Fitzgerald but the origins can be traced to Louis Armstrong and before (cf Potter 2000).
[56] Analogue telephony was optimised for a bandwidth of approximately 200-5000Hz as described by Harvey Fletcher (1922, 1923).

population of 5040 people for a community in his ideal republic, adding that that number could be 'conveniently addressed by a single orator'. Looking at the famous photograph (the one that used to have Trotsky on it, before it was falsified) of Lenin addressing the crowd in St. Petersburg, I cannot help wondering whether all those people really heard what the man was saying. I have not come across any images or references to Lenin actually using a megaphone. But there are enough examples of people using them elsewhere in the world before 1917. In WWI they were widely used to relay commands. And before that, in Chicago 1904 at a rally for the American Republican National Convention someone by the name of J. Henry Smythe surprised the meeting cheering for President Teddy Roosevelt through a Megaphone, earning himself the nickname 'Megaphone man'.[57] In a letter from 1921 Lenin requested information about a loud speaking telephone that was tested in Kazan (a city with an important concentration of military, industrial and scientific activity, 1000 kilometres east of Moscow).[58]

2.8.1 Nazi Germany

> *Without the loudspeaker, we would never have conquered Germany.* (Adolf Hitler, quoted in Attali (1985)[59]

Adolf Hitler's oratory power was fuelled by the state of the art sound (amplification) technology in Germany in the 1930s. His first amplified speech was, according to Ehlert (2004d), as early as 1928 for 15,000 people in Berlin. A German magazine[60] from that year formulates Hitler's agitating skills as: 'die Gewalt der Rede', which translates as 'the power of speech', but 'die Gewalt' can also be translated as 'the violence'.

The ELA research in Germany reached a high level of finesse as is demonstrated in a happening in Nuremberg in 1938. By combining the signals of two microphones with

[57] Philadelphia Bulletin June 20, 1908.
[58] Lenin, letter to N.P. Gorbunov: 'I read in today's papers that a megaphone amplifying the telephone and carrying the voice to a crowd has been tested (and has given fine results) in Kazan.' (Lenin 1921).
[59] Or: 'We should not have conquered Germany . . . without the loudspeaker', R. Murray Schafer in Cox & Walter (2004, p 35). He refers to the citation in German from the *Manual of the German Radio* 1938-39: 'Ohne Kraftwagen, ohne Flugzeug und ohne Lautsprecher hätten wir Deutschland nicht erobert'. The citation can be traced back to a Radio Exhibition in 1936 (cf Breßler 2009, p. 176).
[60] Die Gewalt der Rede, in: *Illustrierter Beobachter*, 3. Jg., Nr. 2, 28.1.1928, S. 18f (cf Ehlert 2004d).

opposing polarities (ie when the signal in the one swings up the signal in the other swings down), a certain amount of cancellation of unwanted sounds can be achieved, provided only one of the microphones is spoken into. This allowed the engineers to position the person delivering a speech right in front of the loudspeaker without creating a feedback loop (Ehlert 2004f). This 'phase-trick' was used thirty years later in the Grateful Dead's 'Wall of Sound' sound system. In this famous system all the loudspeakers were rigged behind the band with separate elements for the different inputs. The two-microphone phase trick was used to cancel out the sound of the instruments leaking into the vocal channel and to increase gain before feedback (cf Jackson 2006; Surhone, Tennoe & Henssonow 2010).

2.8.2 The Token Microphone

The way the 'totemic' or 'talking stick' aspect of 'having the mike' (as in 'having the floor') influences communications is very well demonstrated in a recent movie called *Bridesmaids* (2011). In one scene the two protagonist bridesmaids are competing in expressing the fineness of their relation to the bride. Addressing relatives and friends at a pre-wedding-do they alternate in pulling a handheld microphone out of each other's hand to ensure 'having the floor'. Another very recent example, paradoxically without a microphone, is the use of what is dubbed the 'human microphone' at the Occupy Wall Street actions in autumn and winter of 2011/12 most notably in New York but also in many other cities around the world. Regulations in New York City prevent the use of megaphones or sound systems without a permit, so the organisers had to revert to a different strategy to relay the speeches of important visitors, such as philosopher Slavoj Zizek, filmmaker Michael Moore and international activist and thinker Noam Chomsky (October 2011). The speakers would utter a sentence, loud and not too fast, allowing every sentence to be repeated by those bystanders within earshot of the speaker; essentially amplifying what was said. The procedure would start with a 'mike-check', to make the audience aware of the proceedings. As related in a blog by thenation.com editor Richard Kim (2011):

> with every few words / WITH EVERY FEW WORDS!

> repeated and amplified out loud / REPEATED AND AMPLIFIED OUT LOUD!
> by what has been dubbed / BY WHAT HAS BEEN DUBBED!
> the human microphone / THE HUMAN MICROPHONE!!!

Kim (ibid) goes on with some observations:

> There's something inherently pluralistic about the human mic too; it's almost impossible to demagogue, to interrupt and shout someone down or to hijack the General Assembly for your own sectarian purposes. […] No doubt, a great frenzy erupts when left gods like Michael Moore or Cornel West descend to speak, but many people only hear their words through the human mic, in the horizontal acoustics of the crowd instead of the electrified intimacy of "amplified sound." Celebrity, charisma, status, even public-speaking ability—they all just matter less over the human microphone.

A fascinating aspect of those speeches is that they were filmed and broadcast live by Radio and TV- crews and filmed on mobile phones, appearing on the Internet in no time. A state of the art global audience can be reached instantaneously whereas a local audience was making do, albeit in a socially intriguing way. I have not found any references but it seems likely similar tactics were used before amplified sound. Van Leeuwen (personal communication) points to the call and response interchange in religious practices and the repeating of slogans at mass rallies and demonstrations.

As becomes apparent from the 'human microphone' example, singling out one person to be heard over all others present endows that person with a certain power. 'Having the mike' ensures attention and gives added value to whatever is being said (still there is no guarantee that anyone will listen). This raises interesting questions in relation to how such power is manifested; for instance at panel discussions for an audience the panel members may pass a microphone around (or choose not to) or each one of them may have an individual microphone. A sound engineer at the mixing desk, supposedly a neutral component in the system, might turn up the volume of one of the members a bit more, or 'work' on that person's sound a bit more, filtering out resonances or harsh

aspects of someone's voice. Not unlike a musical balance, there may be many, subjective, factors at play; a neutral balance is an illusion.

The core interest of this thesis is amplification and music; I'll leave a discussion of these questions for a different context.

2.8.3 Megaphones in Music: Façade

Before looking at the electronic realm I will start by looking at the use of megaphones in performances of music. As mentioned before sources are very scarce, but one episode that mixes poetry and music is relatively well documented: William Walton's *Façade*. A Swiss or German opera singer by the name of Senger (referred to as Herr or Mr Senger) who, some sources say, sang Fafner in Wagner's *Siegfried* at Bayreuth developed an (apparently) better megaphone from papier-mâché. The improvement over an earlier megaphone was its mouthpiece that not only covered the mouth but also the nose in order to include the nasal resonance (Evans 1944). Walton's biography *Portrait of Walton* (Kennedy 1989, p. 28) mentions in a footnote that Senger did not sing at Bayreuth at all but was involved in developing the Fafner megaphone. Through his friendship with Osbert Sitwell Walton lived at the brothers Osbert and Sacheverell (Sachie) Sitwell's house in London in the early 1920s. Their sister Edith Sitwell, who was not yet a famous poet, had published several poems that were studies in word rhythms and onomatopoeia. Either she or Sacheverell suggested to Walton that he should write music to go with the poems (ibid) (Kennedy 1989, p. 27) and in 1922 *Façade* had its premiere at a private concert in the Sitwells' drawing room. Clarinet, cello, trumpet, percussion and flute (the latter not listed in all sources) played behind a curtain, directed by Walton while Sitwell recited the poems. The curtain was an idea of Osbert's who, according to Susana Walton 'found reciting embarrassing'. He asked his friend Frank Dobson, a painter, to design a curtain of a face with a hole to accommodate the aforementioned Sengerphone. Lloyd (2001, p. 29) writes that Walton and Sacheverell Sitwell went to Hampstead by bus to speak to Mr. Senger, who now appeared to be living in England. Susana Walton (1988, p. 57) explains:

> The next problem was that Edith's voice couldn't be heard above the music. So she had to speak through a hole in the curtain, with the aid of a megaphone. Actually it was called a 'Sengerphone', after a man named Senger, who had used to project his voice with greater force while singing the part of Fafner the Dragon at Bayreuth. Sachie and William had asked Herr Senger for permission to use his dragon trumpet,

Not just the story of Herr Senger but also the story of the first performance of *Façade* is somewhat clouded by multiple sources (Kennedy 1989; Young 1983). After several more private performances *Façade* was performed at the Aeolian Hall on London's Bond Street (12 June, 1923). Susana Walton (1988, p.58) writes that 'the Sengerphone could not be heard by anyone not directly in front of it; as a result the performance was raucous and crude'. One review headlined a quote from the hall's fireman: 'Drivel They Paid to Hear'. *The Times* (quoted in Pearson (1996, p. 80)) wrote that it would be impossible to make words clearly audible unless they are spoken slowly and distinctly.[61] Both Pearson and Young describe the scandal that followed which was not so much about the reception of *Façade*, but about the sketch that Noel Coward produced after seeing the concert: *The Swiss Family Wittlebot* in Coward's revue *London Calling* that opened later in 1923 was inspired by the performance of *Façade*.

It would take another three years until the next performance (27th April 1926) at the New Chennil Galleries in London, which was much more successful (pictures of Edith and a very large Sengerphone can be found in Walton (1988, p. 120) and Pearson (1996, p. 77). *Façade* may very well not be the first musical performance utilising a megaphone, but after Wagner's dragon Fafner makes it an important application of amplification in the realm of 'serious' music. Susana Walton's remark about hearing the reciting voice only when seated in line ('on-axis') with the megaphone, hints at a problem with that instrument. The directionality becomes so precise that the voice remains intelligible only for those directly addressed by the megaphone.

Another interesting aspect that several of the authors mention is a similarity to Cocteau's *Parade* (1917, with music by Erik Satie and decor by Pablo Picasso) for which

[61] Which pre-echoes the later sound engineering rule of thumb: 'shit in, shit out'.

Cocteau had had the idea of a hidden megaphone for declaiming words. The Sitwells had seen the London production of *Parade* and were very inspired by it (Young 1983, p. 50). Chadabe (1997, p. 23) refers to *Parade* and the problems of realising the 'found-sound devices' that Cocteau had in mind, they could hardly make the typewriters heard and did not have enough compressed air to get the sirens to work. The found sound would have to wait until Respighi's nightingale and the sirens until George Antheil's *Ballet Mécanique* in 1926. But with the plans for *Parade* the desire to 'make things louder' in a performance situation can be identified as early as 1917. Perhaps such a desire was related to the sonic emancipation formulated by Luigi Russolo in his 1913 manifesto *The Art of Noises* and the *Intonarumori* he created later.

2.8.4 American Popular Music Vocal Styles in the First Decades

> *The natural American voice, conversational in tone with a touch of gentility, would become the lingua franca of popular music.* (Whitcomb 2003b)

Conrad Osborne (1979) in an article about the Broadway belting voice with the evocative title *Just singing in the pain* puts the lack of literature very straightforwardly: 'if scarcity determines value, then this article is an instant collector's item'. Very few early sources about either the belting singing style or microphone singing exist and only a few studies have been published in the past 50 years.[62] Osborne writes in defence of the (female) belting voice as an American cultural icon and ultimately suggests that Broadway shows banned vocal amplification, as properly trained vocalists should be able to do without it. Stephen Banfield (2000) uses Osborne's article in conjunction with Henry Pleasants' (1974) *The Great American Popular Singers*, also acknowledging the lack of literature regarding both the popular and the theatrical (ie Broadway musical) singing voice. Since that chapter a few more authors have looked at the subject: Mark N. Grant (2004) is very detailed about the vocal origins and history of the 'book musical' and musician Ian Whitcomb (2003b) wrote very detailed accounts about the coming of the crooners in

[62] For an overview see Wilson (2003).

general and Bing Crosby (Whitcomb 2003a) in particular.[63] From a very different perspective Allison McCracken (1999, 2001) writes about the expression of a softer masculine side in the 'crooning' singing style. Paula Lockheart (2003) published an article looking at the advent of microphone amplification in American mainstream popular singing, the article is not so much about live, amplified music but more about the introduction of the microphone in radio broadcasts and recording. The articles quoted in this section are at times unclear when they refer to microphone singing, sometimes referring to recorded music and sometimes to amplification used at concerts and sometimes to both. It appears that some authors position the introduction of the live amplified singing voice in the same era (mid 1920s) as the advent of electric recording, but historical sources that support that idea have yet to be identified. I will argue below that before the introduction of the directional (ribbon) microphone in the early 1930s electronic amplification of the singing voice at concerts was very rare.

Jazz critic Will Friedwald (1990, p. 16) writes in his *Jazz Singing*: 'Electrical microphones shook up the recording business, almost as much as it (sic) shook up the film industry.' The revolution first took place in radio, followed short by recording, with the impact the microphone had on vocal production (for instance in the microphone being much more sensitive in terms of frequency and dynamic range than the recording horn). McCracken (1999) borrows Friedwald's authority to point out that jazz became an increasingly vocal genre, in the years after the introduction of electronic recording. Friedwald (ibid p. 50) suggests that while the black orchestra leaders (Ellington, Basie) were the innovators of the music, the white bandleaders (Paul Whiteman, Gus Arnheim) introduced the band singers. And McCracken continues: 'by the late 1920s, band singers were becoming popular attractions in their own right, the result primarily of advances in recording technology'. The effect of radio is not to be underestimated, from the start in the early 1920s radio 'sounded' better (for instance due to a larger frequency range) than the phonographs of those days. That is provided the listener at home had access to adequate receiving equipment.

[63] He also offers a fascinating account of visiting Rudy Vallee in the 1970s.

2.8.5 Shifts in Singing Styles

> *In the beginning, stiff and rigid sounding popular music consisted of effete Irish tenors singing proudly and loudly and amateurs and black-faced minstrels performing on vaudeville stages, followed by the greatest song belter of all time Al Jolson, who sang out sharply from a stage or runway and directly into the ear of adoring fans*. (Grudens 2003)

Regardless of the consequences of radio and electronic recording, both Grant and Banfield identify a shift in the American popular singing voice that became evident in the first decades of the 20th century. The melting pot of cultures in the USA had been boiling for a while. Banfield (2000, p. 69), with regard to the male voice, mentions four different male, 'oppressed, exiled or manufactured' types: 'the Jew, the Negro, the crooning toyboy and the Irish tenor'. The latter died out early in the 20th century (Banfield does not offer a suggestion why) but the Negro (sic) voice had and still has an enormous influence, not in the least on the black-faced minstrel show singers like Al Jolson, who was a Jewish Cantor's son.[64] The tradition of the minstrel show, with usually white, 'blackfaced' (using burnt cork) performers goes back to the 1840s and, with an overlap, precedes the vaudeville shows later in the 19th century. For an overview and analysis see Riis (2011). Lockheart (2003) quotes an earlier book by Whitcomb (1986, p. 129), referring to those minstrels as 'pre-microphone' singers:

> Al Jolson, Irving Kaufman, Harry Richman, and Eddie Cantor sang in a hearty semi-concert-hall style that could be heard at the back of the theatre. They rolled their *rrrrs* and contorted words in the accepted European operatic manner ... [but] influenced by the American minstrel tradition.

Mark Grant divides his *Rise and Fall of the Broadway Musical* (2004) into two parts: before and after the microphone. Quoting Lehman Engel (1975, p. 14): 'Up to about

[64] Besides Jolson, Banfield mentions Irving Berlin and Eddie Cantor, three men of Jewish Russian parentage. Jolson was born in Lithuania near the city Kaunas, which was Russian in those days.

1920, a singer was a singer', referring to the 'legitimate' operatic voice. Engel summarised all the non-operatic styles as 'nonsinging'; opera was performed on international stages and its recordings were sold and heard all over the world. According to Chanan (1995, p. 44) that global audience was a reason why legendary tenor, and first of the true recording stars, Caruso sold so many records: 'informal genres of café entertainment, music hall and vaudeville were dominated in each country by the local vernacular, the work of local producers, both songwriters and publishers' (ibid).[65] Opera singers were big stars and as Grant mentions some of them would appear in Hollywood movies, which we might compare to movie careers by later stars such as Bette Midler, Barbara Streisand, Tina Turner or Madonna. Grant (ibid p. 14) suggests several parameters that define the legitimate voice, generally understood as referring to singing like an opera singer: 'with an emphasis on beauty of tone rather than on enunciating the syllables of the lyric'.[66] The operatic singer:

> … manages the natural breaks in the voice so as to ensure continuity of sound between head voice and the chest voice; when a singer breaks into an entirely different timbre produced from the chest, she is said to be "belting".

In addition he mentions the larger range (also called compass) of operatically trained singers, up to three octaves. Grant's argument departs from the late 19th century operettas such as those still known now by Gilbert and Sullivan (but Grant mentions quiet a few other composers). These 'musical shows' were presented in theatres rather than opera houses, to a different audience than the *beau monde* of opera subscription holders. Judging from late 19th century recordings this 'popular' music was still very close to legitimate singing, but the stage productions were rather different, featuring spoken dialogue and an emphasis on choral singing, with less room for solo performance. In Grant's (ibid p. 17) words these performers were: 'singers first and foremost, actors a distant second'. What the 20th century needed according to Grant was someone who could bring together acting and singing. The combination of a theatrical delivery of lyrics

[65] Enrico Caruso (1873 – 1921) was an Italian opera tenor.
[66] This begs the question: what is legitimate? For reasons of consistency with the cited literature I will leave this question unanswered.

and a musically virtuoso style, different from opera in that the lyrics had to be understandable word for word, culminated in what Grant (ibid p. 36) refers to as 'Broadway's canonical golden age of musicals with better librettos, better lyrics, and more artistically ambitious dancing and concepts at no sacrifice to melodic charm.'

In contrast with the virtuoso operatic musical show melodies, Irving Berlin and George M. Cohan developed a simpler melodic style for their theatrical melodies in the 1900s and 1910s (ibid p. 29). They had simpler 'white keys only' melodies, smaller compass and simple rhythms;[67] Grant refers to rhythmical repetition of the same note as 'riffing', with songs such as Vincent Youman's 'Tea for two' and Glenn Miller's 'In the Mood' as examples. From the point of view of operatic traditions riff songs could be described as 'undercomposed'. At the same time a different singing style was developing in yet again different venues where comprehension of dialogue was much more important. The 'coon' or 'talk' singing, suggesting the Afro-American vernacular, was also found in untrained (meaning non-operatic) folk singers performing in vaudeville and in the minstrel show tradition. Riis (2011, p. 76) describes the 'coon' song as a subgenre of ragtime that uses insulting dialect: 'because it [ragtime] was understood as a black genre, whites wrote and sang ragtime songs in blackface, adding words that reinscribed hackneyed racial stereotypes.' Grant identifies two influences at the turn of the century: the Irish tenor and the Afro-American ballad singer (imitated in the minstrel shows). Henry Pleasants also wrote that 'singing on consonants' (ie working towards greater clarity of the lyrics) had been a practice of Afro-American singers before crooners like Rudy Vallee and Bing Crosby adopted it (in Henry Pleasants' entry for Crosby in the *New Grove*).

Whereas Grant singles out changes in music styles and vocal production, Banfield (2000, p. 79) underlines that the first (of two) shifts in entertainment singing was about class, it:

> …elided or redefined distinctions between black and white, Jew and Gentile, American and British, folk and opera, south and north, comic and serious,

[67] Bruce Johnson (personal communication, February 2013) remarks how ironic that is; Erving Berlin typically composed using black piano keys only. That is to say: he wrote mainly pentatonic melodies.

> ordinary and special, above all between the vernacular of speech and the enchantment of singing by fusing both in the same performer, with or without the aid of a microphone.

At this point in their writing both Grant and Whitcomb introduce blackfaced minstrel Al Jolson (1886 – 1950) of *The Jazz Singer* (1927) fame. In the silent movie era racist stereotypes had made it to Hollywood, as in the 1915 Ku Klux Klan movie *The Birth of a Nation*. The popularity of racist entertainment was reaffirmed with the success of *The Jazz Singer*. It would take until the 1930s before Hollywood discarded the minstrel-based stereotypes (Riis 2011, p. 79). Jolson had been a famous minstrel show artist from the 1910s and in the words of Grant (2004, p. 22): 'was a one-man oxymoron of traditional singing and Irish/African-American talking-singing'. Grant bestows upon Jolson the honour of liberating musical theatre from legitimate singing, by bringing together his 'performer ego' and his singing style: 'No matter what the situation onstage, Jolson played Jolson.' and 'Jolson inadvertently turned the theatre song into a dramatic soliloquy that powerfully speaks the interior of a specific person or character'.

Pleasants, Whitcomb (1986) and Lockheart mention Jolson's later response when confronted with a microphone: 'It's a sad day when Jolie needs a mike to sing into', and Whitcomb adds that Jolson hurled the microphone to the ground. This was at a radio show in 1932; Jolson had appeared on radio before and he continued making radio appearances until his death in 1950. The year 1932 suggests that it would have been a very early occurrence for Jolson to sing using a microphone to, besides facilitate radio broadcast, amplify his voice for the audience in the studio. A decade earlier Jolson filled the Palace Theatre on Broadway (built 1913 seating 1,736) and Grant (2004, p. 190) cites sound designer Jack Shearing offering an explanation: 'There were spots on stage at the Palace Theater that Al Jolson would go to, he knew where his voice would carry'.

Both Whitcomb and McCracken mention an early Al Jolson hit song 'Rock a Bye Your Baby with a Dixie Melody'[68] in relation to the origins of crooning. The term was used prominently in minstrel songs referring to 'mammies' singing a lullaby to the

[68] Al Jolson: 'Rock a Bye Your Baby with a Dixie Melody' September 1918, Columbia 2560

infants they were looking after.[69] McCracken (1999, p. 5) quotes a line from the song: 'When you croon, croon a tune from the heart of Dixie' and mentions examples of similar songs. For McCracken 'a 'crooning' voice is low and insinuating, somewhere between the ominous tolling of a bell and the soft murmuring of a spell being cast.' Writing about these mammie songs, Whitcomb wonders whether how much 'crooning' ('singing softly in a person to person mode' in Whitcomb's words) was actually going on in those days before microphone recording. By raising that question he makes a valuable point: the problem involved is that for acoustic recording singers needed to sing very loud. Our recording based knowledge of that era is biased simply by the fact that only loud singing and playing is documented. That gives rise to thought about earlier technologies; Lockheart (2003, p. 368) points out that in the early days of mechanical recording particularly sopranos (very popular on stage) 'did not record well'; not because they weren't singing loud enough, but as a consequence of the limited frequency range of the early recording media, and an increasing risk of over-modulation (distortion) at the higher limit of that frequency range. Chanan (1995, p. 68) discusses instrumentalists and vocalists adapting their dynamic range to the recording and broadcasting mediums and the associated transducers. In Rudolf Arnheim's (1936, p. 79) book *Radio*, the author asks the question whether music on the 'wireless' should be limited to intimate chamber music: 'The volume of a large symphony or opera orchestra, which even at best depends on an extremely optimistic conception of the capacity of the human ear, is absolutely without value in broadcasting'.

It is important to acknowledge that, however spectacularly unique, our early recordings give a biased account of what singing (let alone music) sounded like in those days. I will discuss these biases of different transduction technologies in §2.14.

2.8.6 Crooning, Microphone Recording and Early Radio

A comparable bias as a consequence of the sensitivity of early sound equipment can be found in early radio broadcasts, albeit the other way around. William Vennard (1967) describes how the primitive early crystal radio mike (it is not unlikely he meant carbon)

[69] That is exactly what Jolson tells studio and radio audiences in an introduction to that song for a radio show in the 1948 KRAFT music hall which can be found on a 1961 Decca LP record, DL 9095, with Al Jolson and Oscar Levant.

was very sensitive, microphone technique meant standing far back from the microphone when not singing softly. He gives the example of Rosa Raisa singing with her back to the microphone.[71] Vennard writes that those were the days of the crooners, 'and fortunes were made by singers who could not be heard in a hall without amplification'. Unless Vennard is referring to the use of megaphones he was about a decade off; radio microphones suffered from over-sensitivity in the early 1920s, electronic amplification of singers would have been very rare before 1930. An early crooner by the name of Jack Smith the 'Whispering' baritone was wounded in a gas attack in WWI, reducing his voice to a whisper.[72] Whitcomb (2003b) suggests the absence of amplification was a cause of his singing style:

> It is not known from whence the perfect diction, clipped but rounded, originated. Undoubtedly, the absence of public address systems and mikes was a factor; as a result, singers possessing "small voices" found it necessary to project with a high degree of enunciation. It is said Smith's diction was so well developed that he could be heard clearly not only in intimate niteries (sic) but in large theaters as well.

Whispering Smith started recording in 1925 and Banfield (2000, p.72) suggests that he would have needed the agility of a microphone to record his extended vocal technique that existed of: 'alternated parlando and singing, not between verses or periods, but between notes, even syllables, sliding up singing tone from a gargle…'. Banfield compares Smith's particular enunciated baritone to Vallee's light ('nothing special') baritone that suffered from a '…strongly American, rather laddish enunciation of consonants and cocky smirks on the vowel…' that in turn Banfield likens to Fred Astaire's (but here discussing performance rather than recording):

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[71] Rosa Raisa (30 May 1893 – 28 September 1963) was a Polish-born, Italian-trained, dramatic operatic soprano. She was famous for her vocal power.

[72] Serge LaCasse (2000, p. 74) in his discussion of intimacy in public performance points at a reference in Rudolf Arnheim's (1936) *Radio*, which ends thus: "Just as we take for granted today that film and stage should not without more ado lend their actors to each other, in the same way in the acoustic realm microphone artists will be differentiated from 'concert-hall artists'".

> Something in the post-War youth culture called for this new vernacular regardless of what the microphone could achieve, for Astaire began on unamplified Broadway and Vallee used a megaphone at first. (ibid p. 73)

Lockheart (2003, p. 373) quotes Edison in 1926 from an article in the *Los Angeles Times* explaining why sopranos' voices did not broadcast well on radio:

> Thousands of people have signed a petition asking that sopranos be kept off the air […] of course most of them don't know that the soprano voice 'distorts' the radio.

The entrepreneur added that it was better to listen to music on the phonograph anyway, it being an instrument of 'good music' (this was at the time when Edison still opposed electric recording in favour of old-fashioned acoustic recording, his original invention). Whitcomb (2003b) talks about this issue:

> The trial-and-error process of the early 1920s revealed that a natural type of voice – rather than a classically trained one – was best suited to radio microphones. An everyday, casual, off-the street and in-your-living room voice. So it was that all manner of folks were invited to step up to the radio mike. Strolling singers – rank amateurs at best – were sometimes hauled in off the street … Radio, it was soon discovered, didn't require either the skills of the concert hall or the vaudeville stage. Rather, it preferred friendliness.

Female vocalists, in order to appear on radio (without overloading the sensitive microphone) had to sing in a lower register, Lockheart and Whitcomb both mention Vaughn DeLeath one of the earliest female broadcasters, as the first to be identified with crooning; an engineer suggested she should stay in the lower registers, to 'croon it'. Whitcomb calls her the 'Original Radio Girl' because she was involved in broadcasting tests at Lee De Forest's laboratory in 1920. Radio shows were very rarely recorded in

those days, again we do not have reliable sources to know what different voices would have sounded like on the radio in those earliest days.[74]

Katz's notion of the phonographic effect was mentioned before; in the same vein we could consider the radio voice and crooning as 'radiophonic' effects.[75] Charles Henderson in his book *How to Sing for Money*, quoted in Pleasants (1974, p. 134) coined the term 'phonogenic'; Pleasants adds: 'He might have coined "microgenic", too':

> … the arrival of radio and the public-address system had opened the way to, had indeed demanded, a less forceful, more intimate, more natural kind of vocal production and vocal communication.

2.8.7 Vocal Apocalypse

Legitimate singing did not disappear from Broadway from one day to the other, as Grant asserts. European born and classically trained composers kept making operettas, however influenced by vaudeville and contemporary show business.[77] Sigmund Romberg (1887-1951) was versatile enough to also write songs for Jolson, which hints at the possible crosscurrents going on. Grant's important point is that already before microphone recording (and therefore before amplification) the reciprocal influences of legitimate singing, minstrel, vaudeville and folk on the development on the American popular music vocal was well underway. Or in Grant's (2004, p. 36) own biblical parallel:

> The four horsemen of the legitimate singing apocalypse – nonsinging, legitimate belt, radio croon, and rock growl - spelled Armageddon for legitimate singing as the default style of American musical culture.

[74] Radio historian Elizabeth McLeod (1999), (1984, p. 731) in an online article gives a detailed overview based on the work by Dr. Michael Biel professor of Radio/TV at Moorehead State University in Kentucky, and his 1977 doctoral dissertation "The Making and Use Of Recordings in Broadcasting Before 1936".
[75] Ultimately the aim of this thesis is to establish such subtleties for electronic amplification but someone will have to come up with a catchy term ('ampliphonic' sounds terrible).
[77] Grant mentions Victor Herbert (1859-1924), Rudolf Friml (1879-1972) and Sigmund Romberg (1887-1951).

This reference to the rock growl hints at future Broadway developments: the rock musical, which I will describe further on in this chapter.

2.8.8 Bessie Smith

It might prove impossible to establish who the first singer was to regularly perform using electronic amplification; perhaps it is easier to determine whom the last artists were that did not do so. I will briefly sidestep into a discussion of unamplified singers.

Al Jolson's refusal to use a microphone was mentioned earlier, but one non-operatic vocalist who kept singing on her own devices was blues legend Bessie Smith (1894-1937); she 'scorned even the megaphone' (Henderson & Palmer 1945; Pleasants 1974, p. 74). Pleasants (ibid p. 164) suggests regarding Billie Holliday that she may have belted early on in her career, singing without a microphone in Harlem's clubs:

> But hers was not a voice that would have responded generously or amiably to the kind of treatment that Bessie's voice rewarded with that big sound. On records and on mike in clubs Billie's breath was wonderfully light on the vocal cords, which is why a voice neither rich in texture nor ample in size could be so eloquently tender …

John Potter (2000, p. 54) attributes the classic blues singers (apart from Bessie Smith he lists Ma Rainey, Ida Cox and Ada Brown) with 'powerful voices characterized by plenty of vibrato and a solid breathing technique', who were depending upon elements of 'conventional classical singing technique to make themselves heard'. Like Louis Armstrong they sang in a way that was close to speech, although the blues singers were closer to shouting. In another book, *Vocal Authority* Potter (1998) suggests these singers learned their singing in minstrel shows and vaudeville developing powerful voices as they had to deal with the acoustics of the tents (the canvas was not entirely alien to singing as noted earlier). Bessie Smith was famous for her voice and presence and for a long time toured the USA with her company by private train, performing in their own tent. The extent of her fame is best demonstrated by a quote from photographer and cosmopolitan Carl van Vechten who compared going to hear her sing at the Orpheum in

Newark to going to the Salzburger Festspiele to hear opera star Lilli Lehmann sing Donna Anna in Mozart's 'Don Giovanni' (Hodes & Hansen 1978, p. 60). According to many sources she always sang unamplified, 'There's no explaining her singing, her voice. She don't need a mike; she don't use one', wrote pianist Art Hodes (ibid p. 64) about her. One other aspect, besides her phenomenal voice, might be the way in which she commanded silence and attention. In the same book drummer Zutty Singleton (ibid p. 66) remembers that Bessie Smith liked her music soft:

> And how she could sing. She always wanted the music soft ... she didn't like loud music, and she brought out those blues right from the heart. Bessie was a big woman and she carried herself in a way to demand respect. She was always well groomed, and graceful in the movements of her hands and body. No wonder everybody loved to watch her and listen to her sing.

Danny Barker (Shapiro & Hentoff 1966, p. 234) compared her presence to that of an evangelist:

> She, in a sense, was like people like Billy Graham are today. Bessie was in a class with those people. She could bring mass hypnotism. When she was performing you could hear a pin drop.

In Chris Alberson's (2003, p. 77) biography *Bessie*, Lil Armstrong (pianist Lillian Hardin Armstrong, Louis Armstrong's side-woman and second wife), recalls:

> There was some big-time bootlegger on the South Side who always had these parties going. Louis took me there a couple of times and everybody got up and played. The music was always very loud, but one time Bessie Smith got up to sing, and the man who ran the place wouldn't let her start until everybody stopped laughing, talking, and carrying on. He didn't do that for us, but I guess maybe he was afraid of Bessie; she had a reputation for having a bad temper.

2.9 Megaphone Singing in Popular music, Larger Audiences

At the start of the 20th century North American cities were growing, large numbers of immigrants reached the USA from South and Eastern Europe between circa 1890-1930. Randy McBee (2000) writes how the growing cities facilitated growing 'commercial leisure', changing the way people in their teens and twenties organised their leisure and possibly more important how they met people for romantic purposes. In the first decades of the century society has become more pluralistic writes Carol Oja (2000, p. 314) in her book *Making Music Modern*:

> Through the combined effects of a large influx of eastern and southern European immigrants, an internal migration of African Americans from the rural south to northern cities, and the greater accessibility through phonograph recordings and radio of music of diverse styles and peoples…

The pluralistic society became stronger after WWI but unfortunately racism intensified. Oja (ibid) cites the post war anti-German sentiments, and European Americans feeling: '… their dominion threatened'; and as a consequence: 'intolerance grew, finding varied means of expression.' In the late 19th century a dance band would perform in the style of Sousa marches, two decades later, in the pre WWI craze white audiences danced to Afro American music played by Afro Americans. Paul Lopes (2002, p. 21) describes in *The Rise of a Jazz Art World* how: 'fuelled by the popular (white) dancers Irene and Vernon Castle and James Reese Europe's band syncopated music: 'spread along the public in rags, two-steps, foxtrots, and tangos…'.[78] After the war the dance craze became a jazz craze but this time white people were dancing to white musicians playing. What is often considered as the first jazz record was recorded by a white band,[79] the first person to be considered 'king of jazz' was Paul Whiteman. For a discussion see for instance Lopes

[78] James Reese Europe was instrumental not only in spreading syncopated music in the USA (and Europe) but also by professionalizing Afro American bands and orchestras. In 1910 he was one of the founders of the Clef Club that would, as R. Reid Badger (1989) writes: 'provide a central union, clearinghouse, and booking agency for the employment of black musicians anywhere in New York and to oversee their contracts and guarantee their professionalism. By fronting a highly publicized orchestra of its best musicians, the club also sought to secure the black musician's place in the forefront of the public's mind.'

[79] The Original Dixie Jass Band recorded *Dixieland Jass Band One-Step* and *Livery Stable Blues.* Victor Talking Machine Company no. 18255, February 26, 1917.

(2002) or Berrett (2004) who juxtaposes the careers of Louis Armstrong and Paul Whiteman. Through all novel entertainment industries a tacit racial divide established itself, for instance in the 'race-records' (see Roy 2004) and the Afro American musical theatre (Riis 1989; Woll 1989).

The two 'dance-crazes' before and after WWI took place in ever expanding dance halls and palaces accommodating up to thousands of people (Erenberg 1984, p. 146). McBee (2000, p.60) cites research from 1915 that counted 11,500 people dancing in 79 public dance halls in Cleveland: 'By 1924, the fancier dance palaces, gardens, parks, and ballrooms were attracting six million patrons in New York City alone and nearly that many in Chicago.' The larger halls accommodating larger crowds needed louder music, Johnson (2000, p. 88) writes about the growing venues: 'The size of such spaces, and the ambient noise of huge crowds socialising, necessitated an increase in the volume and definition of the music'.

Lockheart (2003, p. 370) describes the changes in dance styles from waltzes to foxtrots in the American ballrooms from the mid 1910s to the mid 1920s. In addition, the success of the radio in the1920s demanded music that appealed both to the local dancing audience and to the radio audience at home, which helped the success and consequent professionalisation of orchestras like Whiteman's. The dance orchestras added vocal refrains to their recordings that were previously less vocally oriented. Also the development of riff-songs that was noted by Grant should be mentioned in this context; Grant (2004, p. 188) who suggested that the only vocalist to ever use a megaphone to effect was Rudy Vallee. Lockheart writes that at live performances the vocalists would sometimes have used megaphones (with the risk of only being heard by those in the firing line (ie on-axis) with megaphone, as noted by Susana Walton writing about *Façade*). In Ross Russel's (1971) *Jazz Style in Kansas City and the South West* the author dedicates a chapter to Jack Teagarden who sang besides playing trombone. At a gig in 1924 Teagarden, 'using a small megaphone in the style of the day, sang his first vocals'. There are occasional references to vocalists in Paul Whiteman's orchestra using megaphones. Bing Crosby and Al Rinker in September 1926 heard Jack Fulton sing: 'In a little Spanish town' through a megaphone (Giddins 2001, p. 136). Whitcomb (2003a) quotes Al Rinker about the first time he and Crosby played together:

> We went over a couple of tunes and we knew right away that this guy had a beat. Not only that, but he picked up his megaphone, and he could sing! So this was great, a real surprise to us.

Charles Thompson (1976, p. 20) in his Crosby biography omits the megaphone at that incident but mentions it on the next page; Bing was singing, crooning, more and more in their first band, 'through a little megaphone'. Crosby (1953, p. 170) remembers in his autobiography *Call Me Lucky* being part of Whiteman's orchestra playing in San Diego:

> I was sitting in the fiddle section cradling my prop violin, the one with the rubber strings. I also had a little humming called harmony humming to do through a megaphone as a background for an instrumental solo.

But on other occasions they would appear without megaphones: Crosby, Rinker and Harry Barris made an unsuccessful debut as the 'Rhythm boys' at a Whiteman show at the Paramount in New York: 'some said the Paramount itself defeated them, particularly since they sang without microphones or megaphones' (Giddins 2001, p. 154). [80] Another Crosby biography (Grudens 2003) tells that the Rhythm boys were a hit but inaudible in the Paramount in New York. Rudy Vallee (1975, p. 91) once shared a bill with the Rhythm Boys:

> Above the clatter of the diners the Rhythm Boys might just as well have stayed in bed [...] Suddenly a hush fell upon the crowd [...] One of the Rhythm Boys was singing a song called "Montmartre Rose", and even though he lacked any amplification or means of channelling his sound waves to us, his voice commanded instant silence.' (quoted in Giddins 2001, p. 197)

According to Pleasants (1974, p. 137) also citing Vallee this was in 1927 in Baltimore.

[80] Their musical act around an upright piano may very well not have accommodated singing through a megaphone.

McCracken's (1999) paper about crooners opens with a quote from a newspaper article 'Rudy Vallee: God's Gift to us Girls'.[81] The article from 1929 reviews a Vallee concert and mentions him singing through a megaphone. Vallee's popularity in 1929 shows that crooning; the 'gods gift to us girls' effect, or the eroticisation of the intimate microphone voice (analysed in McCracken's paper) had already made its impact. Vallee became an iconic megaphone singer; Pleasants (1974, p. 136) refers to his signature use. Also Vallee was often portrayed with one, for instance, in *Liberty Magazine*, May 24th 1930 (Greene 1995) and on the cover of sheet music of a song also 1930. And to support this point, he appeared with a megaphone in a Betty Boop Cartoon in 1934.[82] In his *Vagabond Dreams Come True* Vallee (1930, p. 68) writes:

> I have found a megaphone to be absolutely essential when we consider that the great cathedrals of today, seating three and sometimes four thousands people, were not built for the natural reception of a soft voice like mine.

He continues with an important observation about the visual obstruction that megaphone use implied:

> ... the eye must see what is going on. This seems absurd when, after all, I am singing, and that singing is performed expressly for the ear. And yet the Selfish EYE must have its share of the entertainment and demands that it also have a share in everything that is going on. Instead of sitting back, relaxing and listening to the voice alone, which after all is the proper way to enjoy a vocal rendition, so many people feel very unhappy when they cannot see the face from which the sound is issuing.

In a later autobiography (Vallee 1975, p. 110) the singer discuses how broadcasting took away the show from the patrons in the club, hotel or studio where the broadcast took

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[81] Martha Gellhorn – who later married Ernest Hemingway, *New Republic* August, 5, 1929.
[82] Vallee's cameo in *Poor Cinderella* is at 7:10-7:24: <viewed 20 August 2012> http://www.archive.org/details/Betty_Boop_Poor_Cinderella_1934

place: 'In the next few minutes after the broadcast I will be singing these same songs through my megaphone'.

Johnson (2000, p. 90) describes megaphone use in Australia in the early 1930s and how already in 1933 or 1934 they became obsolete with the arrival of electronic amplification. In the same chapter Johnson writes about a British crooner of South-African descent who, like Vallee, was an iconic megaphone singer judging from an advertisement in (UK) *Melody Maker*, February 1933 for the 'Al Bowlly ultra compact Megaphone: A new Loud Speaker for Vocalists!'. Bowlly enjoyed great popularity in both UK and the USA and recorded over a thousand 'sides' between 1927 and 1941 when he died in London during a German air raid (cf Whitcomb 2003).[83]

The acoustic megaphone as amplifier never completely disappeared; for instance in Steve Reich's music for a production of *Ubu Roi* in San Fransicso 1963, for clarinet, violin and kazoo. The kazoo was amplified 'by means of a large Pacific Gas and Electra traffic cone' (Potter 2002, p. 161).

2.9.1 From Megaphone to Microphone

The transition from megaphone to microphone and its relation to the coming of the crooners are unclear; and as Chanan (1995, p. 70) concludes, it is hard to say what came first: 'the desire to croon or the instrument that made it possible'. By 1930 almost all the ingredients for electronic amplification were available: amplifiers, directional loudspeakers and drier acoustics of theatres in the wake of the conversion to sound motion picture. As observed in the previous chapter a directional microphone that transduced more selectively was not commercially available until well into 1931. Edward Kellogg (1930, p. 103) in an address to the Society of Motion Picture Engineers in January 1930 mentions PA systems in relation to reverberation of venues:

> I am not in a position to say whether a voice amplifying system suitable for application to music has been developed, but we would be in serious error if we

[83] In 1935 Bowlly published a book called *Modern Style Singing: ("Crooning")* (published by H. Selmer) that I have not yet been able to obtain.

> formed our estimates of the possibilities from some of the public address systems, which we know.

Kellogg writes about the success of PA systems for speech amplification but underlines that the quality was not very high in terms of frequency range. Spoken language could be successfully transmitted to a large audience (a lack of low frequencies, similar to telephony, was no issue) but aesthetically the result was not very pleasing:

> I can fancy an artist, jealous of her reputation, exclaiming, "What, let the people listen to that tin horn and call it my voice?" and our sympathies would be with the artist, or the people, or both. (ibid)

Colin O'More, a program supervisor for CBS, wrote in *The Musician* of January 1932 that crooners 'were the sole products of amplification: in the studio, they are actually inaudible' (quoted in McCracken 1999). His remark supports the notion that until 1931 it was uncommon for vocalists, using a radio broadcast microphone to be amplified for the studio audience. In an interview with Vallee in 1971 by Chuck Schaden (1971 from 6'23") Vallee tells us that feedback was a problem:

> CS: Did you use the megaphone, your trademark, at that time? [1928/9]
> RV: At that time there was no amplification of any kind as far as I...the only electrical speakers I ever heard used, were in the subway trains in New York, had little speakers in some of the cars would say 'watch the door, watch the door' and that was the only time I heard a voice being amplified through a speaker. And of course, in all the broadcasting studios, outside the studios there were big sort of radios in the hallway where you could hear the program that was going on inside the glass enclosed radio studio. And I said: Well why can't they have a speaker right in the same room with us? And they said you'll get a feedback, the sound will come out of the speaker and go back into the microphone with your own live voice, and it just won't work out. Of course they didn't know that it could work out if you put the loudspeaker in the correct position. And at that time we had no

> way of sending the voice forward except to either cup your hands around your mouth, roll up a newspaper or pick up what cheerleaders have been using for years of football games to send their voices up in the stands, use a big cheerleader megaphone.
> CS: hmm, so that is the way that developed, that is very interesting.
> RV: Well, it was very obvious, what else could you do!

Vallee apparently later claimed that he personally devised his first sound system in 1930 as we can read in Pleasants (1974, p. 134), also in (Lockheart 2003):

> "It sounds like a real Goldberg contraption," he told Paul Whiteman, "but it works. I borrowed an old carbon mike from NBC, hooked up a homemade amplifier with some radios, and I've got a sort of electronic megaphone. I had the legs sawed off the radios so they don't look so strange."

Unfortunately Pleasants does not refer to a source for this quote, one of the earliest references to singers using electronic amplification. But with Kellogg's remarks in mind, using a carbon microphone and radio loudspeakers (not the directional loudspeakers that were developed for the cinema) it would not have sounded very good amplifying a low pitch (baritone) soft male singing voice.[84] Whether first trialled by Vallee or not, Pleasants (1974, p. 134) philosophises on the consequences:

> Radio had removed size of voice as a competitive factor. When the turn of a knob could make any voice sound as big as any other voice, a singer, in order to excel, had to look for other areas of excellence.

Pleasants presents another quote from Vallee (1930, p. 68) about his choice to amplify his voice using a megaphone, in relation to the intelligibility of the lyrics:

[84] Vallee's own writing is full of boastful stories making his claims harder to believe in my opinion. On the other hand he was introduced to the Theremin and its powerful loudspeaker by L.H. Shewell who performed on Vallee's show from January 1930 (see Glinsky 2005, p.113/4).

> What I did was simply to risk the censure of the public opinion by using it on every song, and singing many songs through it, because I believe that one of the biggest defects in most people who sing songs is that they get the melody out but not the words.

Grant already directed us towards the discussion of discernable lyrics, and the 'demand that the words always be audibly and correctly pronounced' is something that kept coming up in the history of singing (cf Wistreich 2000). Pleasants (1974, p. 136):

> Along with Vallee's megaphone and Goldbergian public-address system, electronic amplification had, in less than a decade, taken singing back about 300 years to the objectives and practices of the early seventeenth-century reformers, Caccini, Monteverdi and Cavalli.

The latter composers, the grandfathers of opera, had 'freed vocal music … from the artificial melodizing of renaissance polyphony and wedded it to the music of Italian speech' (ibid).

2.10 Bing Crosby at the Cocoanut Grove

> *In making quiet voices audible, the mike forever altered our perception of the human voice*… (Friedwald 1990, p. 14)

John Potter (1998, p. 105) writes about Crosby's microphone use: '… [it] enabled him to put all his energies into text/tempo creation, unencumbered by the need to project which had given him so much trouble when singing live in large halls'. The Rhythm Boys (Crosby, Al Rinker and Harry Barris) were part of the Whiteman organisation performing with the orchestra and separately as a trio in the second half of the 1920s. They left Whiteman in 1930 and found an engagement with Gus Arnheim's orchestra at the Cocoanut Grove, a nightclub at the Ambassador Hotel in Los Angeles from July 1930 to May 1931. A station called KNX had a studio at the nightclub and broadcast the shows

nightly. In April 1930 the nightclub was home to the second Academy Awards (Oscar) ceremony, making it likely it had some form of a public address system, perhaps even a state of the art system given the importance of that event. Two sources, Giddins (2001, p. 227/8) and Grant (2004, p. 39) suggest that at the Cocoanut Grove Crosby's voice was electronically amplified for the local audience although there are no unambiguous cues or specifications. Grant does not provide a reference (but he might have read it in Giddins) and Giddins writes about Crosby's general microphone use, his remarks might refer to radio or recording. Yet he writes: 'Overnight megaphones became a joke, as the tradition of vocal shouting receded into an instant prehistory' (ibid p. 227) which does suggest a relation to amplified singing. Grant bases his analyses on witness' accounts and on an unpublished manuscript of Al Rinker's memoirs.[85] Another source *Singing Jazz by* Crowther and Pinfold (1997) suggests otherwise, or at least that the sound system was not in place from the beginning of the Rhythm Boys' run at the club, quoting Rudy Vallee (without reference but the quote can also be found in (Thompson 1976, p. 41): [87]

> [Vallee] had witnessed an early appearance of the Rhythm Boys at the Coconut (sic) Grove in Hollywood. They were having difficulties in being heard, "... since they didn't have any amplification ... and didn't use megaphones, nobody paid the slightest attention to them". Crosby realizing this, left the stage and headed towards the audience. "Suddenly the room was quiet as a grave. Out in the middle of the floor was one of the trio singing. The crowd was quiet, very quiet, and when he finished the place went into ecstasy ... this young man walked right off the floor with no expression whatsoever on his face. No triumph! No elation! No conquest! It was as though he were deaf like Beethoven and couldn't hear the audience had liked what he did".

Thompson writes this anecdote took place at the Montmartre Café in Los Angeles where the trio played in the weeks before their Cocoanut Grove engagement, making it hard to tell at which establishment Vallee heard Crosby sing, in this anecdote.

[85] I asked Larry Giddins in an email about additional sources but he replied he did not know of any sources besides the ones mentioned in his book (personal communication March 2012).
[87] Not every author fancies Vallee, for instance Crowther and Pinfold (1997) call him 'lugubrious'.

Giddins (2001, p. 228) also provides a quote from Al Rinker that suggests that the crowd did have to focus their attention on the singer, which might suggest no amplification was in place: 'When the Rhythm Boys or Bing were singing from the bandstand all the dancers… would practically stand still and watch us when the band took over they would dance again.' A 1931 film clip of Crosby singing with Arnheim's orchestra at the Cocoanut Grove shows him singing into a typical radio carbon microphone, that would not have worked very well, similar to Vallee's contraption, amplifying a soft crooning voice.[89] On the other hand these movie clips were probably not recorded live, the musicians and dancers mimed in sync to a recording made earlier.

There is yet another possibility, early in January 1931 Crosby recorded 'I Surrender Dear' with Arnheim's band for RCA-Victor; Giddins (ibid p. 238) about that side: '… the performance is if not his finest to date, then certainly his most paradigmatic. Bing's huskiness is wonderfully captured by the Victor technicians.' The recording is one of the first music recordings using Harry Olson's new ribbon microphone (Clarke 2012), either the RCA Photophone PB-31 (the model used in the RCMH in 1932), its predecessor the PB-17 (which can be seen in Olson's (1931) paper or the model presented later that year the 44A). Perhaps the RCA engineers tried that microphone for amplification purposes at the Cocoanut Grove, together with RCA's baffle loudspeakers that were developed for the cinemas. The RCA (Olson's) ribbon microphones were defining for the sound of the crooners, starting with Crosby; later on in the 1930s he would buy his own RCA 44DX.[90] Yaxley (2005b) reports the RCA ribbon microphones were very expensive quoting 130 English Pounds for a RCA-44.

According to Whitcomb (2003a), before the Cocoanut era Crosby sang smoothly, not unlike the lyrical Irish tenors style:

> … which resulted in his sounding much like the voicing of a technically correct but uninspired alto saxophone solo. But at the Grove, Bing seems to have brought all of his musical experience to bear on his delivery, and the result was the first stage of a totally new style of singing, different from that of any singer before him

[89] http://www.youtube.com/watch?v=k5jDX-k7m6g <viewed 9 May 2012>.
[90] Crosby's microphone is now in possession of the 'Pacific Pioneer Broadcasters' and kept in the care of California's Thousand Oaks Library.

> and much copied by all who followed.

Grant (2004, p. 40) after writing that Crosby sang: 'live – but with a microphone', at his Cocoanut appearances, continues in superlatives:

> But Crosby did more than co-opt the moniker of crooner; he made the use of the microphone arguably the single most important innovation in audible entertainment since the ancient Greek amphitheater.

Russ Columbo who played violin in Arnheim's band developed into another famous crooner of the era until his sudden death in 1934, and may have learned a thing or two from Crosby's experience:

> After observing Bing for a few months, he began to appreciate what could be done with a microphone (he could barely be heard without one) … and could put up a ballad in a manner not unlike Bing's. Some listeners claimed they could not tell the difference on evenings when Bing failed to show and Columbo went on in his place… (Giddins 2001, p. 227)

Whether from live performance, radio broadcast or recording (Crosby recorded his first record in 1926, electronically) his singing left a lasting impact on the popular singing voice. Giddins refers to Donald Shepherd and Robert F. Slatzer's biography *Bing Crosby, the Hollow Man* from 1981: 'Bing's success was largely due to his development of an innovative singing style.' Friedwald (1990, p. 31) quips: '[Ruth] Etting and [Gene] Austin and the other early microphone singers demonstrated how the new electric recording technique could be used, but left it to Crosby to prove that subtlety did not have to mean somnambulance'.

2.10.1 Other Early References

Johnson (2000, p. 91) documents the shift to electronic amplification: '…as the standard in live performance in Australia over the period 1933-34', pointing to an article in a

music periodical dated June 1933. The reporter remarked that the voices sounded: 'particularly well'. An interview from 1963 with Jimmy Rushing who sang with the Blue Devils and later with Count Basie can be found in Stanley Dance (1980):

> By 1927, the Blue Devils were getting very big in the state, and when they heard me sing one night I was gone again! We toured all over the Southwest and were recognized as one of the top bands. There were no microphones in those days, and unless you could overshadow the horns they wouldn't let you sing. You had to have a good pair of lungs... strong!...to reach out over the band and the people in those big dance halls. Later on, they brought in megaphones for singers like Rudy Vallee, but the crooners and sweet singers couldn't make it before that. As I remember, microphones came into use around 1933…..

Ross Russel (1971) remarked that 'Rushing's voice was like another instrument', and even when the 'Blue Devils' (whom Rushing sang with) played at their loudest, 'that voice could not be drowned out'. Friedwald (1990, p. 14) adds a story of Herb Jeffries losing a gig at a ballroom in the early 1930s: 'because his voice could not fill the hall' and the owner could not afford 'one of those newfangled microphones'. In Russel's book we can also read about blues shouter 'Big' Joe Turner working behind the bar at the Sunset club and at the same time singing through a PA system installed behind the bar. According to Russel this was one of the first PA systems in Kansas City; unfortunately he is not clear about the year, but Turner started working at the Sunset in 1928 or '29 when he was eighteen or nineteen. Russel goes on to say that Turner did not really need amplification; he had a voice like a trumpet. In addition the system had an extra loudspeaker outside the club, above the door:[91]

> When Big Joe, backed by the two-man rhythm section, burst into song, the entire neighbourhood knew it, and people loitering on the streets, trying to make up their minds as to which of several possible clubs situated there would draw their

[91] Another, more anecdotal, source mentions Turner singing from his 'station' behind the bar with just a loudspeaker outside. http://library.umkc.edu/spec-col/club-kaycee/JAZZSPOT/0venue.htm#nightclubs <viewed 29 February 2012>

> patronage, were moved to enter the Sunset. […] Big Joe Turner, the loudspeaker, Piney Brown [the owner], and the effervescent two-man rhythm section gave the Sunset a magic quality. (Russel 19731, p. 16/7)

2.11 Broadway Musical

As sketched in the previous paragraphs a shift in singing styles in American popular music had already occurred, before electronic amplification became available in the concert halls, theatres, nightclubs and hotel lobbies. The technology would have a lasting influence on popular music but also on theatrical singing, particularly on the Broadway show and musical. At this moment in time the vast majority of musicals and revues are amplified using a dedicated microphone for each instrument and vocalist. All these 'inputs' come together in the operator's mixing desk, where the musical balance is maintained. The shift from unamplified to fully amplified took from roughly 1940 until the Rock Musicals of the 1970s that would not 'rock' if it was not for electronic amplification.

Two singers who are often referred to in the context of unamplified Broadway shows are Fred Astaire and Ethel Merman (E.A. Zimmerman 1908-1984). Astaire, before becoming a movie star, started his career singing on Broadway in the 1920s and as Tommasini (1999a) underlines (in the debate around an electroacoustic system in the NY State Theatre):

> Think of Fred Astaire singing with that tiny voice and no microphones in Gershwin shows of the 1920s. Yet Gershwin loved Astaire's literate, jaunty, conversational singing style and wrote with his voice and personality in mind. No one complained that Astaire could not be heard. Ira Gershwin wrote clever lyrics because he knew that people were leaning forward in their seats hanging on every word.

The musical *Gay Divorce* (1932) was Astaire's last Broadway show and composer Cole Porter had Astaire in mind when he wrote the songs for it. The show's most famous song *Night and Day* reveals some of the changes in song writing style that Grant refers to, a

smaller range (vocal compass) and a rhythmic hook (cf Knapp & Morris 2011, p. 93/4). Astaire is regularly mentioned by authors referring to Broadway singing before amplification often acknowledging his 'small voice', for instance in, again, Tommasini (2006).

Compared to the world of the radio crooners and Roxy's shows at the RCMH, Broadway theatre took longer to pick up amplification. Perhaps audiences were more attentive in those days but certainly quieter in a theatre than in a dance hall, dancing not being a silent activity. Another reason could be the coming of age of 'belting', a vocal technique, specific to the Broadway musical, that allowed singers like Ethel Merman to project and be heard in the Broadway theatres. The authors mentioned in this context do not agree about an exact definition and also place the coming of age of the style about a decade apart. Before 1930 the female belt can be traced back to the Afro American blues shouters and to their white contemporaries who imitated the style in character roles stereotyping female Afro American singers. Merman's debut in Gershwin's *Crazy Girl* at the Alvin Theatre in October 1930 was the first performance of a 'leading-lady belter' (Grant 2004, p. 38). Merman was heard

> … without amplification over a pit orchestra that combined the celebrated Joseph Smith strings and the Red Nichols jazz band, which included Nichols and Charlie Teagarden on trumpet, Glen Miller on trombone, Benny Goodman on reeds, and Gene Krupa on drums. Overnight Merman made the belt voice legitimate.

2.11.1 The Broadway Belt and Orchestration

Merman seems to be instrumental in the story of unamplified Broadway singing. Without fail her name (and more often than not, only hers) is brought up in discussions of Broadway singing; in addition to Pleasants', Osborne's, Grant's and Banfield's there are many references to her singing voice in *The Oxford Handbook of the American Musical* (cf Knapp & Morris 2011, p. 138, 272, 318). Stravinsky (unreferenced) was a fan, referring to her voice: 'What an instrument! It could fill Madison Square Garden without a microphone!' and Irving Berlin: 'When you write lyrics for Ethel, they better be good, for if they are bad everybody's going to hear them anyhow' (both quoted in *Brass Diva*

(Flinn 2009, p. p. viii and 424). The ubiquity of Merman's name whenever unamplified Broadway singing is mentioned suggests that perhaps the whole ideal of unamplified Broadway musicals is based on her voice alone. Some other names do pop up however, Tommasini (1999a) mentions John Raitt and so does Engel (1975, p. 157) who adds Vivienne Segal, Dennis King, Howard Marsh, Robert Chisholm and Ray Middleton to the list.

According to Grant with *Crazy Girl* the female belt made its Broadway stage debut. Banfield (2000, p. 65), after Osborne (1979, p. 61), situates it in the 1940s describing Celeste Holm's auditioning before Richard Rogers for the role of Ado Annie in *Oklahoma* (1943) and Merman's appearance as Annie Oakley in *Annie get your gun* (1946). That show was written by Dorothy Fields and composer Irving Berlin and the famous Broadway arranger Robert Russel Bennett (who had orchestrated *Girl* Crazy for Gershwin) was called to New Haven where the show had just opened.[92] Producers Rogers and Hammerstein were unhappy with arranger Philip Lang's work and Bennett was brought in to 'fix it'. Bennett observed what he called a 'modern technique' of arranging where the vocalist sang the melody unsupported, ie not doubled by instruments or a whole section of the orchestra: 'That was called "microphone technique" and was the best way to do any song for recordings of any kind' (Bennett & Ferencz 1999, p. 197). In the same book, in an essay called *Orchestration of Theatre and Dance Music,* Bennett signals an influence from recording and broadcasting on Broadway shows, whether amplified or not:

> In accompanying singers of the musical-comedy stage, a great problem was presented when the popular fancy turned away from big voice to little, thin ones of personal appeal but no vocal power. This necessitated for years the presence of the melody strongly played in the orchestra, since the singer would leave some doubt as to just what the melody was if left to his or her own devices in the matter. Not until the use of microphones, which transforms a "croon" into a full vocal tone, was it thought possible to make the orchestration into a pure

[92] It is still common to create and try-out shows 'off-Broadway' before they are opened 'on-Broadway', often in New Haven, Massachusetts.

> accompaniment. Somehow a wave of such orchestrations followed the radio and motion picture boom. High sustained violins (divided), pianos, guitars, and *pizzicato* bass for rhythm, low sustained woodwind (maybe sax *pianissimo*) or a harmless counter-melody in low unison clarinets, with trumpets and trombones chirping out the moment the voice pauses for breath – that became the accepted architecture of song orchestration when voices were "miked". It is also used where no loud-speaker system is present. The reason is vague but somehow the hammering of the public ear by "miked" music has caused voices to grow fuller and more penetrating when left unaided (ibid p. 289).[94]

In an interview (Pareles 1983) with Hans Spialek one of Bennett's orchestration colleagues, he laments the loss of the 1930s orchestration tradition:

> They're going to kill me for saying this, but you have no more real orchestral sound in musical comedy. I think it's those microphones - they ruin the natural color. And that's the art of orchestrating. We had to bring out voices that sometimes were not voices at all - just talking voices - over a big orchestra in a big room, and sell them to the audience. Now, you could stand at a microphone and sing 'Small Hotel' slowly, and in the background you could play 'Stars and Stripes Forever' with 16 brass, and you wouldn't know the difference as long as it harmonizes.

2.11.2 First Amplification on Broadway

There is some debate as to when amplification first made it into the Broadway theatres, some sources suggesting the 1957 production of Leonard Bernstein's *West Side Story* as being the first musical to use 'foot mikes'. Banfield (2000, p. 77) refers to producer/director Hal Prince (1974) who was perhaps referring to his own productions when he wrote that they did not use microphones until *West Side Story*. Burris-Meyer & Mallory (1959, p. 6) refer to research done at the Stevens Institute of Technology in

[94] George Ferencz, editor of Bennett's book is unclear about the date of this citation. He writes in a footnote that 'it would seem to date from the late 1930s'. The essay appeared in *The Music Lovers' Encyclopedia*, Doubleday, New York 1950 (bibliography) or 1955 (footnote on page 284 of that book).

Hoboken, New Jersey. In cooperation with the Stevens Dramatic Society, 'control of spectrum, distance, direction, movement and dynamics' were demonstrated in a 'legitimate' production called 'The Sound Show' at the (on campus) Grace E. and Kenneth W. DeBaun Auditorium in the fall of 1934 (and a second one in 1941).

Earl Carroll's *Vanities* at the St. James theatre New York in the winter of 1939/40 is often mentioned as the first musical Show or Revue to use amplification (cf Engel 1975, p. 157). It was reviewed by *New York Times* theatre critic Brooks Atkinson (1940): 'No revue that frantically hugs the microphone can be much more than a pain in the ear.' And he finishes: 'The microphones which very nearly make this "Vanities" a menace, could be yanked out and tossed into the alley, which would not be a bad idea at that.'

The second part of Grant's book is dedicated to sound design in the Broadway musical tradition. He is very detailed in early occurrences of amplified shows, starting off by looking at the size of the theatres. The 5,000 seats at the Hippodrome and the 3,000 at the Earl Carroll theatre presented audibility problems. Notwithstanding an experiment with 5,000 acoustic discs the latter closed in 1939 as the 'sound was judged too tenuous' (2004, p. 191). Grant cites a 1982 study by consultant Peter George concluding that (well-designed) Broadway venues with fewer than 2,000 seats could be operated without 'electronic enhancement', Grant makes sure to point out that now all of the houses are smaller than that, and use amplification.

The first show to (secretly) use amplification according to Grant was Cole Porter's *DuBarry Was a Lady* in 1939, to overcome heavy brass orchestrations.[96] That poses an interesting example as Ethel Merman, the darling of the unamplified belt was in the cast. Since that show and Carrol's *Vanities* the number of examples increases rapidly over time, in the words of Engel (1975, p. 157):

> Six or seven mikes were spaced out evenly in the footlight troughs. Sometimes mikes were also hidden in scenery when singers had to perform at too great a distance from the forestage. For two decades this crude method of amplification sufficed.

[96] Grant mentions Broadway historians Lehman Engel, Miles Kreuger and Gerald Bordman in the sentence before but gives no other sources.

Engel (ibid p. 155) also points to the relation between louder orchestration (more saxophones for example) and the need for vocal amplification (which in turn would accommodate even louder orchestration etcetera):

> The orchestra in the pit, through the addition of new instruments and more complex contemporary orchestration, has grown busier and louder, while the singers on the stage have diminished in volume and style from opera-size to whispering crooners. But for modern-day electronic know-how, the accompaniment today would indeed annihilate the accompanied.

In addition to that argument Grant (2004, p. 195) mentions more complicated stage direction, choreography and set design, being visually 'more dazzling' but 'not always optimal for vocal directionality. By means of example, a set design with a more 'open stage' instead of a rear wall (whether from wood or canvas), takes away the acoustic reflections that have supported performers since the Greek amphitheatres. In his analysis of the Broadway singing style Grant pointed to the merging of singer and actor. Since the 1930s dancing became more and more important in the musical, not only did a Broadway performer have to be a powerful, projecting singer and actor, enunciating every word, he or she had to be increasingly a gymnastic and fit dancer at the same time. In Banfield's (2000, p. 77) words: '… verbal audibility without musical sacrifice was just one of the very much-increased multi-disciplinary demands made on show performers', to the point that in some dance sequences the vocals had to be pre-recorded with the performers lip-syncing. Acting along to pre-recorded music was already a common procedure in film as an alternative to live recording.[97] Banfield mentions this practice in *Follies* (1971), citing Hal (1974) who blamed a lack of training of the performers and television which had 'pushed the audience back in their chairs' instead of leaning forward breathless, determined to catch every word. That the problem is bigger than a matter of lazy audiences or unqualified performers (not everybody can sing like Ethel Merman), is well

[97] For a discussion of sync practices and the different approaches to early cinematic sound recording see for instance O'Brien (2005).

demonstrated by Banfield's (2000, p. 78) analysis of the *West Side Story's* love song *Maria*. The song revived the large (operatic) vocal range, spreading out over two octaves, but: 'handsome young dancers are not tenors' and (baritone) Larry Kert (playing Tony) required amplification to realise the song on stage.

2.11.3 Full Amplification on Broadway

Engel (1975, p. 161) argues that it is a 'fault to "mix" a mechanical quality with a real one' and therefore suggests to not just amplifying singers but also the orchestra, similar to the discussion in the performance of mixed music.[98]

For *Promises Promises* (1968),[99] composer arranger and song smith Burt Bacharach engaged producer Phil Spector (famous for the 'Wall of Sound'; the production technique not to be confused with the sound system in use by the Grateful Dead) who transformed the orchestra pit into a recording studio with acoustic separation between the instruments (Grant 2004, p. 195). According to Scott Warfield (2008, p. 240) *Promises* was the first show to do so: '…every member of the band, including four female back-up singers, was miked.' Both Warfield (ibid) and Wollman (2006, p. 124) assure us *Promises* was pop music and not a rock musical, that label is reserved for the more successful musical *Hair*, where the orchestra became a rock band and the vocalists used handheld microphones for their amplification. One novel aspect of *Hair*'s choreography was to ensure all the microphone cables on stage were pre-set and intertwined to prevent a big knot. British theatrical sound designer John Leonard (2001, p. 111) describes a similar 'cable ballet' for the West End version of *Jesus Christ Superstar* (1972):

> After each song, the microphones were either placed on the stage to be picked up by the next singer, or hauled into the wings by their cables … the overall effect was more that of a rock concert than a traditional musical, but the show started a rise in the tide of amplification in musical theatre.

[98] In the same breath he suggests optimising channel separation between stage and pit by covering the latter with the conductor in a glass bubble.
[99] Based on Billy Wilder's *The Apartment* (1960).

David Collison was the sound designer for the UK production of the show, he describes it in more detail in his books (Collison 1976, 2008). The use of voice amplification for ordinary (non-rock) musicals moved into the faster lane with the introduction of the 'body mike'. Early versions consisted of a 'lavalier' microphone worn with a cord around the neck (Grant writes as early as 1964 in *Hello Dolly*; Burston mentions a production of *Funny Girl* also in 1964).[101] Miniaturisation allowed tiny microphones to be positioned (using Leucoplast) to the performer's forehead, connected by a skin coloured wire to a 'body pack', a little battery-powered radio transmitter. These became widely used in the 1970s but arguably the musical *Cats* (1982) had, for the first time, every vocalist outfitted with an individual radio microphone. With the microphone so close to the source a huge leap in directness (resulting in a more intimate sound) and a larger gain (more amplification) could be realised before a system started to oscillate into feedback.

2.11.4 Production Values

'Broadway has always been about making money' write Jessica Sternfeld and Elizabeth L. Wollman (2011, p. 112); they describe the 1970s as problematic not only for the (musical) industry but also for New York City in general; Times Square, the shining beacon of Broadway, had become 'a symbol of urban decay' (ibid p. 113). Crawling back on its feet in the 1980s opened the door for 'the British invasion' (*Cats*, *Phantom of the Opera*, *Les Misérables,* all Cameron Mackintosh Ltd productions) by 'highly capitalised, globally competent […] transnational players' (ibid p. 118) and the entry in 1990 of an even bigger player: Disney. The Walt Disney Corporation struck a deal with the city to: 'restore the dilapidated New Amsterdam Theater in exchange for an exclusive lease of the building' (ibid p. 113). Broadway musicals of the 1990s and 2010s were produced by big corporations attracting, and marketed for an international audience (tourists) producing shows increasingly based on movies. The process of decision making with regard to the use of amplification (and the level thereof) in relation to choices of

[101] Possibly Barbara Streisand, the original 'Funny Girl': Streisand was miked for *Funny Girl*, which meant all of her costumes were fashioned with a small buttonhole for a microphone to poke through. Ray Diffen, worked on the *Funny Girl* costumes, wrote that 'the aerial was wound around her body, the microphone was fixed to her bra and the battery pack was taped to her leg, or the small of her back. The battery pack then was quite unwieldy, as big as a packet of cigarettes.' http://barbra-archives.com/live/60s/funny_girl_broadway_2.html <viewed March 21, 2012>

orchestration, casting, set design and sound design is run ultimately by the producers with (or without) the director of a show. One contemporary guiding principle is the notion that the sound must be roughly the same in all the seats in the house; this is much easier to accomplish with amplification than without (eg extra loudspeakers can be installed to address seats that are further from the stage). In order for a musical production to be commercially viable a show will have to run sometimes as many as eight times a week, every week; producers want to assure a similar level of quality for each performance. After a few weeks of projecting over an orchestra, without the support of amplification singers might start losing their voices (usually a system of understudies is in place to tackle this problem).

Echoing Prince's sentiment mentioned before (Burston 1998; Tommasini 2006): one more aspect is the conviction of Broadway show producers that audiences have come to expect a cinematic experience, with the sound as direct and lacking in dynamic-range as that coming from the TV-set at home. Sternfeld and Wollman (2011, p. 115) remark that where sound design used to mean placing microphones around pit and stage it has grown with the available technology to: 'emulating sound that was once only possible on film'. One example of how audience expectations have changed can be found in *Jesus Christ Superstar* which was released as a (very successful) recording in 1970 before it was produced as a stage show.[102] The 1971 Broadway version was forced to compete with the successful recording: '… the theatre had to replicate the recorded sound' says producer Stuart Ostrow (quoted in Grant 2004, p. 207). The sound design could not live up to the studio recording and the production suffered: 'for all its amplification and lavish visual spectacle', the production, 'struck many spectators as underwhelming when compared with the album' (Sternfeld and Wollman 2011, p.115).[103]

2.11.5 Amplified Musicals and the Unions

When Charles Parsons suggested reducing the number of string players in an orchestra with his Auxetophone he ran into trouble with the 'Music Fraternity'. The number of

[102] Andrew Lloyd Webber and Tim Rice had tried a similar scheme when they released the album for *Joseph and the Amazing Technicolor Dreamcoat* in 1968, according to Grant (p. 206) inspired by the Beatles' concept album *Sgt. Pepper Lonely Hearts Club Band* (1968).
[103] See also Collison (1976, p. 112) for a description of the UK and the US versions.

musicians in a Broadway musical pit has always given cause to debate between producers and unions. From the late 1920s, in particular during and after the depression the number of musicians' jobs had been going down. James P. Kraft (2003) lists three reasons: first as a consequence of the syndication of radio stations, second an increase in the use of recorded music in hotels and bars and third the sound movies. With the advance of pre-recorded material and an increased use of synthesisers in the orchestra pit and with the rise of the rock musical in the 1970s even more causes for reductions became apparent. Keyboard players using synthesisers and samplers have been known to reduce or replace string sections and woodwind sections (one well programmed synth with perhaps one of each 'real' amplified string players can create the suggestion of a large string orchestra). Until 1993 New York theatre producers were required to hire prescribed numbers of players depending on the size of the house they were working at. If fewer musicians were needed non performing musicians 'walkers' had to be paid anyway. After a short strike in 2003 the unions and the League of American Theatres and Producers (LATP) agreed to a minimum of 18 of 19 players, depending on the theatre's size. Grant (ibid p. 207) provides numbers related to the 2003 production of the ABBA compilation musical *Mamma Mia!* with only 2% of each 100$ ticket going towards musicians' salaries. Rasmus Fleischer (2006) reports on similar developments in Sweden related to technical production and reproduction of music interfering with musicians' employment.

To conclude this section I will refer to Grant's overview of the state of the Broadway musical in 2003, which I think, still holds in 2012.

- Every performer onstage wears a wireless microphone;
- Every musician in the pit (or elsewhere) was individually miked;
- There were probably more loudspeakers in the theatre than there were musicians or performers;
- There were an uncounted number of hidden video screens actively being monitored during live performances by the actors, musicians conductor and other tech people;

- The sound operator who sat in the rear of the theatre at the mixing console was arguably more important than either the stage manager or the conductor in running the show; and
- The overall decibel level as a result of all the above approached rock-concert levels, even for most nonrock musicals.

The video monitors he mentions in the fourth point are in use to make sure everyone can see the conductor (on the side stage for instance or for a remote orchestra section, a fairly common technique, not just in musicals). In situations where the orchestral music is 'piped' in from a different location video monitors ensure the performers can see the conductor, who in turn follows the action on stage through a video feed.

2.12 Microphone Singing; Monitoring

The visual communication between musicians is one thing, for a musical performance to be successful musicians have to be able to hear themselves and the other performers. In operatic singing a vocalist projects her voice into the auditorium, relying on acoustic (early) reflections (from the stage or the room) for feedback. The ability for a singer to hear what she is doing is dependant on the equilibrium of the balance between orchestra, soloist and the auditorium's acoustic response (this is where the analogy of singing in the bathroom comes in; the highly reflective tiles make the bathroom very responsive and give the singing bather a suggestion of fulfilling projection). This equilibrium becomes harder to maintain when amplification opened up drier and larger venues for musical concerts. In a football stadium the early reflections, as a consequence of the sheer size, are more like echoes (technically that implies surpassing the 50ms threshold) confusing timing of singers and instrumentalist alike. In the case of outdoor performances of orchestras, usually for large crowds (like the famous Hollywood Bowl), the orchestra is positioned in a shell that creates an acoustic environment in which a balance can be created and maintained, while directing the sound towards the audience.

Electric guitarists and keyboardists benefit from their instrument amplifiers that, in addition to 'making' their sound also provides 'fold back'; the guitar, bass and

keyboard amplifiers are often referred to as ‘back line’ (a term that may also include other band-instruments such as a drumkit).

2.12.1 The Singer’s Dilemma

When an orchestral instrumentalist tries out a new instrument he or she can ask a peer to play the instrument while listening to it out in a hall to hear what it sounds like and how well it projects. Some details will be different as a consequence of someone’s playing style but it can be a decisive test for a new purchase. Singers will never know what they sound like ‘out there’, in the hall. Compare the strange experience of hearing one’s own voice played back from a recording; it sounds very different from how we hear our voice from day to day. An operatic singer has trained to sing ‘on’ the hall, to work with the acoustic feedback that a reverberant room provides. An amplified singer using monitors for fold back has to rely on the sound engineer in the venue to ‘produce’ what that singer sounds like. Ultimately that implies a relation of trust between performers and their sound engineers; that relation is relying on information from trusted people in the audience (that hear the result of the engineer’s work). And obviously this issue is not limited to singers, drummers, like guitarists in front of their amps, mainly hear their own playing, the other sources added through a monitoring system.

2.12.2 No Wires Attached

Until recently singers usually relied on floor monitors to hear themselves, these are a separate set of highly directional ‘monitor’ loudspeakers directed at the performers rather than at the audience. Their function is to assure performers hear themselves and the other performers; making that balance or ‘monitor mix’ crucial for a successful concert. In addition to the ‘wedges’ (after the typical wedge-shape of floor monitors) so-called ‘side-fills’ may be in use, loudspeakers on each side of the stage again addressing the performers. A contemporary sound system actually consists of two systems, one (often referred to the ‘house’ system or the Front Of House (FOH) system) for the audience controlled by an engineer in the auditorium and another (the monitor system) for the performers themselves, controlled by an engineer from a different desk, usually out of sight on the side-stage. The latter ‘monitor-mixer’ looks after individual mixes for the

performers. Because both loudspeaker systems function in the same acoustic space creating and maintaining balances can be very complicated (and an important reason why bands and other amplified acts have to do a sound-check before a show, with the added complexity of the room response changing once it has filled up with people).[104] For example if a house engineer turns up the volume of the FOH sound system stronger acoustic reflections from the room, in addition to more 'leakage' from the actual FOH loudspeakers onto the stage, can influence (mess up) the balance on stage. In a similar way the highly directional monitor loudspeakers still emanate a lot of low and low mid frequency sound towards the audience; if a monitor mixer turns up the volume in the wedges, more unwanted sound is radiated towards the audience, often causing the FOH engineer to turn up the mix… For a discussion from a perspective of sound system engineering see McCarthy (2007, p. 190).

In the last decade, in addition to, and sometimes replacing loudspeaker monitoring all together, performers have started to use so called 'in-ear monitors'. This technology allows the monitor mixer to prepare individual mixes that are transmitted wirelessly on separate radio-bands to the special receivers worn by the performers. The receivers feed special, often tailor made, in-ear speakers, comparable to the miniature headphones used on portable audio systems, but placed deeper in the ear to create a stronger acoustic isolation from the surroundings. This disconnection from the performance space is often perceived as a disadvantage but a drop in monitor and back line levels (or getting rid of monitor loudspeakers all together) allows for a significant increase in overall sound quality (eg there is no more or less 'bleed' from the monitor loudspeakers into the microphones) together with a drop in overall sound pressure level. To recreate the presence of an audience the signal from microphones picking up the audience response and ambience sound are often blended into the in-ear monitor mix. As a consequence of this recent development, singers in contemporary (eg musical or pop) performance are patched into the sound system, completely bypassing a room's acoustic.

[104] Not only do the people in the audience function as (non-linear) sound absorbers, their presence raises both the temperature and the humidity of the room, affecting the speed of sound and as a consequence the resonant frequencies of a room.

The voice is transduced by a close (hand held or head worn) microphone, and folded back to miniature in-ear loudspeakers; no wires attached! [105]

2.12.3 Monitoring, History

Possibly the first attempt at a 'fold back' system is mentioned in Burris-Meyer and Mallory (1959, p. 6 description and picture on p. 40). It was trialled as a means of 'acoustic conditioning' at New York's Carnegie Hall in 1940 for a performance by Paul Robeson as a soloist with the Philadelphia Orchestra conducted by Eugene Ormandy. He sang excerpts from Louis Gruenberg's 1933 opera after Eugene O'Neill's *The Emperor Jones* (a review can be found in *The New Yorker*, December 28, 1940).[106] Burris-Meyer and Mallory describe what they call the acoustic envelope:

> Singers and solo instrumentalists prefer to perform in a reasonably reverberant place because the ability to hear themselves clearly helps to insure against technical errors… Large theatres with large audiences present often do not have the acoustical characteristics that make for optimum performance. […] Pick up the performer by microphone; filter out all frequencies below 500 cycles and project via directional loudspeaker to the performer…

In the accompanying photo a classic round horn loudspeaker and an amplifier can be seen, according to the diagram on the page before on the side stage (right) of the podium. Earlier in the book (ibid p. 6) they mention using a similar system in the Metropolitan Opera (the old one that was demolished in 1967) in the seasons 1940-41 and 1941-1942. Those early examples are rarities; 25 years later when the Beatles started performing in American sports stadiums they had no monitors. And not only did they not get any acoustic feedback, the enormous volumes produced by tens of thousands of screaming fans made it impossible for them to hear what they were doing; making music without seeing is feasible, but without hearing it becomes very hard. The documentary film of the

[105] The miniature microphones attached to vocalists' heads are usually omnidirectional, which poses a problem for providing monitoring to musical singers: whatever the singer is hearing will also be picked up by the microphone, at risk of closing the 'feedback loop'. (cf Grant 2004, p. 196)

[106] According to Glinksy (p. 244) Paul Robeson also appeared at Carnegie Hall that year on a double bill with Thereminist Clara Rockmore .

Beatles' concert at the Shea stadium in 1965 is instructive in this matter, including the tiny looking column loudspeakers, and the lack of any sort of fold back besides the band's backline (guitar and keyboard amplifiers, they may have used those for some vocal monitoring). Perhaps the problem is clear but just to make sure, what one hears in listening to 'live' recording is in not an adequate record of what the audience heard when at the time. For the recording the microphone signals would have been split into a separate chain, leaving out the blurring effect of the numerous little loudspeakers and (to some extent) the screaming fans. In one of the songs Lennon can be heard talking gibberish (after 'Can't buy me love'), suggesting how aware they must have been that they could not be heard (see Auslander 2012). Eleven minutes into the movie one of the Beatles can be heard saying:[108]

> It depends entirely on the person, you know, on the individual… Most fans want to see us and, say 60% wanna hear us as well as see us, but the ones who just wanna see us, are the ones who are influenced by each other, you know if one person screams or shouts the person next to them – they'll all – follow suit.

And a few moments later:

> I am just sorry for the people who can't see us live. Sometimes you haven't missed anything, because you wouldn't have heard us, but sometimes I think you might have enjoyed it.

There are a few stories about on the Internet of early attempts of providing monitoring for the Beatles (see §4.4.1). Not being able to hear what they were doing is often suggested as one of the reasons for the 'fab four' to stop playing concerts (see Auslander 2012).

The lack of monitoring and the screaming and shouting was not unique to Beatles concerts. In a book about 'pop package' tours by Martin Creasy (2007), concerts at cinemas all through England are described featuring bands like Manfred Mann, Engelbert Humperdinck, The Rolling Stones etcetera. The book presents accounts of musicians,

[108] I am not a connoisseur and cannot distinguish which particular Beatle it was.

cinema staff that ran the shows, and audience members. Several accounts mention the screaming and not hearing much of the music. Kathie Soane Wilkin, a regular at the Aldershot cinema:

> I loved the music. It was loud, but the screaming was even louder. I doubt if anyone could have heard much, but that didn't matter. I would have been screaming too. I knew all the songs at that time, but you would just hear the introduction and the rest would be lost to a wail of screaming and cheering (ibid p. 32).

Peter Jay of 'Peter Jay and the Jaywalkers':

> We didn't have a PA or big sound system to take around – we'd roll up at the venue and just use the house equipment. The sound must have been awful. It would just be a crap PA and you would have to try to make yourselves heard over all that screaming and shouting. Even on the Beatles tour it was the same. It seems unbelievable now. On tour with the Beach Boys was the first time I'd seen a mixing desk. They operated it from down in the orchestra pit (ibid p. 60).

Paul Jones (of Manfred Mann):

> I used to have the most dreadful problems with my voice because I was always shouting and screaming to hear myself. It was ghastly. There were no fold back monitors, so you didn't hear your voice coming back. At the same time, the amps they were using behind you were not anything like as powerful as nowadays. Little Vox AC30s and things like that. The music wasn't drowning you out so much; it was more the girls actually (ibid p. 51).

An article about recording and live engineer Bill Porter in Mix Magazine (Blakely 1982) tells the story of Elvis Presley's monitoring.[109] Porter had recorded many Elvis songs at the RCA studio in Nashville, and the singer asked him to help out with the live sound for his shows at the International Hotel in Las Vegas in 1970. The problem was monitoring, three monitors (only one of which was working) were flown to far away, about 18 feet (ca. 5.5 metres) over the stage. Porter brought in a pair of Shure Vocal Master column speakers and put them sideways on the floor, tilted toward the singer. He mixed a split of Elvis' microphone signal with a feed from the front of house mixing desk (a mix of the other instruments) so the singer could hear everything. From that concert on Porter mixed all Elvis concerts until the singer's death. The article gives a good description of how Porter became an audio engineer at a TV station, a recording engineer and then a live sound engineer, in addition to starting the first university recording program in the USA at the University of Miami in 1975.

Collison (2008) mentions several early examples of the use of monitors in the UK in the late 1960s. Bill Hanley (cited in Mitchell 2006), a live sound pioneer, perhaps best known for designing and operating the sound system at the Woodstock festival mentions using side fills (not unlike the 'acoustic envelope' that Burris-Meyer and Mallory described, perhaps more powerful) before using floor monitors working with Neil Young.

> Neil Young used my sound system as a monitor system so he could hear himself singing, and I never realized how important that was […] They took the Rebel speakers and put them on the floor, then used a unidirectional mic, and there was no feedback. Prior to that we just used side fills, and that idea never crossed my mind. And it took me a while to get used to doing that.

C.P. Lee (1998, p. 46) in his book about Bob Dylan's 'electric coming out' details the sound gear for Dylan's world tour in 1966, notably including monitoring (I will come back to that tour in chapter five and to Dylan's 'coming out' in the literature review).

[109] The article was reprinted online in 2010, the year of Porters dead. http://mixonline.com/mag/bill_porter_small.pdf <viewed 10 March 2013>

Hanley mentions no year for Neil Young's use of monitors but that might very well have been in the mid 1960s as well.

2.13 Making Things Louder…

After these more practical and historiographical paragraphs I would like to underline one element that surfaces from the first two chapters. Parsons' intention with his Auxetophone was to add air pressure to a sound wave in only adding sound level while leaving the other sonic parameters intact. In speech or song we have a certain dynamic range that we can use depending on the situation or desired expression. If we want to we can talk or sing louder, but it will (usually) have an effect on what it sounds like. A whisper sounds different from a scream; a soft note on a violin sounds different from a loud note on a violin, although skilled vocalists can create very precise dynamic steps with no perceivable change in voice quality, only adapting their output for balance. For an orchestra a composer or arranger can choose to add more string players or double the woodwinds, which will make things louder but again, also impact the timbre.[110] An electric guitarist can choose to hit the strings harder in order to play louder or he can turn up his amplifier. Turning it up will have very little effect on the timbre (unless distortion is intentionally sought after).[111] In amplifying the human voice the aim, in general is to reproduce it, with the aspects of voice quality intact, compensated for effects that relate to the transduction (ie reflections or resonances picked up by the microphone). Although there are many options for colourations or special effects, commonly the process of amplification is desired to be neutral. As I will discuss further in the following chapters, how neutral the process is, is not just a technological function but as much a matter of local acoustics, and what the amplification is used for.

[110] Two or more players of the same instrument playing the same notes (ie in unison) can never do so exactly the same; the slight alterations ensure that two violins are not simply twice as loud as one violin, but only slightly louder. That is not all bad, the slight differences create a fullness of tone as a consequence of the 'chorus' effect. See for instance Joe Wolfe's (2003) webpages about musical acoustics.

[111] This sort of distortion is usually created by over-modulating the input circuitry of the amplifier; the output circuit controls the amount of amplification.

2.14 Transduction Effects

At this point I will discuss some of the essential effects that occur with technical transduction of acoustic sound whether for recording, radio broadcast or amplification. I have dubbed these: 'transduction effects', they are related to the physical properties of sound in relation to the transducers, microphones and loudspeakers, their properties and the way they are applied (at what distance for instance). Some consequences of transduction always occur, whether for recording, radio broadcast or amplification. Paramount are Emmerson's three essential dislocations of sound transductions, time, place and causality. Other, more technical, consequences are related to frequency response, dynamic range and directionality. None of these effects are problematic, they come with the use of microphones and loudspeakers and we have learned to make good use of them. They are of importance in this thesis because they underline the importance of microphone and loudspeaker choices, the relation between those choices and the intention of the transduction process. They also shine a light on the problem, if not the impossibility, of 'natural' or 'faithful' recording or amplification; a loudspeaker recreating the sound of the violin is never the same as the sound of that violin; a microphone always has a perspective. It can be near or far, it can pick up very little or a lot of the local acoustics; it can be inside an instrument offering yet another, more unusual, perspective.

Behringer, a contemporary manufacturer of equipment for the budget (home) recording market, produces a series of studio loudspeakers named 'Truth': 'When it comes to your studio recordings, you want honesty. In fact, considering how important your art is, you should demand it!'[112] Truth is an interesting choice of words here that does not easily transfer to the actual product; apart from all transducers displaying non linearity across the frequency range, our individual hearing is non linear as well, and can be slightly different from person to person, even before, with age, wear and damage set in.

[112] From manufacturers website: www.behringer.com/EN/Products/B2031A.aspx <viewed 21 June 2012>

2.14.1 Unmicrophonic

As has been made apparent in the previous chapter, different microphones, at different distances, have different effects and different loudspeakers (with individual directional properties) yield different results in different acoustics. In the three decades before electronic recording the mechanical phonograph and its horns for recording and play back displayed similar effects. In order to record mechanically one had to play music or talk or sing very loud in order to record anything at all. The performers had to be arranged in very specific ways, softest (and high pitched) instruments or voices closest, almost in, the horn, aiming to project as much sound as possible in the direction of the transducer.[113] The result had almost no dynamic range and a frequency response that did not reach 2kHz.

The early radio microphones were very sensitive and could not handle loud and high-pitched voices, in terms of transduction the opposite of mechanical recording. The particular consequences for the interpretation of early recordings were discussed earlier in this chapter, in the discussion of early radio and crooning. Not being able to record soft or quiet sounds before the 1920s and not being able to record loud sounds in the early days of electric recording (what Al Bowlly referred to as 'unmicrophonic') can be considered transduction effects. Those should be taken into account in discussions of early recordings and radio broadcast and how they represent the performance practice of that time.

2.14.2 Transduction Effects: HiFi, even Better Sound!

'Better sound' and 'High Fidelity' usually relate to attempts at realising transductions with a linear frequency response (within the range of our hearing ie 20Hz to 20kHz) and increased dynamic range. Some esoteric manufacturers of audio gear claim extended frequency response sometime more than double the audio range. Some of the brands claim that even though we cannot sense those higher frequencies they still impact the (musical) experience of recorded music.[114]

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[113] Producers of recordings and radio programs selected musics and artists that 'record well'.

[114] Such claims are usually unsubstantiated, let alone supported by blind double testing. A good approach to such testing was taken by John Huntingdon (2010), looking at so-called star-quad cable.

Surprisingly, at least to the uninitiated, for sound reproduction in cinemas the frequency range is sometimes reduced instead of extended. In large cinema theatres the frequency range of the projected sound is limited to compensate for (amongst other things) the natural loss of higher frequencies over distance, creating a more reliable transmission to a larger number of seats. This procedure is referred to as the X-curve, with the X standing for 'experimental'. It has been an international standard for three-and-a-half decades, prescribing for cinemas over 2000 seats a high frequency roll off resulting at 6dB at 8kHz when measured at two thirds of the room (cf Allen 2005).[115] An important reason for the use of this compensation is to ensure similar results in many different theatres; in cinema sound studios or dubbing theatres the work is mixed with the X-curve in place. In live sound the sound system is tuned and optimised to work in a certain venue with a certain sort of function for the amplification in mind. This tuning process is done before the sound check of every performance, eliminating the need for an approach such as the X-curve.

Early mechanical recording only managed a frequency range up to 2,000Hz (Edison's phonograph worked in a range of 400Hz-1,500Hz), electric recording provided a big improvement. The benefits of the microphone first came about in radio, causing a strong decrease in record sales in the early 1920s (see Welch 1994). Better playback and later electronic playback again increased frequency response (up to 5,000Hz) and dynamic range. After WW-II slowly the range of Hi-Fi equipment increased and with the addition of stereophonic recording and playback a more spatial reproduction became viable.

Stanley and Maxfield (1933, p. 239) in their book *The Voice* quote a range of 40Hz to 10,000Hz for 'good' recording and playback of orchestral and vocal music.[116] Ordinary home phonograph or radio sets in those days used to reproduce 60Hz to 5,000Hz.

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[115] That is 3dB per octave from 2,000Hz and upwards. For smaller theatres the compensation is less; no compensation for theatres around 500 seats, and high frequency attenuation for small and very small theatres (150 seats and less).

[116] They also point to the importance of *binaural* (ie stereo) recording for reproduction of music. Rather than an entire orchestra reproduced by a single source, a suggestion of spatiality can be created using two sources.

2.14.3 Wavelengths and Directionality

Transducing sound can be a matter of sheer size: for soundwaves the frequency is inversely proportional to the wavelength (depending on temperature and humidity) ranging from 3.4 meter for 100Hz to 34cm for 1,000Hz and 34mm for 10,000Hz. Over time microphones and loudspeakers were developed with an increasingly better (that is more linear) frequency response and dynamic range and since the 1930s both are available with different polar patterns, as discussed in chapter one (Ballou & Lubin 2009; Beranek 1954; Jones 1931; Jones & Giles 1931; Wente & Thuras 1934). One important aspect is that these polar patterns are always frequency dependent. A loudspeaker that has a very narrow polar pattern for high frequencies is still radiating the lower frequencies in all directions. Full range loudspeakers reproducing our (subjective) full range of hearing only exist in theory; in practice we use smaller components (drivers) for the higher frequencies (tweeters) and larger drivers for the lower (woofers), and even larger ones for the very low frequencies (sub-woofers) (Davis 2006; McCarthy 2007). In the 'cross-over' bands, the overlap between the different drivers' non-linearity occurs (dips or peaks in the loudspeaker's frequency response). Dealing with that non-linearity is one of the crucial aspects of loudspeaker design whether aimed at home or for professional use.

2.14.4 Transduction Effects: Microphones

A cardioid, directional microphone in practice only assumes that a cardioid polar pattern seen in the microphone's manual or sales brochure is for a limited frequency band; for higher frequencies the polar pattern is narrow; for low frequencies it becomes more omnidirectional. Omnidirectional microphones become a little bit directional towards higher frequencies. Regardless of the problem of directionality, microphones, over time, have become increasingly linear; that is to say their response is equal for every frequency within its useful range. The non-linearity of the response and polar diagram introduces colouration; recording engineers will choose, and often try out several models, that create a colour that goes well with what is being recorded, often making use of the proximity effect (the build up in low frequency when a directional microphone is used at a short distance). Professional singers, sometimes bring their own microphone to a performance,

often a microphone that matches their voice (sometimes a microphone that matches a budget).

2.14.5 Transduction Effects: Dynamic range

> *At the dawn of the 20th century, when making Edison cylinders, everyone had to play loudly to overcome the background noise of the medium. Musicians playing soft instruments had to move in close to the recording horn or they wouldn't be heard and there was very little dynamic range as musicians were taught never to play softly!* (Katz 2007, p. 167)

Transduction in either direction will always impose a scaling effect on the dynamics of sound; microphones, amplifier, recording technologies and loudspeakers operate at different technical levels of the sound signal. Stanley and Maxfield (1933, p. 239) quote a dynamic range for the majority of home reproduction equipment from noise to overload (the level at which a system begins to distort the sound) of circa 30-40dB and a dynamic range of an orchestra of 55-65dB. Peter Copeland (1991, p. 19) reports on the benefits of electronic recording:

> Recording engineers could "tame" performances of wide dynamic range, so that loud passages would not overload the cutter (or give repeating grooves in the master-wax), and soft passages would not get lost behind the surface noise.

The dynamic range of recording media has increased since the phonograph with 40dB for early 78rpm records; 60dB for magnetic tape to 96dB for 16 bit digital recording (ie Compact Disc). This is the difference between the highest level at which 'writing' the medium causes distortion and the lowest level at which the signal gets lost in the noise (of electronic circuits or of the medium, ie surface noise on vinyl or magnetic tape hiss, as a consequence of its granular nature). The dynamic range of most popular music is according to Bob Katz (2007, p. 113) 6 to 10dB, sometimes limited to a single decibel:

> In typical pop music, soft passages 8 to 15dB below the highest level are effective only for brief periods, but in classical, jazz and many other acoustic forms, low passages can effectively last much longer.

And Katz (ibid p. 167) adds:

> Ironically, in the 21st century, we have come full circle. While the medium's noise floor is inaudible, we're making popular music recordings that have no more dynamic range than a 1909 Edison Cylinder!

This problem is not simply of our age, from Broadway arranger Bennet (1999, p. 290) comes the timeless remark: '…recorded music removes all dynamic distinction between a muted viola and the Battle of the Marne'.

Recording a very dynamic romantic Symphony (eg Bruckner 9 or Mahler 2) is very well possible; playing it back with the same dynamic range (sometimes as big as 50 dB) in a living room is very problematic. At soft sections one would have to bring up the playback level, at a loud section one would have to run for the volume knob to turn it down. A realistic dynamic range in a concert hall is not the same as the dynamic range in a living room, or a pair of headphones.

The dynamic range in a sound system is adapted and scaled in several stages; apart from the level of the acoustic source there is a sensitivity of a microphone and a amplifying 'gain' stage in the microphone pre amplifier. After levels set on the mixing desk's control (the balance so to say) there is an output level of a mixing desk, which is scaled to the input level of a pre amplifier, which is scaled to the level of the main amplifier (usually referred to as the 'power' amplifier).[117] Often all of these stages have individual controls. A power amp that is set to the maximum level but with very little signal coming in will result in amplifying noise that will be audible from the loudspeaker. Noise can build up in the different segments of the chain, when the scaling is not optimised.

[117] The actual response of the loudspeaker to the power amp is yet again frequency dependent and also dependent on the actual level. This relation is expressed in a multi dimensional phenomenon called impedance.

The problem with dynamics, whether for recording or amplification, is that there are choices to be made on how to adapt the musical dynamic range to the technical dynamic range and to the dynamic range of the playback medium. Regarding musical dynamics there is no technical answer to what the 'best' adaptation is, in the end that is a decision that is informed by functional (eg why is amplification used), acoustics and artistic arguments.

2.14.6 Transduction Effects: Loudspeakers

In *Audio-vision, Sound on Screen*, Michel Chion (1994, p. 92) describes the difference between someone addressing us frontally or someone addressing us with her back turned towards us, as a consequence of the directionality of the higher frequencies. As pointed out in the paragraph about mixed music, loudspeakers behave very differently in their interaction with room acoustics when compared to musical instruments. Playing back a recording or amplifying a musical instrument, the loudspeaker will behave differently in relation to directionality and in the recreation of the waveform. Loudspeaker positioning is an essential skill in sound amplification; when too much sound bleeds onto the stage, feedback may occur, limiting the level that can be achieved (this is referred to as 'gain before feedback'). When the loudspeakers are pointed at walls or other reflective surfaces the room acoustics receives extra impulses, creating more reflections that can hinder achieving the direct sound quality that is usually aimed for. But there are also examples where direct sound of loudspeakers is unwanted and they are intentionally facing away from the intended audience. One good example is a system design by Piet Nieuwint for an outdoor performance of Glück's opera *Orfeo* (dubbed *Orfeo Aqua*) that was set at a lake near Workum in Friesland, one of The Netherlands' wetter provinces.[118] The performance took place early in the morning before dawn with the rising sun as a crucial player. Loudspeakers used to reinforce vocalists and orchestra were aimed at the water creating a strong reflection that reached the audience, instead of the direct sound of the

[118] Simmer 2000/Frysk Festival. *Orfeo Aqua* (C.W. von Glück). Directed by Jos Thie, musical direction by Hoite Pruiksma, sound design Piet Nieuwint. Nieuwint has been teaching live sound at the Royal Conservatoire in The Hague since the late 1980s he inspired a whole generation of live sound engineers in The Netherlands, including myself.

loudspeaker. The approach reminds a bit of the Greek amphitheatre and the essential reflections created on the empty orchestra floor between the stage and the audience.

2.14.7 Transduction Effects: Social Distance

The most important non-technological but rather social consequence of the transduction effect is what is known as 'social distance'. The notion of proximity encoded in for instance the human voice can be observed in the usage of all different electroacoustic technologies. A famous example is found in Roosevelt's 'fireside chat', his voice sounding familiarly close, whilst not being physically present. It is such an essential aspect of the sound transductions that it can be considered a transduction effect. Van Leeuwen's approach to social distance, after Hall's system of 'proxemics' will be discussed at length in chapter three.

2.15 To Review

The significant point I want to make is that these transduction effects do not automatically imply devaluation or degradation of the input sound. Rather it shows the fabulous wealth and redundancy of sound (including speech and music) in different dimensions. Even when recorded using the low fidelity mechanical phonograph music remained recognisable as music and not as something else; and it remained appreciated (not to say loved). Bach's keyboard counterpoints are still Bach's counterpoints even when played on an 8-bit chiptunes games console. The recordings of Caruso, the famous tenor, still bring some people to tears, even though the recordings have a very limited frequency range.

Music history or singing history, in the era discussed, cannot simply be divided in before and after amplification, before and after radio, or before electric recording and after. With regard to radio, recorded music and their interrelation, the mid 1920s can be considered a viable marker with an essential influence on the creation, production and consumption of music. To use that same marker as the beginning of music amplification practices beyond, largely undocumented, experimentation, is imprecise and ignores the gradual development process in transduction technology for each of the different electroacoustic technologies.

As discussed in the first chapter, the early (documented) steps in live amplification came hand in hand with the sound film revolution, with the acoustic treatment of the older cinemas, efficient directional loudspeakers and the (commercial) availability of directional microphones. A strong industry, which pre-electric recording and pre-sound cinema already were, and radio became in a relatively short time, took much longer to develop for live sound, as briefly outlined in the previous paragraphs. More research is needed into that history is needed and oral history will be a very important component as the level of documentation and registration is minimal in comparison, again, to the other electroacoustic industries.

3 Literature Review

3.1 Approaches to Amplified Sound

> *These three dislocations effectively modified all the standard relationships of body to sound – it did not replace them altogether, but extended and challenged them.* (Emmerson 2000)

3.1.1 Emmerson

Simon Emmerson writes about the (acousmatic) dislocations of place, time and mechanical causality: the telephone, recording and amplification. With Emmerson's (2007) book *Living Electronic Music* he is one of the first authors to take a systematic approach to amplification and in particular to using this technology as a tool in music composition. He makes a very important point with regard to this 'causal dislocation' that is sometimes overlooked:

> This is often an ambiguous dislocation as the source of the sound is usually present and the direct acoustic sound can often still be perceived (ibid p. 124).

His observation makes it apparent that when the level of amplification is higher the dislocation becomes more obvious. There is a relation between the level of amplification and how we perceive and experience the acoustic source under amplification, and as such with the function of the use of amplification.

Without the intention of being exhaustive Emmerson proposes six different 'musical functions of amplification of live sound' along with some very good examples about which he adds in a footnote:

> Some of the examples which follow are not normally described as 'live electronic' music but they are vital – even central – to any discussion on 'live music requiring electronic technology for its presentation'. (ibid p. 125)

Emmerson's musical functions of amplified sound are as follows:

1.	Balance	Correcting acoustic imbalances
2.	Blend	Integrating timbres
3.	Projection	Zooming in on sound/intentional dislocation.
4.	Perspective	Creating illusory spaces
5.	Coloration	Intentional distortion
6.	Resonance	Use of feedback

Of the practices discussed in the previous chapters most will fit this list; Bing Crosby's singing amplified at the Cocoanut Grove was a matter of balancing his (soft) crooning voice with a dance orchestra. Amplifying acoustic instruments in mixed music allows for a blending of electronic and acoustic sounds. Spatialisation is mentioned with projection; literally a detail of an instrument's sound (or by-product) is transduced and attenuated or dislocated to a loudspeaker in an altogether different location in the same room. By adding (digitally simulated) reverb to a singer's voice suggestions of a larger or altogether different space can be made. John Cage's use of amplified cactuses can be considered as a means of zooming in. The 'amplified plant' instrumentation is not limited to Cage's works *Child of Tree* (1975) and *Branches* (1976);[1] Australian composer and performer Greg Jenkins (2003) extends its usage with digital processing:

> I have recently been using an amplified cactus as a performance instrument. This involves applying contact microphones to a cactus then amplifying and digitally processing the resonances that are produced when the spines of the cactus are

[1] Cage: *Child of Tree (Improvisation I)*, for percussion made of plants and/or plants used as percussion (1975, before March 8); *Branches*, for percussion made of plants or plants used as percussion (1976).

> plucked, a little like a harp string. I've come to see the cactus as an organic metaphor for technology; a thorny ally in the artistic process.

Colouration can again be found in the crooners' specific use of the microphones, using the precedence effect of directional microphones that results in a boost of low frequencies enhancing a voice's warm and intimate character. Emmerson mentions the use of contact microphones in Crumb's *Black Angels* as an example: mounted on the body of an instrument it transduces a more partial waveform than using a microphone at some distance. Colouration can be created at higher amplification levels: eg electric guitarists distorting their amplifiers. But ultimately that distorted sound can be reproduced at a very quiet level.

Although often perceived as something of a negative aspect or a technical fault, feedback is used to advantage by electric guitarists as mentioned in chapter 2, but is also used in contemporary music in different ways, as suggested by Nicolas Collins (2008, p. 41):

> Feedback became the ur-sound of chance: it erupted whenever composers hooked up sound systems without the benefit of technicians.

Some of the works of David Tudor use feedback in this way; Cage's *Variations* II was mentioned earlier, another example is the *Rainforest* that existed in a few different incarnations. The work 'focused on principles of feedback and resonance of objects' writes Emmerson (ibid p. 161), he quotes Tudor (1972, p. 26) from an interview, which I find too relevant not to repeat here:

> One of the ideas in my *Rainforest* series is that loudspeakers should be individuals, they should be instruments. So if you need a hundred of them to fill a hall, each one should have its own individual voice ... After all what is a loudspeaker? At present it's a reproducing instrument, but my feeling all along has been that you should regard it as a generating instrument…

Emmerson's work is ground breaking in opening up a more precise discussion of this technology that has predominantly been identified with 'mass-media', without recognition of the many different functions it can perform. At this point I will add one additional function to Emmerson's list, perhaps the most common one, or in the words of John Potter (1998, p. 171), 'the most literal': making sounds louder so more people can hear them; that is to say amplification as a means of distributing sound to a large(r) audience.

Another valuable point of discussion brought forward by Emmerson is that of 'authentic performance practice' or Historically Informed Practice (HIP), usually related to baroque and renaissance music, or simply 'old music'; but after the rollercoaster of technological developments since legendary works of the mid 20th century were created, equally applicable to electronic music. Emmerson (2007, p. 170) discusses choices made in the process of remastering and digitising historic magnetic tapes, also referring to the 'vinyl renaissance' and the popular interest in valve amplifiers and other retro-gear, cf Shepherd (2010). With relation to the subject of this thesis he writes: there does not appear to be an equivalent in 'authentic' loudspeaker demands'.[2] That is an interesting point because, like magnetic tape, the technology (microphones, loudspeakers) available at the time of conception informed the creation of certain works. When performing an electronic masterpiece from the 1950s we can consider using loudspeakers from that era, instead of state of the art current technology. One other example is the use of computers to emulate and operate the (originally analogue) ring modulators prescribed in some of the 20th century works (see Sluchin 2000).

Emmerson also calls for research into the history of the amplification of music, or rather 'Rock Music PA' (p. 161), of which I have sketched a beginning in the previous chapter. As mentioned in the first chapter David Collison (2008) provides a significant overview as well, particularly focused on the UK.[3]

[2] Having said that, guitarists can be very specific about the brand and age of the 'driver' units in their amplifiers (ie the actual transducers).
[3] I recently came across an online publication dedicated to 30 years of rock lighting and sound in Australia (Harrison, Baldwin, & Grafton 2002).

3.1.2 Approaches to Amplified Sound: Berio

A mix of Emmerson's functions can be found in a publication named *Live Electronics in Luciano Berio's Music* (Giomi, Meacci & Schwoon 2003, p. 31). This journal article looks at the 'Principles of Amplification and Sound Spatialization' in the Italian composer's work. 'Simple amplification' should be viewed in light of its musical consequences':

> Our listening is today conditioned by top-quality recording. A recording of this type always has an analytic nature and therefore my ideal is that of creating a type of acoustics and of sound that is typical of a great recording studio.[4]

Berio's consideration, according to the authors, 'implies consequences for the entire electroacoustic chain' for the quality of the transducers but also for the 'interaction between these and the natural sounds of instruments and voices'; Berio: 'What interests me is extending the possibilities of instruments, of the voice, but in an organic manner, which is not in conflict with the sources of sound.' (ibid). The authors point out that this has nothing to do with traditional or rock-and-roll amplification; not about increasing the loudness but 'rather to modulate the natural acoustics of a space'. In another book (Berio 2004) some of Berio's remarks about rock music are recorded:

> ... voices and instruments are very much amplified... Microphones, amplifiers and loudspeakers become not only extensions of the voices and instruments but become instruments themselves, overwhelming at times the original acoustic qualities of the sound source. One of the most seductive aspects of rock vocal style is, in fact, that there is no style. Voices... are magnified in all their naturalness and spontaneity, creating the sort of relationship vis-à-vis formalised styles of singing that a cinematic close-up bears to a classical portrait.[5]

[4] Television interview with Berio in 1999, 'Superquark' RAI–Radio Televisione Italiana.
[5] Original in Berio *Commenti al Rock*, 'Revista Musicale Italiana', May/June 1967.

This aspect of magnification mentioned by Berio, or zooming in as Emmerson would call it, is analysed in detail by John Potter.

3.1.3 Approaches to Amplified Sound: John Potter

Singer and scholar John Potter was a member of the famous Hilliard Ensemble in the 1990s. The vocal quartet specialises in baroque and renaissance music (but are equally at home in contemporary and 20th century music). Potter has published and edited several books on the subject of singing from a very broad perspective, not limited to any tradition, and generally including amplified practices. In *Vocal Authority* (1998, p. 170) Potter describes an important consequence of microphone singing and 'its significant long-term effect on potential meaning-generation'. Where classical singing focuses on projection, in order to be heard in a concert hall: 'A great deal of attention is given by both singer and listener to the medium itself…' making the 'mode of delivery' more important than the message, leaving: 'the breadth of potential meanings' restricted.

Potter mentions several composers who have explored the microphone's potential to enable 'attention to be directed specifically at the text.' He mentions Stockhausen's *Donnerstag aus Licht* and Berio and his work *Sinfonia* in particular, about which Potter (ibid p. 171) writes '…[the voices] are supposed to be balanced in such a way, […] that the listener is aware of their presence but cannot distinguish everything they sing or say.' In addition he mentions extended vocal techniques that 'often use the smaller sounds that would be inaudible without amplification', these are usages of amplification that are rarely found in pop music.[7]

The microphone, by removing a vocalist's need to project, assured that in pop music it became a democratic device, 'which enables the singer to leave open the possibility of a large number of additional meanings to be constructed by the listener'. At the other end of the spectrum, amplified classical music (eg Pavarotti, the three tenors or stadium performances of operas) amplification was used 'strictly in its most literal sense'. How microphone use benefits the pop singer while the classical singer is limited by tradition, with or without a microphone is very well demonstrated in Potter's analysis of a

[7] Creaks, whispering, breathy voices all the vocal sounds we do not usually associate with singing (Potter 1998, p. 170) see also chapter seven of that book.

duet from 1987 ('Barcelona') between Freddy Mercury and Monserrat Caballé (ibid p. 187).

In a more recent book together with Neil Sorrel called *A History of Singing* (Potter & Sorrell 2012, p. 241) the authors explain how in the mid 20th century the microphone widened the gap between classical and popular singers: 'the jazz-influenced microphone-assisted idioms were beyond the reach of the classical singers (who consequently spurned the 'popular'). On a different continent that was not an issue at all; Potter and Sorrel (ibid p. 181) write about an interesting contradiction Sorrel observed in Indian music: singers (some of) who interestingly objected to being recorded, but who insist on electronic amplification at performances, nowadays very common in India:

> Today, however, we can be bold enough to claim that every Indian performer will expect amplification in a recital, even for a small audience in a relatively small hall. That suggests that the musicians have become so used to amplification that they rely on amplification even when it is really not needed.

The biggest consequence is, writes Sorrel, 'not one of purist horror' but the amplification often being substandard, even when 'superb equipment' is used. Significantly, as I argue in this thesis, it is often not about the equipment or its quality:

> What is surprising is to observe a lengthy sound check a few hours before the performance […] only to see the performers (main artist and accompanists) disrupt the settings during the performance itself by signalling to sound technicians for more volume.

Some of the complicated aspects of amplified music come to the fore in this example, the relation between performers and mixer, monitoring and the inability for a performer to judge what it sounds like 'in the hall'. In addition there may be some muscle flexing going on, when each performer would like to 'be louder' than the others.

Sorrel also mentions some benefits of amplification; minute details (he mentions ornamentation, subtle pitch changes and slight nuances of vocal colour) can be heard

easily (again Emmerson's *projection*). And, an aspect that also comes up in the discussions about Broadway musicals: 'Perhaps amplification makes the physical toll of singing easier to sustain'. Another important aspect Sorrell picks up is that amplification is not just about making things louder (what he refers to as 'an intimidating stampede'); it can be used to 'enhance restraint and intimacy'. He continues:

> Thus amplification cannot be dismissed simply as crude and detrimental but can be a means of allowing the voice to relax and focus on the musical details and expression rather than waste effort in straining to be heard. The problem is that the snags so often outweigh the benefit and the persistence of inferior amplification and disrupted settings can suffocate its potential.

These are two significant points Sorrel makes: first amplification is not just about making things louder, something I hope to substantiate in this thesis. And second the 'persistence of inferior amplifications' which is one aspect that comes forward from the section on criticism, later in this chapter, and possibly a consequence of the misunderstanding that amplification is 'just' about making things louder.

3.1.4 Approaches to Amplified Sound: Johnson

Johnson's (2000, p. 81) *The Inaudible Music: Jazz, Gender and Australian Modernity* was mentioned before in the previous chapters; the author presents a broad discussion of technology and music, inclusive of amplification. He argues that with the microphone, for broadcast, recording and amplification came 'greater public expression through technology'. Touching on problems of amplification and 'high brow' music he writes: '…it is popular music that provides the vehicle for this innovation, in ways unavailable to art music because of the terms on which the latter maintained its cultural authority'. The author argues that the relation between technology and musical expressiveness is central not only in music practices but also to the academic cultural discourse of contemporary culture and popular music. In a few pages Johnson lays out the problems that I address in this thesis, including the complicated relations between performance acoustics and electronic amplification (ibid p. 89). Johnson's particular focus is on Jazz in Australia,

which arrived 'as a compound of live performance and sophisticated technology' (ibid p. 8), and how both popular music and the technology supported the advancement of women. He is one of few authors who in his historical discussion thoroughly separates the particular consequences of the different technologies, recording, radio and amplification, and their social and technological developments. Although focused on jazz he does stretch his discussion of microphone use to contemporary opera practice and he explores different evaluations of the use of amplification.

3.1.5 Approaches to Amplified Sound: McCarthy

In Bob McCarthy's (2007, p. 18) *Sound Systems: Design and Optimization* he states:

> …loudspeakers are not Musical Instruments!: A central premise of this book is that the Loudspeaker is not given any exception for musicality. Its job is as dry as the wire that feeds it an input signal: Track the Waveform.'

McCarthy's is the first book of its sort, looking at design, set-up and control of sound systems from a practical point of departure but not shying away from the (applied) physics of sound. It is currently in use in several educational institutions for subjects looking at performance practice or 'live sound'. I do however contest the statement that a loudspeaker does nothing more than tracking a waveform, as I will argue in this thesis, there are several ways for a loudspeaker to add to a performance.[8]

3.1.6 Approaches to Amplified Sound: Van Leeuwen

In *Speech, Music, Sound* Theo van Leeuwen (1999, p. 24) observes that amplification can be selective by either mixing (levels on a mixing desk) or microphones (ie microphone type selection and position). The immediate question coming from that observation is, who gets to make these selections? At a political debate can a sound engineer manipulate the mix to favour one speaker over others? And at a concert, who decides on the balance and the total level? These matters of agency I will analyse in chapter five. The theoretical

[8] Here David Tudor's remarks cited in §3.1.1, about the instrumentality of the loudspeaker come to mind. In 2010 I presented a paper at the New Interfaces for Musical Expression conference with the title: *The Loudspeaker as Musical Instrument.*

perspective of this thesis rests in part on Van Leeuwen's social semiotic work, which I will discuss in detail in chapter four. In this section I will first look at Van Leeuwen's writing on social distance followed by other authors' perspectives.

3.2 Social Distance: Hall, Van Leeuwen, Tagg

In a discussion of 'sonic perspective' Van Leeuwen points out that in the case of recording and amplification 'social distance' becomes an independent semiotic parameter. Edward Hall (1966, p. 11) in his book *The Hidden Dimension* introduced this classification of proximity inspired by observations of animal behaviour. Animal behaviour exhibits what is called a flight distance and a fight distance, if you approach an animal it may choose to run away, if you come too close it may react, however desperate by attacking. According to Hall this is how for instance a lion tamer works, playing on the fringe of the two reactions, in the 1966 edition of Hall's book accompanied with an excellent drawing (ibid p. 11).

> The hypothesis behind the proxemic classification system is this: it is in the nature of animals, including man, to exhibit behaviour, which we call territoriality. In so doing they use the senses to distinguish between one space or distance and another. (ibid p. 120)

Hall establishes four zones or classes of distance: the intimate, the personal, the social and the public, each with a close and far phase. The effects can be found in speech sound; a whisper is intimate ('for reasons of intimacy or conspiracy'), a public speech is presented at the top of one's voice, but also in smell (if we are too close to a co-worker we may be troubled by a garlic breath, smelly feet or armpits). Or we may be close enough to touch someone, opening a whole range of communicative devices, with strict social implications. The workings of the proxemics change over time (we take a very different stance towards body smells when compared to the days before daily showers and tooth brushing) and are also culturally different. In the Netherlands and Germany where houses have solid double-brick walls (to keep warm in winter) people are confronted with sounds produced by neighbours much less than for instance in a city like

Sydney where houses have thin walls. In France (to the tourist) everyone seems to be kissing everyone always even when newly introduced, to the astonishment of Brits, Germans and Dutch people. Hall (ibid p. 123, Van Leeuwen 1999, p. 24) compares informal voice usage across different cultures: Arabs speak louder than Americans but the upper class Brits and Japanese speak more softly.

Erving Goffman (1973, p. 2) in a discussion of broad and narrow communication (which we would refer to as multimodal) writes:

> …one finds that when the individual is in the immediate presence of others, his activity will have a promissory character. The others are likely to find that they must accept the individual on faith, offering him a just return while he is present before them in exchange for something whose true value will not be established until after he has left their presence.

That is not to say a telephone conversation or a speech heard on the radio are the same as an immediate presence, but the closeness of voice is maintained, the notion of 'faith' can still be suggested.

Van Leeuwen uses Hall's observations in a discussion of the speaking voice; we use our voice in different ways when we address others in different situations; a breathy whisper in someone's ear usually contains a highly personal message, not the headlines of the financial pages. That relation between social distance and content is explored for example in the movie *A Fish Called Wanda* (1988) with the two male protagonists John Cleese and Kevin Kline uttering highly intimate messages, in order to romanticise Jamie Lee Curtis, in languages they do not master.

When there is no technological interference: 'soft and loud are crucially associated with distance' (Van Leeuwen 1999, p. 133); when we record (or amplify) someone's voice with a microphone the social distance is maintained; a whisper is still a whisper, a scream a scream, even though the level may be completely different. Elizabeth Wollman (2006, p. 210) observes how important the relation of social distance and electronic amplification is: '…successful live rock performances are designed to cultivate

a sense of intimacy, even in the largest of venues.' Intimacy can be suggested even at the highest amplification levels, and as such be detached from musical dynamics.

Van Leeuwen (1999, p. 12) describes how Hall's classification becomes an independent semiotic system when speech is recorded or amplified. He adds a class to Hall's system by splitting the social in a formal and informal distance:

Distance	*Vocal quality*	*Message*
Intimate	Whispering, soft voice, undefined pitch	Highly private
Personal	Soft voice, low pitch	Personal, for a friend
Informal	Full voice, higher pitch	Business-like
Formal	Loud voice, high pitch	For a group in formal context
Public	Maximal loud voice, more like shouting	Reach as many as possible

Table 4 Social distances (Van Leeuwen 1999, after Hall 1966)

A recorded whisper is still identified as a whisper when played back; social distance becomes detached from physical distance and voice level (in theatre a whisper can be amplified to be as loud as a scream). Social distance is indexed by loudness: '… from the intimate whisper of the lover to the hysterical scream of the demagogue' (ibid p. 24). Before the electroacoustic technologies there was a direct relation between voice level and social distance. Voice level would signify actual relationships, along the lines suggested by Hall. The electronic transductions have changed that; a soft breathy whisper can now be heard by a crowd, and conversely the screams of rock singers can be endured listening to on headphones.

Examples that are often mentioned in this context are the crooning singing style (Crosby, Sinatra) and Roosevelt's 'fireside chats' that were meant to convey an intimacy between the President and citizens listening to the radio; in contrast with the affected, projected radio (and cinematic) voices of the 1930s and 40s. Van Leeuwen points out that this change, the mixing of the public and private paved the way for: 'the production of other kinds of meaning with vocal style'.

Ultimately related to microphone distance (and type selection), social distance is a matter of both timbre and level. The recorded scream of a rock singer can be played back

at a bearable level in one's headphones; a whisper can be amplified to a deafening sound. The close mike's whisper has a boost in the low frequencies enhancing the intimacy; the shrieky treble of a scream suggests a distance. With increasing distances to cover our voice become higher and sharper; Van Leeuwen (ibid p. 24) observes a similar relation in the timbres of musical instruments, by way of example he compares the intimacy of Miles Davis' muted trumpet, 'smooth jazz' to the power of the trumpets in a military brass band playing at full blast.

By using amplification, intimacy can be suggested over distance, which underlines the strangeness of the dislocations that occur. Those dislocations do not take place at for instance traditional concerts with audiences focussed on listening (and let me emphasise here that the tradition of silent audiences at classical concerts emerged only in the late 19th century, as I will discuss further in chapter five).

The importance of the relation, or sometimes the tension, between the public and the private when it comes to music, is well demonstrated by Tagg (2013, p. 1) in the preface to his *Music's Meanings*, by making a comparison to our sexuality:

> Deep fissures can arise between how we see ourselves as sexual beings in private and how we respond to displays of sexuality in the media, just as our intensely personal musical experiences seem to be at the opposite end of the notional spectrum to all the technical, economic and sociocultural factors without which much of the music that so deeply moves us could not exist.

Tagg places the problem of getting of grasping the duality linked to the dichotomies of the private/public and the objective/subjective at the heart of his thesis on 'ways of understanding the phenomenon of music as a meaningful system of sonic representation.' (ibid p.2)

3.2.1 Social Distance: Gehl, Kress

Jan Gehl (2011, p. 65) in *Life Between Buildings* uses Hall's theory in relation to the design of public (open) spaces. He adds some relevant observations related to the theatre:

> The distance between the stage and the farthest audience seats in a theater is usually a maximum of 30 to 35 meters. In theaters primarily feelings are communicated, and even though the actors are able to "enlarge" visual impressions by means of makeup and exaggerated movements, there are strict limits to how far away the audience can sit if it is to get anything out of the performance. At even shorter distances the amount and intensity of information is greatly increased because the other senses can now begin to supplement the sense of sight

The social distance of the speaking voice can equally be 'enlarged', a whisper can be heard in traditional, smaller theatres, but with the aid of amplification much larger audiences can be addressed using the quietest sounds. By way of example of amplified intimacy in the theatre: I worked on a national tour of the theatrical musical *Annie* in the 1990s. At the dramatic highpoint the millionaire male character, finally won over by the orphan's charm, whispers 'I love you Annie'. On actor Wil van Selst's instructions I would move the fader that controlled the level of his radio microphone all the way up so his whispering voice thundered through the theatres. Every week he would say the sentence a little bit more quietly and I would amplify his voice even more, making his whispers ever more impressive, booming trough the theatres.

In addition Gehl mentions how social distance is referenced in language: 'a close friendship, a near relative, a distant relation, keeping somebody at arm's length or keeping one's distance from somebody'. Another linguistic aspect is described by Gunther Kress (2010, p. 59); a grammatical distance in time 'I wanted to ask' or 'I wondered if I could…' can signify a social distance in power:

> *Distance in time* as signifier contains an ambiguity, which allows the less powerful speaker to both acknowledge the *distance in power* between him/herself and the addressee and a means – being distant in time (rather than in space) – or temporal distancing from the request….

Kress' suggestion underlines the notion that power relations can be expressed in social distance: the power of sexuality expressed in the crooners' voice, political power in Roosevelt's fireside chat(s). Control over social distance using the sonic aspects of amplified sound raises questions about who is in control over those sonic aspects, which I will address in chapter five.

3.2.2 Social Distance: Smalley

Composer and scholar Denis Smalley (2007, p. 41) applies Hall's theory in an article that discusses space in terms of acousmatic music, based on Henri Levebre's work in *The Production of Space* that treats space as a social morphology and as such 'bound up with function and structure'. Smalley points out that 'performed space is gesturally rooted':

> In performed space in instrumental music we can identify mixtures of Hall's four zones at work, producing three spaces – gestural, ensemble, and arena space; gestural space is nested in ensemble space, and ensemble space is in turn nested within arena space.

The arena space describes a range of possible venues for musical performance including larger arenas, while the ensemble space is the 'personal and social space among performers': a group of performers produces a collective performed space. The gestural space is created by the intimacy of a performer and her or his instrument: 'Sounding body and performance gesture are physically indissolubly linked in intimate space'; for a violinist or a flautist this intimacy is stronger than for a pianist or a percussionist who operates in a more personal space: two can play a marimba, quatre-mains, like four handed piano playing. In addition I would argue there can be a mix between those gestural and ensemble spaces for instance in one of an orchestra's string sections, playing the same notes with the same bowing, the players moving as one.

Smalley asserts that for an audience the experience of these spaces is bi-modal, incorporating seeing and hearing. But the actual physical distance from spectator to the performers is an important factor; at a concert by a string quartet it is better to be a bit

closer than to an orchestra: ‘I need to be at a right distance to feel involved in energetic passages, and at the same time be able to contemplate subtleties of expression.’ (ibid)

The complex of the three nested spaces can be mediated by technology such as amplification and the use of large video screens, creating what Smalley (ibid p. 43) introduces as ‘Mediatised performed space’, the term mediatised after Philip Auslander whose work I will discuss later in this chapter. Smalley distinguishes between the use of amplification within the arena space: ‘…so that an extrovert and gesturally extravagant, or a more introvert and gesturally discrete, performance can thereby hope to achieve more acceptable impact or intimacy’, and even larger venues:

> With popular or rock music concerts or open-air musical events, where relative distance between gestural space and further boundaries of the arena can be so extended that aural and visual contact are lost, the video image [in addition to amplification] is able to zoom in on the intimate and personal spaces of performance, thereby transporting a mediatised intimacy to the remote perceiver.

Technologies, Smalley continues, can cure the deficiencies of performance spaces that have become too large to fulfil their ‘primary communicative function’.

The transduction of social distance is something we have accustomed ourselves to after Sterne’s ‘Age of Ensoniment’, over half a century of TV, 80 years of sound cinema. Amplified sound simply complies; we have come to expect the same sound quality, with a similar effect on social distances as heard on radio and TV. The consequence for electronically amplified sound is the necessity of a detached sound, drowning out the acoustic source. It is the amplified, transduced sound we want to hear, not the acoustic, distant sound! This of course raises questions of originality and authenticity, which I will address later in this chapter.

3.2.3 Social Distance: Gracyk's Rock Aesthetics

In his book *Rhythm and Noise* Theodore Gracyk (1996) sets out to establish an aesthetics of rock, a genre that relies on amplification for recording and concerts. [10] Rock performed with an unamplified acoustic guitar and sung without a microphone lacks 'rocking' and reverts to singer-song writing (in my opinion). As suggested by (Frith 2002, p. 286) rock music is essentially a recorded music that is constructed in the studio, rather than a performance art. Gracyk (1996, p. 74): 'In rock music the musical instruments are almost always several steps removed from the audience'. In the case of recorded music this is clear, some steps are easily identified: for example playback technology, recording medium, mastering and editing, mixing, multi-track recording and microphone selection. Not that this is unique to rock and pop, classical music nowadays is recorded on multiple tracks and in several takes, the recording is 'produced' in editing mixing and mastering, after the musicians went home. Gracyk (ibid) argues: 'In live performance, speakers deliver a combination of amplified and electronic sounds. We almost never hear "original" sounds; when the electricity fails the music stops', which again cues the question of authenticity and sound.

Again according to Gracyk, human voices and acoustic instruments are several (modifying) steps away from the audience by (in concord with Van Leeuwen's observations) microphone selection and mixing/filtering: 'shaping the sound in response to the auditorium's acoustics'. The 'distance' created by the technology causes Gracyk to conclude that rock music is essentially not a performing art: 'recording is the most characteristic medium of rock.'[11] This analysis leaves me wondering, then what are rock bands playing their instruments on stage doing? Are they not performing or are they essentially not a rock band? Would that last question be answered differently if they had not previously recorded the songs they are playing before? This is problematic if, as I argue, for a rock band the amplification technology is essential: electric guitars need amplifiers and the rock voice needs an amplified close microphone.

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[10] Potter (1998, p. 159) remarks that socio-musicology is overwhelmingly interested in rock, a trend that has changed in the past decade.

[11] This is not the place for this debate but for a contrasting opinion (Hennion 1997, p. 428) suggests the opposite: 'Unlike classical music, which seeks to give primary significance to the music itself, rock's core element is the stage. Records, television, radios, posters all refer to the stage as their gold standard.'

From the discussion of social distance it becomes clear that the distance created by technology or the distance between performer and audience can become an expressive parameter in amplified performances of music. Close distance can be suggested by using close microphones, still with the aid of digital reverberation a close sound can be made to sound 'far-way', while retaining the sonic parameters of the intimate.

A final example, at a Bon Jovi concert at a large football stadium I witnessed the rockers leaving the stage to perform a few songs on a semi-circular catwalk extended into the audience.[12] Playing acoustic instruments (acoustic guitars, cajón and accordion)[13] an 'unplugged' setting was created, amplified with microphones so the 65,000 people could hear. The distance between performers and audience was bridged in two ways, literally by leaving the stage to be closer to the fans and musically by playing acoustic instruments, as if in a local bar.

3.3 Amplified Sound as a 'Channel'

The question 'what happens when the power fails' offers a good test to find out what it is that amplification does. In the case of a rock band we would probably be left with the vocals, and the modest strumming of solid body guitars; if not overpowered by the drums. Such a test suggests the amplified sound is an addition to the acoustic sounds (provided there are any) operating in its own 'channel'. Abraham Moles' (1966) *Information Theory and Esthetic Perception* includes an approach to music and its different technical reproductions. Moles, unfortunately not including amplified music, looks at different 'spatial and temporal' channels used to get music from a studio to the consumer: 'Esthetic information is specific to the channel which transmits it; it is profoundly changed by being transferred from one channel to the other'. Moles was referring to recorded music but a later author looks at the implications for amplified sound. Irmgard Bontinck (1994) in an article 'Mass media and new types of youth music, methodological and terminological problems', uses Moles' concept of a 'technical

[12] Sydney Football Stadium, 17 December 2010.
[13] A cajón is a box-like percussive instrument that originates from Peru. It is common in Peruvian, Cuban and other Latin American musics, but equally in Flamenco.

transmission channel' as a way of describing amplified sound at concerts.[14] Live musical representation is communicated to the listeners through a natural channel ('the room in which they are performed, with all its specific qualities that affect this communication'),[15] amplification is regarded as an artificial channel that is a technical transmission chain: microphones, mixing desk, amplifier and loudspeakers.[16] Citing Kurt Blaukopf (who was again referring to recorded music):

> It is inadmissible to try and treat as equivalent [in the sense of an uncritical notion of authentic sound] music communicated by technical means and music presented directly, because this would mean disregarding the process of transformation necessarily resulting from technical communication'.

Later Blaukopf (1992) refers to this transformation as 'Mediamorphosis'. Unfortunately he does not offer a consideration of amplified music from that perspective.[17] 'Morphosis' suggests a process rather than a binary opposition; as I argue, the effects of amplification are dependent on the amplification level, from soft to loud. The 'media' morphs differently with regard to that level.

Even though the notion of a channel makes sense when we cut the power, there is a problem in the way Bontinck does not account for the interaction between 'natural and artificial channels'. I argue for an approach that emphasises the reciprocal relation between the two; at many contemporary concerts they are inseparable, reaching our ears through the same air in the same room at roughly the same time (and a power cut at a concert is not common practice, even though philosophically attractive, it is a technical malfunction). Nevertheless Bontinck is doing pioneering work, considering amplified music in her analysis, she points out a crucial relation between the two channels: 'the

[14] That article originally appeared in the International Review of the Aesthetics and Sociology of Music, Vol.VI, No. 1, 1975.
[15] The natural channel has always had an amplifying function, specific acoustics serve specific purposes: cave, Greek amphitheatre, cathedral, or concert hall (cf Blesser & Salter 2006).
[16] Bontinck makes her argument a bit unclear by mentioning 'recorders' in the chain.
[17] Blaukopf (1992, p. 265) does signal a potential problem that is equally relevant to recorded and amplified music: 'The extent to which the acculturation accelerated by mediamorphosis may decrease or even eliminate the variety of vocal styles in the world remains an open question.' On the other hand after Sorrel's remarks about Indian vocal music amplification is not necessarily a threat.

channel specifics of the artificial channel of communication affect various changes in the natural, directly communicated tonal pattern'. Bontinck looks at amplification as a separate category specifically for 'Youth Music', meaning rock and pop. She presents three consequences for 'musical behaviour' as a result of the 'qualitative reshaping of the musical message':

- Changed spatial listening;
- Habituation to specific sound qualities;
- Specific shaping of the dynamic range.

Arguably that last consequence refers to the increased maximum level at pop concerts and to the decrease in dynamic range (when compared to a symphonic concert or chamber music in a recital hall).

Bontinck juxtaposes 'youth music' with 'serious, literature-bound' music that is (concerning these points) restricted by a score. Nowadays (but also in the 1970s when Bontinck wrote her article) it is not uncommon for this 'serious music' or other acoustic music, with or without score, to be amplified, as a means of making a performance available to a larger audience (eg an outdoor performance) or as an aesthetic means, using for instance one of Emmerson's functions. In the article Bontinck suggests that social scientists should familiarise themselves with the technological developments of the 20th century in order to deal with the methodological and terminological problems that come with these developments. Unfortunately Bontinck's subtle sentence about the relation between the two channels and the three consequences mentioned above has not been picked up by many authors and apart from Emmerson's work not much has been done towards the methodological and terminology problems outlined by Bontinck.[18]

In a book edited by Bontinck (after a symposium in 1972), Michel P. Philippot (1974) published a short chapter: *Observations on Sound Volume and Music Listening*. Philippot makes some interesting, stereotypical, but unsubstantiated observations:

[18] Like Emmerson, Bontinck (ibid p. 168) also mentions intentional distortion to which she refers as 'anti-fidelity'.

- This brings up our first hypothesis according to which the sound volume more or less consciously desired by the listener is inversely proportional to the real sound volume of the source. This hypothesis seems to be verified by the fact that electro-acoustic amplification is always used with small ensembles and not with big orchestras;

- A large portion of the music which is heard today does not reach the listener's ear directly but via an electro-acoustic channel (loudspeaker). Consequently the performances may have a sound volume that is no longer limited to that of the musical instruments. The fact that the sound emanates from a point source, the loudspeaker, arouses the wish for a higher sound volume;

- The sound volume of musical performances seems to be inversely proportional to the degree of complexity (in the sense of the term used in information theory) of the musical message;

Here the author refers to Moles' work on information theory, however Moles did not make the specific relation of complexity to sound level.

- There may be a correlation between the phenomenon of a massive dissemination of extremely simple musical information at high sound levels and a communication crisis among individuals – a crisis, which above all calls in question the semantic aspects of communication.

At the end of his article he warns about hearing loss, which is of course always a good thing (although by now, and perhaps as it was then, that is a well-known aspect of amplified music). It is unclear what the author means by writing that loudspeakers are a point source (which they are not). Assuming he means loudspeakers being very directional, he might allude to the contrast in radiation patterns between acoustic instruments and loudspeakers (as described in the discussion of mixed music in chapter two).

3.4 Architectural Acoustics

> *… says Stern (Mike) Avery Fisher Hall is a lousy place to play for electric music – we should have never have been playing there at all. It's more geared for strings and orchestra and you can hear the soft things. Otherwise most of the things get lost and it just sounds like a wash. I like to avoid that place whenever possible because it's too live and you cannot really feel the kind of music Miles was playing.* (Cole 2005, p. 95) (The *We want Miles* album was recorded at that concert, 5 July, 1981)

From approaches to amplified music in the social sciences I will move to a discussion of the subject in architectural acoustics. Looking at the literature of these disciplines there appears to be an ambiguous relation with electronic amplification. Bagenal and Wood's *Planning for Good Acoustics* (1931, p. iv) an early book with respect to electronic amplification gives a very clear viewpoint in that regard in its introduction:

> From this point of view a Greek theatre was a better loud-speaker for a given size of audience than an electric device because it interposed less between artist and listener, and easily produced its own conventions.

Although purpose built concert halls for amplified music are being built, both in the acoustic sciences and building agendas of city councils there appears to be an emphasis on designing and building acoustic concert halls and opera theatres; given the general perception that audience numbers for classical music are going down that is an interesting development. Santa Cruz (Tenerife), Melbourne, Copenhagen, Helsinki, Gateshead Tyne and Wear (Newcastle UK), Miami Beach Florida, Reykjavik, Singapore, Hamburg, Oslo, Rome and Los Angeles have opened new concert halls, often by famous architects such as Gehry, Calatrava and Piano. All these halls will be used for amplified music of every sort yet the acoustics are either optimised for symphonic orchestral music or have facilities installed that allow for flexibility in acoustics. By way of example in 2009 in the

concert hall of the Sydney Opera House (the larger of the two main auditoria) 65% of concerts (197 out of 303) were amplified (Taylor & Claringbold 2010).[19] In many cities the development of pop venues is left to commercial developers. One exception is the 'Zenith' in Paris, built in 1983 after an initiative by culture minister Jack Lang, close to the Cité de la Musique. It was the first of seven similar venues realised in France with Zenith Dijon and Zenith Nantes as most recent additions. With each new Zenith project the acoustic knowledge and experience was updated resulting in 'adequate acoustics' (as expressed in reverberation time) for the one in Nantes. One impressive feat of acoustic science is the 'Heineken Music Hall' in Amsterdam that was built on the initiative of Leon Ramakers, joint owner of Mojo, the biggest entertainment booker in The Netherlands. The room's acoustics, realised by Peutz Acoustics, are exceptionally dry in relation to the cubic volume, the walls absorb up to 90% of the sound for mid frequencies.[20]

3.4.1 Architectural Acoustics: Literature

Burris-Meyer's work was mentioned in chapter one, in a more recent book called *Theatres and Auditoriums* in its third edition (Burris-Meyer & Cole 1975, p. 288) a definition for sound reinforcement is given: 'it consists of achieving intelligibility for speech and acceptable intensity for music or other sounds, the actual source of which is in sight of the audience.' But on the next page the following caution is given:

> Where the human voice is used in speech or song, it must be reproduced with such fidelity that the audience will not suspect that electronic control equipment is being employed. If this condition cannot be met, it is better to abandon electronic sound control. After all, there are many productions and theatres that do not require it.

[19] That paper also describes the use of drapes and a canopy to 'temper' the acoustics for amplified concerts.
[20] Below 100hz reverb time for the empty hall is still 1.85 seconds but for 1000hz it is only 1.18 seconds. For a hall that measures 60 x43m at an average height of 18m (Volume is 48,000m^3) that is very dry; it accommodates 5,500 patrons standing or 3,400 seated (cf Lautenbach, Verkamme, & Heringa 2007).

Auditorium architecture books that look into sound amplification are few and often the focus is on classical concert halls and opera houses. Peter Lord's *The Architecture of Sound: Designing Places of Assembly* (Lord & Templeton 1986) spends a paragraph each on concert halls, theatres and churches. About the latter remarks (ibid p. 82):

> Even the clergy are losing the art of oratory and demanding sound reinforcement. The intrusive microphone is seen to be threatening to destroy the art whose essence is immediacy of presence.

Michael Barron ((2010, p. 395) in his book *Auditorium Acoustics and Architectural Design* spends a few words on amplification in a paragraph about electroacoustics. He makes some valuable remarks, in relation to loudspeaker directivity in particular:

> In a reverberant space like a concert hall, directing the loudspeaker sound exclusively at the (absorbent) audience becomes more crucial, since if the loudspeaker sound excites the reverberation it will undermine the speech intelligibility. But while a PA system provides variable acoustics of a sort, it carries a severe penalty for performing arts in that the sound is no longer lifelike. A major element in the unnaturalness of the simplest system arises because the listener localizes on the loudspeaker nearest to him.

Interestingly in the last two books amplification is considered a necessity as a consequence of acoustic parameters and not so much as a creative or necessary parameter in music/sound production.

(Forsyth 1985) mentions both the performance space at IRCAM and works by 20th century composers taking new approaches to concert music. He describes Xenakis' *Terretektorh* (1966) with the musicians of a symphony orchestra scattered amongst the audience; and Stockhausen's *Musik für die Beethovenhalle* (1971) with groups of musicians spread out around the building. And he looks at the architectural electronic compositions in Varèse's *Poème Électronique* and Stockhausen's spherical auditorium for the German Pavilion in Osaka 1970 (see Blesser & Salter 2006, p. 171).

Jaffe (2010) tells the story of the 700 seat Zankel recital hall which was constructed under New York's Carnegie hall, replacing a cinema (it was originally a hall for small ensembles when Carnegie opened in 1890). The hall's management wanted to diversify their programming by desiring slightly lower reverberation times to accommodate many different musics including the ones that need amplification. Jaffe also writes about designing shells for modern amphitheatres for music concerts (like the Hollywood Bowl, there are many similar venues in the US that never quite caught on in Europe). An orchestra performs in a shell in such cases, to provide them with the necessary acoustic feedback to play, at the same time directing acoustic energy towards the audience. Sometimes those concerts are reinforced, one anecdote is about such an occasion with the Metropolitan opera and choir squeezed onto a small stage with no adequate room to position microphones:

> I was standing at the rear of the crowd at central park with Rudolf Bing, director of the Met and a man known to be quite free in his criticism of shoddy work. I mentioned to him the problem associated with the small area of the shell for Met performances and hoped he was satisfied with the orchestral sound. He replied. "Forget the orchestra … just make sure we can hear the singers." (ibid p. 147)

3.4.2 Critical Reception of Assisted Resonance and Acoustic Enhancement

> *Hall's such as London's Royal Festival Hall that are found to be insufficiently resonant may resort to discreet boosting of their resonance by using electronic delay circuits, but this last-resort use of modern technology is felt to be somehow out of place in the performance of symphonic music. It is felt somehow to be cheating, and it does not advertise it presence.* (Small 1998, p. 26)

According to Jaffe (2010, p. 174), as a consequence of the negative connotation of the word 'electronic', the 'assisted resonance' (AR) system installed in the Royal Festival Hall in the early 1960s was: 'accomplished with great secrecy, and those involved were cautioned on pain of death to tell no one of the installation'. Jaffe tells two amusing

anecdotes, one about conductor Hebert von Karajan who was pleasantly surprised with the changed acoustics, attributing it to the plaster having finally dried out. New York times critic Harold Schonberg on a visit to London also reviewed the hall favourably after the first concert he attended at the venue. But when he found out about the electronic AR system he reported being duped and the sound of the hall was not as good as he first thought (ibid). In a later review (Schonberg 1981a) is more positive about a similar system installed by Jaffe in the Silva Concert Hall in Oregon:

> This is not amplification, with a decibel-hungry technician riding gain during a concert. The electronics are installed and then, theoretically, forgotten. […] In Mr. Jaffe's sophisticated system, he has tried to create an electronic reinforcement capable of responding in various directions. He says that a flick of a switch can provide a dry acoustic, and another flick a "Romantic" sound, with any degree of gradation between. This reinforcement works in tandem with the hall's natural acoustics, providing less than 5 percent of the total volume of sound. Nobody, he promises, will be "riding gain" during a concert, twiddling dials as the Broadway amplification virtuosos do.

Thirty years later, at the Technical University Delft, The Netherlands a system named Acoustic Control System (ACS) was developed by Diemer de Vries[21] and Guus Berkhout (Berkhout, de Vries & Vogel 1993; Prinssen 1996). The system was designed with a large amount of small loudspeakers surrounding the audience (eg built into an auditorium's wall) and controlled by a computer system that calculates the room's response to signals picked up by an array of microphones according to a particular setting. One benefit of installing such a system is that it can make a dry theatre into a more reverberant environment allowing performance of operas or orchestras. Systems like this provide a solution for 'multi' or 'all purpose halls', for smaller cities that cannot afford to sustain a separate theatre, opera and concert hall. In 1999 an ACS system on loan was temporarily installed in the New York State Theatre, residence of both the New

[21] Diemer de Vries lectured in room acoustics as part of my music and recording engineering program at the Royal Conservatoire The Hague. He took us to audition one of the first ACS systems installed, in the regional theatre in Tiel (the Netherlands) around 1993.

York City Opera and the New York City Ballet. The double use of the venue, with different acoustic requirements for opera and ballet, created a situation in which an electronic solution could be explored, adapting the venue's acoustic response to the needs of the performance at hand. The test created a storm of criticism, covered by New York Times reviewer Anthony Tommasini (1999b) in two articles that year. In the first (August) article the reviewer took a neutral stance but in a later article called 'Defending the Operatic Voice From Technology's Wiles' (Tommasini 1999a) in November of the same year, Tommasini sides with the opposing voices, on a very principled basis:

> While these systems sound nothing like the amplification typical of Broadway, they still rely on technology to assist the sound, or enhance it, or whatever euphemism the inventors use to describe a process that is still amplification: sound from the stage and the pit is picked up by microphones, carried via wires and disseminated through speakers.

The opposition, from what the critic referred to as 'opera buffs' to the use of amplification technology was very strong for a while, with fears that it would be the first step towards 'Broadway style amplification', even though the chairman of the State Theater's board stated that the system is not for amplifying voices but to enhance the room's acoustics: 'We view it as electronic architecture' (quoted in ibid). Some of the distrust seems to stem not so much from the use of technology per se but from the possibility of human agency, as suggested by Schonberg cited before:

> … Paul Kellogg, the artistic and general director, has said his strong preference is to set the controls in the house at certain levels and then leave them alone so that the State Theater will have a characteristic house sound like any unenhanced hall for music. Fair enough. But it is so easy to tinker that it is hard to believe that sound engineers will keep their hands off the knobs.

In his articles Tommasini makes a strong case in the defence of the unamplified, natural voice to be heard in (opera) theatres as a contrast to the amplified practices on Broadway.

Notwithstanding the protests, the test with the ACS system was considered successful and it was purchased in 2001 as we can read in an article by theatrical sound designer Kai Harada (2001).[22] Seven years later in a review of John Adams' opera *Doctor Atomic* at the same venue, Tommasini (2006) looks back: '[…] today City Opera rarely receives complaints from patrons about its sound enhancement system. And critics have mostly stopped mentioning it.' In *Doctor Atomic* the orchestra is amplified and the vocalists wear radio microphones allowing for 'Broadway style' amplification. In this case however the composer prescribed the amplification. Similarly to other late 20th century operas by Louis Andriessen (*Rosa*, *Writing to Vermeer*) but also earlier concertante works like *De Staat* were conceived with amplification in mind. Tommasini (ibid) shows he is not a Luddite:

> All art forms change over time. And the technology of amplification is more sophisticated than ever. As a composer who grew up in the age of rock and has immersed himself in electronic music, Mr. Adams, a modern master of orchestration, a digital-age Berlioz, has every right to incorporate all such resources into his works. Obviously, using body microphones for "Doctor Atomic" is not the same as using them for "Don Giovanni."

Blesser & Salter (2006, p. 199) analyse the passionate debate of: '…the importance of *natural* acoustics, with *artificial* acoustics being denigrated by implication.' The artificial becomes synonymous with electronically processed sound as opposed to a space's natural acoustic response:

> But even in the "natural acoustics" of a concert hall without electronics, listeners hear the acoustic interventions of sound-dispersing statues, sound-reflecting ceiling panels, sound-diffusing walls, and sound-absorbing panels. There is only

[22] In an article called 'A Century of Microphones: The Implications of Amplification for the Singer and the Listener' Richard Barret (2005) refers to this discussion. Unfortunately he misrepresents Harada's article by writing that the 'New York City Opera now routinely mikes performances', suggesting they amplify individual sources for their performances rather than the very specific use of an electroacoustic system. Something Barret may very well have misunderstood. Barret also quotes the curious article by Philippot (1974) that was mentioned before, affirming the lack of sources related to this subject.

> one relevant question. Does any particular intervention benefit the aural experience of a musical space? Debates about natural versus artificial are thus spurious and misleading. Man-made musical spaces are the result of human intervention, and electroacoustics is simply an aural technology of the twentieth century.

Christopher Small (1998, p. 28) who in his famous book *Musicking* takes issue with the social lack he identifies in the 'scared places' that classical concert halls have become, writes: 'a concert hall is a social construction' and 'The technology of the concert hall has produced a gain in acoustic clarity, but that clarity is balance by a loss of sociability.' (ibid p. 27) What emerged from the discussion about the relation between music and architecture is that composers and performers adapted to the acoustics of the rooms they performed in or composed works for. With the coming of electroacoustic amplification we have come to rely on technology to make that adaptation, with varying results. For instance as discussed rock or pop bands performing in classical concert halls, even while using a sophisticated contemporary (line-array) sound system, the concert hall at the Sydney Opera House needs significant dressing up with drapes and canapés as discussed by Taylor and Claringbold (2010).

3.4.3 A Second Additional Function

The 'Assisted Resonance' and 'Acoustic Enhancement' discussed in this paragraph can be considered as an additional function to Emmerson's overview of functionalities (see §3.1.1).

3.5 Authors not Mentioning Amplification

After the several authors who acknowledge amplification in their analyses of musical performance I will mention a few authors who ignore the subject. After a brief selection I will continue with a discussion of some of the many authors who do write about amplification, but in a critical, negative way. [24]

[24] Unfortunately the list of authors who do not is much longer than the list of authors who do.

There is at least one good reason to not write about amplification in articles about (contemporary) music; in the end it is the music that matters and not whether it comes from a loudspeaker or not. But that does not explain why very little has been written about the subject and that many books looking at rock and pop music ignore the subject. Even though Bontinck's article was reprinted in 1994 very few authors treat amplification as a separate category or a mode of production that differs from unamplified music. And titles can be deceptive: a German book *Der Einflus der Technische Mittler auf die Musikerziehung unserer Zeit* edited by Egon Kraus (1968) takes a conservative perspective; in a chapter 'Motivation des Singens und Ihre Bedeutung für die technisch verstärkte Beatle-Stimme' by Friedrich Klausmeier the technical amplified Beatle-voice reaches high sound levels at concerts as an expression of youth's power. A book with a catching title: *Capturing Sound: How Technology has Changed Music* (Katz 2004) ignores the subject completely, doing the title an injustice by focusing only on recorded music; *Engineering the Performance* by Susan Schmidt Horning (2004) looks exclusively at recording engineering. I am not saying there is anything wrong with these publications but the titles suggest more than what is offered. A book called: *Metal, Rock, and Jazz: Perception and the Phenomenology of Musical Experience* (Berger 1999) that looks specifically at venues presenting concerts of these genres refers to amplification only once, as a casual remark: describing a particular venue the author mentions that the 'drums are not miked' (ibid p. 69). Even though amplification is commonplace in the Broadway musical, David Craig (1990) in *On Singing Onstage* makes no mention of the subject at all.

Michael Chanan's magnum opus *Musica Practica* (1994, p. 36) only mentions the phenomenon in relation to 'hysterical behaviour of pop music fans'. The chapter dedicated to recorded and electronic music ('Musica Practica Electronified') makes no mention of the subject at all.

A last curious example comes from Edward Kealy (1979): in an article discussing sociological aspects of the recording sound engineering profession he only refers to 'concert mixers' as studio mixers who want to be involved with a band even after a record is finished, going as far as sharing drug habits with rock stars on tour.

3.6 Critical Sounds

> *The composer's voice has assumed the task of projecting and amplifying the poet. Today, unfortunately, the poet's voice is often amplified more in a literal than in a figurative sense.* (Cone 1974, p. 44)

3.6.1 Critical Sounds: Historical

Osborne's 'Singing in the Pain' in 1979 summed up arguments from a technical, vocalists' perspective, and condemnatory critiques keep appearing, as for example Vincent Canby's (1995) enigmatic comment in the *New York Times* fifteen years later:

> Contemporary sound amplification techniques – especially the use of body microphones – may not be exactly the bane of today's theater, but they're radically affecting esthetics that until recently have remained unchanged since Aeschylus.

This quote from Canby's article appears in several journal papers and book chapters but I'm afraid I have to argue against the suggestion that theatre aesthetics have not changed since Aeschylus. I am not a theatre historian but the difference between a huge amphitheatre and perhaps Shakespeare's Globe, should give us food for thought. Nevertheless, Canby's exaggeration shows how much the use of amplification bothers him, and he is not alone. Atkinson's review of Earl Carroll's *Vanities* of 1939/40 was mentioned in the previous chapter, the first in an endless stream of reviews that complain about the 'sound' suggesting (usually) the engineer should be fired or the production should not have been amplified in the first place. Fascinatingly the libretto of the musical *Hair* mentions Atkinson's favourable review of the show in 1968, although without a source (the critic was retired by then) or any reference to the music or amplification (also in Wollman 2006, p. 12).[25]

Not unlike the introduction of other new technologies (think for instance about the first steam trains), speech and music amplification has not always been received with

[25] Atkinson did however comment on other aspects: 'The show's staged nakedness, broadened the community of theater lovers remarkably. Thousands of them had never seen anything more exhilarating in their lives.'

open arms. Already in relation to Edison's plan for an Aerophone, in a newspaper article ('The Aerophone' 1878) the author complains that Edison has invented too many things and he should be stopped. Fascinatingly he mentions privacy issues, the fear of being overheard or being spied at by a hidden phonograph, as a big social problem that will destroy: 'all confidence between man and man, and render more dangerous than ever woman's want of confidence in woman.' And although the privacy debate in relation to communication and technology is still raging, for this author the possibility of amplified speech seems simply destructive: 'Mr. Edison has since reached a still more conspicuous peak of scientific infamy by inventing the aerophone – an instrument far more devastating in its effects and fraught with the destruction of human society.' Perhaps with that very article in mind one of Edison's assistants Francis Jehl (1936, p. 180) wrote:

> The Aerophone … was not a popular invention; many feared that casual and indiscrete remarks would be roared out to the adjoining neighbourhood. The attitude of the public was said to have been one of 'comic wrath', since it threatened to invade their privacy.

George Bernard Shaw who by chance worked for Edison in England in 1879 commented after using Edison's 'loud speaking telephone':

> …a much too ingenious invention, being nothing less than a telephone of such stentorian efficiency that it bellowed your most private communications all over the house, instead of whispering them with some sort of discretion. George Bernard Shaw *The Irrational Knot* (1880).

Criticisms, like this one, came from a social point of view; another perspective is that of amplification as cheating, it being unfair to be supported by technology to compete with an able, professional operatic singer (as if that was what Vallee, Crosby and later Sinatra had in mind).

3.6.2 Critical Sounds: Originality and Authenticity

Another often vented spleen is that the sound from a loudspeaker is not real, not original, not authentic, not lifelike which in the case of most pop music is very problematic; for popular music vocal production a microphone is essential. In Gracyk's account, discussed earlier, it appears that sounds emanating from loudspeakers are not original, which creates a problem for rock, it being dependent on loudspeakers, whether live or recorded. At performances rockers are present on stage while those 'unoriginal' sounds come from the loudspeakers, which I would argue makes it at least more original than playing back a recording. This raises the question of lip-syncing and authenticity that I'll address in the next chapter.

Simon Frith (1986) in a paper called 'Art versus technology: the strange case of popular music' opens with a description of how the BBC kept the crooners from their radio programs as they were found 'effeminate'.[26] Frith's second example is the reception of one of Dylan's first 'electric' performances in the UK in 1966. Lee Marshall (2006) looks at Bob Dylan's famous switch to performing with an electric band at the Newport Folk Festival one year earlier. By changing his acoustic guitar for an electric (which he had already used on recordings earlier that year) and performing with a back up band Dylan took his leave from folk music, establishing himself as a 'rocker' or rather a 'folk-rocker'. As Marshall asserts this is one of the most written about performances in music history, Gracyk (1996, p. 9) goes as far as comparing it to the 1913 premiere of Stravinsky's *Sacre du Printemps*. Daniel Levitin (2006, p. 14) goes back even further in music history remembering the days of the *Diabolus in Musica*: 'It was pitch that had the medieval church in an uproar. And it was timbre that got Dylan booed'. The fascinating point in the analyses of the Bob Dylan moment is that what caused the commotion was his using a backing band and an electric rather than an acoustic guitar; the fact that his singing was amplified seems to have no foot in the debate whatsoever. The moment is referred to as Bob Dylan going 'electric', a moniker he owes to his guitar choice rather than his amplified singing voice. The problem (one of definition I would argue) reminds us of the use of the common term 'Unplugged' for concerts where (rock) musicians

[26] See Lockheart (2003) for the reception of the crooners in terms of their perceived masculinity or lack thereof. Frith (1986, p. 263) very appropriately refers to Dennis Potter's TV-series *Pennies from Heaven* that celebrated 'the association of crooning and sexual decadence'.

change their electric for acoustic guitars, which are plugged in and amplified nevertheless (sometimes reaching the same sound pressure levels as a traditional rock concert).[27] Marshall (2006, p. 17) presents several causes why the Newport concert was so scandalous, including a scuffle between Alan Lomax and Dylan's manager Albert Grossman, with the former presenting a purist view on blues and folk music and the latter embodying the 'corrupting commercial influence'. Dylan was 'brainwashed by the recording industry' and the electric guitar 'represented capitalism' (ibid p. 24). Other reasons brought forward by Marshall may have been the shortness of Dylan's 16-minute set, or Dylan's voice not being audible in the sound mix; earlier that same day Dylan had performed 'acoustic' (ie singing amplified playing an amplified acoustic guitar) but members of the audience had asked for the sound to be turned up because they could hear the banjo workshop next door. After the tumultuous set Dylan returned to the stage with an acoustic guitar (apparently Johnny Cash's) and played an 'unplugged', solo, encore. Auslander (2008, p. 111), based on a band member's testimony, remarks the crowd was angry because Dylan played only three songs. But none of those arguments explain the reception in the UK as reported by Frith. C.P. Lee (1998) suggests that one of the reasons for the reception, in Newport and in the UK was that the amplification was just too loud, not just for the folk music audience, but for that era in general.

3.6.3 Concerts, Bootlegs and Live Recordings

Marshall (2006, p. 18) bases his analysis partially on the PA-tape or soundboard recording, which has, as he remarks the problem of not covering the audience response. He concludes:

> It is certainly true that the most important thing about the performance for Dylan seemed to be volume, but the soundboard recording of the show does not support the argument that the sound was poor.

[27] The term 'unplugged' came into fashion after Nirvana's seminal MTV unplugged TV performance and album/dvd with the same name. An earlier usage dates from a 1991 Paul McCarthy album *unplugged (the official bootleg)* also for MTV.

The problem with such reasoning is that a soundboard recording is not a good document of what the performance sounded like to the concert's audience; the recording may sound great but the live sound may have been poor in comparison. Not only is the amplification mix adjusted to the acoustic balance at the time (eg the drums may have not been amplified and therefore only audible as 'bleed' into vocal or other microphones) and the sound system in use may have been inadequate, broken or just really bad. And as Marshall writes a page earlier the sound was 'thin', but is unclear whether he draws that conclusion from the soundboard recording or from a witness' account.

Frith's account of Dylan's show is based on a 'bootleg', which was, as appeared later, a recording of Dylan's show in Manchester the week before (Lee 1998).[28] The audience response is clearly captured as Frith mentions slow clapping (suggesting a hostile audience) and abuse 'hurled at the stage', famously someone heckling 'Judas'. Gracyk (1996, p.88) mentions what he calls an 'audience tape' of a Bob Dylan concert in 1975, while some of that concert was recorded 'officially' and released on an album called *Before the Flood* that same year: 'Judging from the audience tape, the official "live" album does not reproduce even an approximation of what anyone in that room actually heard during that event'. The difference between one or two microphones carried by a person in the audience and a recording of a mix created from the close microphones on stage is huge. James Lull (1992, p. 134) mentions a Grateful Dead tradition:

> Certified Dead Heads are seated in a special section in which audio taping of the music is permitted. Some are even allowed to connect their recorders to the concert sound system in order to create clear and properly mixed recordings.

Such a mix is created by balancing the sounds coming from the stage directly (ie the backline, drums and guitar amps, monitors) with the individual microphoned channels. A vocalist will need more amplification than a drumkit or a guitar amplifier and will therefore usually be louder in such a mix; the PA tape ends up being like a 'negative' of what happened acoustically. An 'official' live recording is usually made by creating a

[28] That particular recording was not a bootleg in the sense of illegally recorded but as an unauthorized release by a CBS employee, now released (Columbia CK65760) as "The Royal Albert Hall Concert" (recorded at the Free Trade Hall, Manchester).

balance in a different room (recording truck, in house studio, dressing room) of all the individual channels to recreate an ideal sounding performance. In addition microphones that capture the audience response are usually blended in the mix. Gracyk (1996, p. 89) offers an analysis of the live album, where we can hear the audience singing along: 'We are offered two perspectives simultaneously; the instruments are an idealised audience perspective while the audience is an idealised performer perspective'.

One thing that is implied by the Bob Dylan scandal is that 35 years after Vallee and Crosby started using electronic vocal amplification at concerts it was already so common that even in the heated debate around the authenticity of folklore music, no one seemed to mind Dylan's voice being amplified at all, or raise questions of authenticity regarding his microphone use. On top of that, it suggests that when an acoustic source such as a singing voice or an acoustic guitar is amplified using a microphone to pick up the authentic sound emanating from singer and instrument, it can still be considered acoustic and authentic; authentic enough to have caused the debate about Dylan's choice for the electric guitar. An interesting question is why did the electric performance cause an outrage but his preceding record with electric guitars not? That brings about the strong(er) notion of authenticity at concerts, the signal from the microphone used for a recording is no big deal, the same signal used for amplification raises concerns of authenticity.

3.6.4 Critical Sounds: Recurring Issues

Frith (1986) analyses the tension between art and technology and identifies three recurring issues that surface in relation to (new) technology and music:

1 Technology is opposed to nature: microphones enabled the crooners to be pseudo-present: 'technical dishonesty meant emotional dishonesty';
2 Technology is opposed to community: 'electronic amplification alienates performers from their audiences' and by way of example he refers to the audience's response to Dylan's electric performance.

3 Technology is opposed to art.[29]

Frith provides an excellent example of a music union in the UK rejecting a band from a music competition on the grounds that they used a drum machine instead of a drummer (this was in the 1980s). The tension between musicians' jobs and new technology runs through the entire age of Ensoniment and beyond, as it does through the history of human labour since the introduction of the steam engine, or even the horse-plough. Kraft's (2003, p. 59) book was referred to before in relation to the number of instrumentalists in the Broadway orchestra pits, about the relation between technology and musician he writes:

> The story of the record and radio industries in the 1920s and 1930s shows again that the diffusion of new technologies had profound effects on the work environment and market power of musicians, and it clarifies, therefore, the impact of sound technology on labour relations.

Fleischer (2006, p. 17) cautions that such 'sweeping conclusions' should not be made, he argues that the relation between public performance and mechanical reproduction is not a dichotomy but more complex throughout the different 'media ecologies'. With the introduction of pre-recorded material into musical performance (see Resphigi's nightingale and the Grammophonmusik in the previous chapter) a whole universe of reconfigurations became possible.

3.6.5 Critical Sounds: Broadway

Elizabeth Wollman (2006, p. 2), in a book about rock musicals, summarises the problem of electronic amplification and Broadway musicals very well:

> …the now-typical use of electric instruments and amplification systems in the theater are begrudgingly seen as necessary evils that attract wider audiences while

[29] That is an ambiguous observation in itself; most art needs at least a little bit of technology, given the Greek root (techné) of both words. But the perceived opposition eloquently demonstrates that the arts always find Brinkmanship between traditional (however young) values and 'the new'.

> simultaneously destroying the purity of the musical as it was during its golden age from the 1930s through the 1950s.

The amplification of Broadway musicals attracts the scorn of many reviewers. A review by (Schonberg 1981b) subtitled 'The Surrender of Broadway to Amplified Sound' shows the reviewer coping with the fact that none of the Broadway shows at that time were free of amplification. He mentions a small production "Shakespeare's Cabaret" of which the producers: 'proudly said that the singers were unamplified' but the small backstage band was causing a: 'certain amount of audio pollution' creeping 'into the evening'. Schonberg does not blame the technology or the designers or the mixers:

> The technology is wonderful. Equipment represents the state of the art. Mixers handle the elaborate equipment the way Heifetz used to handle his violin. There is only one problem. The sound is generally awful. It is awful because, no matter how sophisticated the equipment, the nature of the beast is such that honest sound is, literally, impossible to achieve, and every audio designer and sound mixer will admit it. Amplified sound in the Broadway theater leads to a kind of reproduction in which there is little or no feeling of space. No matter where the singer is, the sound source comes from a different location. Those in the audience seated at the left or right, adjacent to loudspeakers, are going to hear sounds from the speakers and not from the stage. The singer is opening and closing his mouth in one spot, the actual sound is coming from a location far removed.

The critic mentions examples from *Annie* with the sound of the singing kids coming from the side walls rather than from the stage. And the same for *Evita*: 'It is a disembodied entity that floods the theater in a raucous manner from no particular location. The audience floats in a bowl of auditory chicken soup.' Schonberg talks to an actual mixer:

> "I'm a hired gun. I give the director and producer what they want even if I think it's awful." He prefers to think "in terms of sound reinforcement rather than

> amplification." But by whatever name it is called, it has little relation to real sounds coming from the human throat.

A year earlier in Schonberg's review (1980) of a reworked production of Gilbert and Sullivan's *Pirates of Penzance*, he notes:

> One thing traditionalists, and anybody with a responsible set of ears, is not going to like about this "Pirates" is the sound system. […] The Delacorte Theater is an outdoors installation, with a thrust stage and no provision for a shell that could throw the sound into the audience. […] But even granting the need for amplification, the system currently in use is a disaster. There are footlight microphones; and the singers also use body mikes. Sound is picked up and passed to a pair of large speakers mounted on towers adjoining the stage. What happens is that the sound comes from a completely different source than the stage. The mouths of the singers are opening and closing, but what the audience hears is sound a good deal removed from the actual site of the action. It is hard to tell who is singing and where the singer is. […] Something has to be done, and surely there are audio experts who could get a more natural quality of sound into the Delacorte system.

Like Tommasini Schonberg does not come across as a Luddite, but he does point out that often the amplification is just not done very well.

Both Schonberg and Tommasini write about 'decibel-hungry' engineers 'riding the gain', and state that it is 'hard to believe that sound engineers will keep their hands off the knobs'. Also John Potter in his book with Neil Sorrel (Potter & Sorrell 2012, p. 235) describes the balance of Berio's *Sinfonia* in which the voices should only be: '…just heard above the orchestra (to the chagrin of many a sound engineer)'. Perhaps this shows the uneasy relation at amplified concerts between the audience, different opinions and different ears, and the sound engineer as intermediate between the performers, the composer's or arranger's intention, the venue's management and that audience.

In the process of making a recording discussions related to the final mix and master are between the performers (although they can be 'hired guns' with no vote) the producer and the mastering engineer. The final product is played back by the consumer on their device of choice, at their own preferred level. At a concert usually most of these decisions are left to the mixer, occasionally together with a musical director, but more often than not this part of the process is ignored completely. Often leading to (in part) unhappy audiences and critics.

A number of points emerge from the criticisms: the unnaturalness of the detached sound; the risks of engineers (who are not considered qualified performers in a traditional sense) fiddling with the balance, and generally bad results at concerts. An overview of performance art critics and amplification will always be biased: except for some rare occasions critics usually only mention sound amplification when it is done badly.

3.7 Why Loud?

> *When (Ron) Lorman began mixing the sound for Miles's concerts, he faced a dilemma. Half of the audience seemed to comprise older fans that had grown up listening to* Sketches of Spain *and* Kind of Blue*, and the rest were younger members keen to hear the louder and more aggressive sound delivered by the new band. Lorman approached Miles and told him about this audio paradox, adding that he was looking for a happy medium. "He looked at me and paused for what seemed like an eternity ad said 'Ron. Turn it up - make it loud. I want them to feel it."* (Cole 2005, p. 97)

After reviewing some of the recurring criticisms regarding the subject I will continue by looking at writers addressing the questions why some concerts have to be loud and why that is a problem.

Stephen (Mithen 2006, p. 91) refers to Deryck Cooke's *Music and Language*:

> Cooke described volume, rhythm, tempo and pitch as the 'vitalizing agents' of a piece of music thus the louder the music is played, the more emphasis is given to whatever emotion is being expressed; conversely the softer, the less emphasis.

The relation to amplification and loud music is very clear and often people wonder why 'does it have to be so loud?' In a recent article in the online *Guardian* (Dillner 2012) the author advices readers to wear earplugs when going to a pop or rock concert. While the article contains nothing new, the comments in the forum raise old and new questions. One reader wonders why concerts are so loud and why there are no regulations, why is the sound crew not constrained to operate within the limits of hearing damage. (Another reader writes that he or she wears earplugs going to the cinema. I cannot help noticing myself that either levels in cinemas appear to be going up, or my hearing is getting more sensitive).

Many publications look at music and the risks of hearing damage but I would like to briefly look into the question why some people like loud music and the problems related, environmental (noise) and health (hearing damage).[31] I'll allow myself an anecdote here. At the annual art fair 'Uitmarkt' on the Amsterdam museum square in the early 2000s, the max SPL was $90dB_{(A)}$ to be measured at the mixer position (which is rather arbitrary and easily bypassed by moving the position further away from the stage). The prescribed level was hard to accomplish given that the backline and monitoring of the bands playing on stage measured a level of $87dB_{(A)}$ on average. Even so we (and this is accomplished by musicians, eg guitarist turning down their amps, monitor mixer and the FOH mixer) managed to stay within limits when an audience member leaned into the mixer tent saying that it was not loud enough! A man standing next to him said, actually, no, the level is exactly right while showing his SPL measuring device and his city council badge.

Apart from personal and cultural (rock music is loud music) reasons explaining why some concertgoers like their concerts loud a few practical and technical reasons can be listed:

[31] For overviews see (Mercier & Hohmann 2002; Petrescu 2008; Størmer & Stenklev 2007; Zhao et al. 2010).

- Overcoming a screaming (singing along) crowd (ie The Beatles at the Shea Stadium). A very loud concert allows each member of the audience to sing along without embarrassment while still hearing the performance;
- Bands are loud, a drum kit played by a strong, rocking drummer, a guitarist who achieves his personal sound by maxing the volume of his amplifier (which traditionally is positioned so it faces the audiences). Idem ditto for a bass player with a preference for an 'Ampeg'[32] stack or similar; vocals and other instruments have to be amplified to match these 'givens';
- Monitor loudspeakers leaking low frequency energy towards the audience, which has to be overcome by more loudspeakers aimed at the audience in that area;
- A mixer who wants to 'produce' the mix, ie control for 100% what the audience hears has to completely overpower the backline and monitors, as a starting point!
- In the great outdoors the sound roams free, inside a venue, unless it has been very well treated with absorbent material, it creates reflections; first from the acoustic instruments (imagine a snare drum hit at a rock drummers level in an empty concert hall) and the (noisy) audience. Then the sound from the loudspeakers (FOH and monitors) is added creating reflections as well, building up the overall level.

The first item cues a remark by Theodor Adorno (1990, p. 54) cited by Frith (1996, p. 238): 'what the gramophone listener actually wants to hear is himself, and the artist merely offers him a substitute for the sounding image of his own person….'. A psychological reasoning that could very well explain not only the success of air-guitar and air-guitar competitions, but also why audiences sing along at full power without possibly even hearing themselves; as a consequence of the amplification or simply because they wear earplugs to protect their ears from that amplification.

SPL was discussed in the introduction; it is an objective measurable quantity. On the hearing side, loudness is a perceived, subjective quality and empirical data can only

[32] Ampeg is a popular brand of bass amplifiers. Their man-sized bass cabinets are in high demand and easily recognised when seen on stage.

be gathered by asking people about it. Like pitch it is an entirely psychological phenomenon: Daniel Levitin (2006, p. 67) starts his discussion of loudness by stating that there is not very much to say about it:

> When you're adjusting the output of your stereo system, you're technically increasing the amplitude of the vibration of molecules, which in turn is interpreted as loudness by our brains. The point here is that it takes a brain to experience what we call "loudness."

He goes on to discuss concertgoers, some of whom like very loud, or extremely loud music. He mentions reports of: 'a special state of consciousness, a sense of thrills and excitement, when the music is really loud'. Why that is attractive to some (and not to others) is a question that is yet to be answered:

> Part of the reason may be related to the fact that loud music saturates the auditory system, causing neurons to fire at their maximum rate. When many, many neurons are maximally firing, this could cause an emergent property, a brain state qualitatively different from when they are firing at normal rates.

In two detailed papers (Blesser & Salter 2008) and (Blesser 2007) look at many aspects of loud music, cautioning that it has been very well established that exposure to loud sounds causes hearing damage, but the question why people like loud music has been insufficiently researched. One obvious reason for the lack of research is that subjects cannot be asked to submit themselves to very loud music, so studies are always indirect. In the 2007 paper Blesser starts by arguing that excessively loud music serves a function, and is not:

- An accident that arises from ignorance of the consequences;
- The result of being manipulated for commercial profits;
- A temporary fad that happens to exist in our culture at this moment in time.

Loud music is not just found at pop and rock concerts, raves or clubs; Blesser points out that it can be found in many places, sporting events, cars, cinemas and the ubiquitous personal stereo. This last cause is not only endangering hearing: a recent increase in traffic accidents appears to be related to people playing music (loud enough it seems) in their headphones making them oblivious to other road users (Ralson 2012).

In answering the question why some of us like loud music Blesser suggests: '…three separate but related motivations for loudness: social rewards, biological stimulation, and selective aural focus.' The latter aims at the drowning out effect of the loudest sound, 'loud sound dominates the aural space'. The biological stimulation, like Levitin, Blesser suggests a special (altered) state of consciousness; about which he remarks it unjustly suggests there is a 'normal' state. Finally Blesser signals a relation between loud music and social cohesion: 'Loud sonic events are bigger, closer, and energetic.' Perhaps that explains why many people enjoy loud fireworks on New Years Eve and similar occasions. Attending concerts of loud music synchronises our brains according to Blesser (ibid p. 6): 'Loud music enhances group cohesion. A live concert, even with reproduced music and lip- syncing performers, provides a connection to others in the audience.' Blesser's ideas echo in Gracyk's (1996, p. 107) book: 'Too often, rock's volume functions as a filter on the world, fostering withdrawal rather than facilitating communication'.

One notable exception to the rule of not subjecting subjects to dangerous levels of SPL can be found in (Todd & Cody 1999) looking into what Blesser calls biological stimulation. With careful monitoring of subjects' safety the researchers managed to measure vestibular system response up to 120 $dB_{(A)}$.[34] The authors anecdotally link this vestibular response to 'sensations of self-motion' such as experienced on a swing (which is something, similar to loud music, that some people like more than others). The vestibular response appears to occur at levels above an individual threshold ranging from 90-120dB(A) (in the case of Todd and Cody's work the range of the stimuli). In the conclusion the paper suggests that there *could be* a relation between the findings and

[34] The vestibular system is responsible for our bodily balance; it shares the labyrinth of the inner ear with the cochlea of our hearing system.

what is referred to as the 'Rock and Roll Threshold' that was proposed by Ken (Dibble 1995):

> Loud music, unlike industrial noise which is known to be harmful, may not be stressful even up to 105dB$_{LAeq}$, and, in his view, "rock and roll just does not work below a certain threshold level, ...somewhere around 96 dBL$_{Aeq}$, provided there is sufficient low frequency energy present."

The reason music may be less harmful at similar levels is that industry noise often displays a broadband spectrum whereas live music has more energy in the 50-100Hz band (in relation to mid frequency material 10dB more for live performance, 20dB for discotheques and 30dB for a rave (ibid p. 496, after Dibble). A more recent paper (Emami & Daneshi 2012) refers to Todd and Cody's hypothesis, which is still mentioned as a possibility:

> The vestibular hearing lies in the range of aloud (sic) low frequencies (50–800 Hz and above 90 dB$_{spl}$), which may be obtainable from loud dance music or overt singing. This response can be a physiological basis for the minimum loudness necessary for rock and dance music, so, vestibular hearing contributes to the affective quality of loud sounds.

The minimum level at which this vestibular response is different for each subject (ie the individual threshold that Todd and Cody describe); for some it starts at 90dB$_{spl}$ for other at 120dB$_{spl}$, at the threshold of pain. This might be an explanation for the fact that some people love loud music and others liken it to hell on earth.

Accurate measurement, accurate enough to support legislation of maximum levels, is very problematic at concerts of music. When to measure, at what position, what weighing and averaged over how much time are issues that make it hard to enforce maximum levels. In a recent tutorial at the 120th AES convention it was pointed out that higher frequencies are more damaging than middle which are more damaging than lower frequencies, which: 'implies that the commonly applied A-weighting filter is not

necessarily appropriate as a means of measuring high musical sound levels for risk purposes.' (Staff-AES 2006, p. 1112). That same publication related work done in Gothenburg, Sweden by Kim Kahari of the National Institute for Working Life from 2003, looking at creating a healthy live-sound environment with 'quality sound at reduced levels'. One aspect was setting up meeting with stakeholders: 'including the musicians' union, sound technicians, university staff, event organizers, and health professionals.' (ibid p. 1111) which is a good way of asserting that it is not just a problem of sound engineering or music culture. Another aspect was validating the methods for sound measurement; at that time health and safety staff would measure for only five minutes: 'often at the loudest point of the event'. The publication indicates that: 'Further work is required to understand better when and how to measure sound levels at live events'. A 'one size fits all' approach is unlikely to work, people are easily annoyed by low frequencies (ie when they are experienced as pollution in a neighbourhood) but an audience's hearing is at risk from a sensitivity to high frequencies.

Loud amplification is not limited to pop and rock musics, Fluxus composer and minimalist La Monte Young often prescribed loud amplification for performances of his works. According to Keith Potter (2002, p. 65) in his book *Four Musical Minimalists*, high amplification levels were needed to 'explore the innards of sound', meaning harmonic partials, 'with full clarity and intensity'. Tapes with drones created by Young to accompany three of Andy Warhol's films in 1967, were played back so loud that the Lincoln Centre, where the films were shown as part of the New York Film Festival, objected. Rather than turning down the volume La Monte Young withdrew his works (ibid).[35] Young's work with his band The Theatre of Eternal Music in the mid 1960s is also famed for the use of loud amplification. In the cause of its existence the band focussed on 'drone based dimensions' (ibid p. 70), and in order to balance the (Young's) saxophone with the string instruments (John Cale's amongst others) creating the drones,

[35] Augoyard,& Torgue (2005, p. 40) list for drone or bourdon: 'the presence of a constant layer of stable pitch in a sound ensemble with no noticeable variation in intensity.' See also Schafer (1977, p. 76/7), and Tagg (2013, p. 337).

they were encouraged to use amplification, 'and a high sound level soon became an important component of the total sound'.[36]

Another minimalist who used amplification was Philip Glass. In 1970 his ensemble was joined by 'sound designer and mixer' Kurt Munkacsi: 'His creation of an amplification system for the group to deploy at dynamic levels common in rock music had its own effect on the composer's [Glass] increasing interest in texture and timbre' (ibid p. 307).[37] In a later interview in SPIN (Hermes 2008), Glass remembers that after hearing Jefferson Airplane play at the Filmore East in Manhattan, he wanted to be like that: 'I want to be *loud*'. And, 'When repetitive structured music […] is played loud, you begin to hear kind of the froth – it's like a river that sends up all this white foam. It was the foam I was interested in'. In another publication (Kozinn 1999, p. 106), Glass is cited about the same phenomenon: 'You actually hear sounds that nobody is playing, a shiny top to the music'.

3.7.1 A Third Additional Function: Immersion

What La Monte Young and Glass were trying to achieve by using very loud amplification can be categorised as what Emmerson (2007, p. 161) refers to as Immersion, which I would like to add as the third additional function to Emmerson's list (see §3.1.1). Referring to Pink Floyd's experiments with a loudspeaker system surrounding the audience (in 1975, discussed in §4.6.9) and clubs, discos and raves (where the audience is usually surrounded by loudspeakers), Emmerson calls this 'amniotic immersion, an all-embracing sonic fluid'. With amplified sound coming from a number of surrounding sources playing back the same signals at high SPLs, it becomes hard to identify a source, suggesting omnipresence. Although in the examples of the minimalists' composers there is not always mention of surrounding loudspeaker positions, La Monte Young and Glass appear to be interested in creating an immersive effect. Jean-François Augoyard & Henry Torgue, (2005, p. 64) in *Sonic Experience: a Guide to Everyday Sounds*) give a slightly different meaning to the term, relating it to a secondary or distant sound which is

[36] Potter (2002, p. 71) relates how John Cale replaced the strings of his viola with electric guitar strings in order to create 'a drone like a jet engine', in addition to flattening the instrument's bridge, allowing him to bow all four strings at the same time.
[37] Glass in the same SPIN interview (Hermes 2008) mentions that Munkacsi worked with La Monte Young before.

immersed in a dominant sonic 'micromilieu', for instance the murmur of the waves interfering with a song sung on the beach.

3.7.2 Loudness as a Problem

> *Unfortunately, our culture has linked loudness with enjoyment.*
> Arline Bronzaft in 'Noise: the Silent Problem' *The Independent* 17 October 2002, quoted in Bijsterveld (2008, p. 11)[38]

In a symposium paper with the alarming name 'The Destruction of Acoustic Specificity by Amplified Sound' Ray Gallon includes all the sounds in our daily sonic environment that come from loudspeakers, amplified music being just one of them. He draws attention to a newer phenomenon using background music as a means to keep people away from certain areas.[39] A good example can be found in the underground parking at Amsterdam's Museum Square everywhere in the garage classical music (Mozart, Haydn) can be heard in a bid to keep out junkies, as rumour has it. Johnson and Cloonan (2009, p. 184) report the use of Bing Crosby songs to keep teenagers away from a shopping mall in Wollongong (New South Wales Australia). This is not specifically related to loudness, the authors discuss the (attempted) use of music to regulate the occupancy of public space.[40] Gallon aims his arrows not so much at amplification being used in general but at the ubiquity of loudspeaker induced background sound.[41] He makes a valid point in remarking that in some places landscapes (as in the way they look) are protected, possibly we should look at similar legislation for (specific) soundscapes. Gallon refers to rave parties where amplification is used to create sensory overload.

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[38] See also Arline Bronzaft (2009), her chapter 'Noise: its Effects and Control' offers a detailed overview of the problem of unwanted noise.
[39] Gallon refers to a paper by Jonathan Sterne in 2003. "Background Music and the Politics of Public Space." Paper delivered at the seminar, *La Musica que No s'Escolta: Escolta Ambiental i Creaciò Musical.* Festival Zeppelin, Barcelona, 28 February 2003.
[40] Whitcomb (2003b) mentions this as well in his essay on Bing Crosby.
[41] Which he perceives as a nuisance as it: 'prevents us from hearing and understanding the acoustic singularities that bring something to us: information, pleasure, the sounds of the space around us which we need to situate ourselves physically, etc'

> Noise is one of the scourges of the modern world, an unwanted product of our technological civilisation increasingly polluting our daily life. (...) We are paying, in nervous strain, noise induced deafness and other physical and mental ills, the price of faster transport and "easier" life. (Schenker-Sprüngli 1967, p. 5)

Two different aspects are of interest here, sound pollution as a consequence of amplified music concerts and the question why people submit themselves to dangerously high SPL when attending concerts or raves. When it comes to music, the former aspect has a history:

> Over and above all this, music has a certain lack of urbanity about it. For owing chiefly to the character of its instruments, it scatters its influence abroad to an uncalled-for extent (through the neighbourhood), and thus, as it were, becomes obtrusive and deprives others, outside the musical circle, of their freedom. (Immanuel Kant 1978, pp. SS53-22)

In Utrecht a historical theatre in the old town by the name of Tivoli has been a pop and rock venue since 1979. With the increase in loudness and growth in the number of concerts the hindrance for the immediate neighbourhood grew simultaneously. Since 2003, to decrease the pollution, they are organising a number of concerts in an alternative venue just outside the old town in a more industrial area with few inhabitants. When the 'Muziekpaleis', now under construction, is finished Tivoli will move to a new venue in a multiplex with the famous Vredenburg concert hall, a jazz venue and a world music venue (both of which have issues with their location and the neighbours).

3.8 Concerts as Commodity

3.8.1 Liveness

Performance and Popular Culture edited by Ian Inglis (2006) is one of the few books that interrogates popular music as a performance art. In his introduction the editor points out that music has been approached as an economic system, as an industrial practice, as a political vehicle, as a developing technology or as a subcultural agent but a' neglect of

live musical performance has been evident in many academic contributions to popular music studies' (p. xiiv). One of the underlying reasons for this neglect may be the (out-dated) notion that in music money is made from record sales and associated copyrights and broadcasting rights. For instance as Philip Auslander writes in *Liveness* (2008, p. 162): 'mediatized forms enjoy far more cultural presence and prestige – and profitability – than live forms'. The cultural presence of recorded music is certainly still dominant, but the economic model has changed over the last decade as foreseen by David Bowie:

> Music itself is going to become like running water or electricity [...] You'd better be prepared for doing a lot of touring because that's really the only unique situation that's going to be left. It's terribly exciting. But on the other hand it does not matter if you think it's exciting or not; it's what's going to happen. (David Bowie, interviewed by Jon Pareles, New York Times, 9th of June 2002 quoted in (Connolly & Krueger 2005).

What Connolly and Krueger (ibid) call the Bowie effect was already felt in 2002, as a consequence of the decline in record sales that started in 1999:

> Only four of the top 35 income-earners made more money from recordings than from live concerts, and much of the record revenue for these artists probably represented an advance on a new album, not on-going royalties from CD sales. For the top 35 artists as a whole, income from touring exceeded income from record sales by a ratio of 7.5 to 1 in 2002.

At the start of the 21st century (and into its second decade) musicians create more revenue (including merchandise sales) by touring and giving concerts, than from selling records. Another technology driven asset is the ability to buy a recording of the very concert that was attended, immediately after the event. Sometimes on a CD (with an impressive amount of cd-burners spinning away after the applause has died out), on a flash USB

stick or as a download with a code acquired separately or attached to the concert's ticket.[42]

3.8.2 Amplified Music for the Masses

> *What is at stake in all these arguments is the authenticity or truth of music: the implication is that the technology is somehow false or falsifying. The origins of this argument lie, of course, in the mass culture criticism of the 1920s and 1930s.* (Frith 1986, p. 265)

In traditional arguments concerning 'high brow' versus 'low brow' art, products of mass culture and mass media were easily dropped into the 'low brow' bin. That traditional bias offers interesting perspectives on electronically amplified performance, is amplification de facto a mass medium? And is it still a mass medium when for instance classical music is amplified? Johnson (2000, p. 83) writes: 'The ambiguous relationship between music and modern technology is masked by the common but simplistic model of a capitalist takeover of popular music through technological mediations.' [43]

Adorno wrote about music and mass media, but never specifically about the use of amplification. Adorno and the other Frankfurters' distrust of mass media was fuelled by their witnessing the rise of the Nazis in Germany and Stalin's oppression in the USSR, with all its manipulative use of all (mass) media. In many cases I do not think concerts of amplified music can be categorised as mass media (but it takes mass media to sell all the tickets). Perhaps at large rallies such as were organised by the Nazis (the massive ones in Nurnberg, for instance) or a Mayday parade in Moscow mass media becomes a viable term for amplified sound, but even then the sound reproducing technology is not a mass medium in itself. The medium takes shape through the mass that is present, a mass of people that may not be there entirely out of free will as I assume was the case at large gatherings in dictatorial states, now or in the past. One notable exception was mentioned

[42] For instance as provided by Abbey Road's 'Live here now' service: www.abbeyroad.com/Service/87/Live-Here-Now <viewed 2 March 2013>

[43] And after Blesser and Salter's suggestion, the optimised acoustics of the classical concert hall are as much a technology as the use of amplification; are concert hall acoustics thus a mass medium?

before, the paging systems that were installed in towns and village across the Soviet Union and its East-European satellite states, in a way they behave more like radio with one notable difference, an ordinary citizen cannot switch them off.

Gregor von Rezzori (2008, p. 259) in his *Memoires of an Anti-Semite*, relating the story of the Anschluss of Austria in March 1938, mentions Hitler's speech being inaudible at times, lost in the 'Sieg Heil!' calls from the mass.[44] Carolyn Birdsall (2012, p. 34) argues that PA technology used by the Nazis played a role in creating mass resonances of the party propaganda machine, together with the other electroacoustic technologies, exploring the concept of 'affirmative resonance':

> In my basic definition, affirmative resonance refers to a practice or event when a group of people communally create sounds that resonate in a space, thus reinforcing the legitimacy of their group and its identity patterns.

The electroacoustic systems not only amplified speeches and music but also the gathering itself:

> The loud cheers of massive crowds at official events not only comprised the affirmations of individual speaking-hearing feedback loops, but also the intensification of the sounds recorded by the microphone, projected through the loudspeaker system, and fed back again into the microphone. This feedback process is an evocative illustration of how affirmative resonance was attempted during the Nazi era. (ibid p. 35)

Metaphorically this paints a strong picture; technically it is more problematic: it was exactly overcoming the problem of feedback that allowed the use of such large-scale amplification systems.

Smalley (2009, p. 43), after Auslander in his discussion of social distance and performed space mentioned earlier does write that what he calls the 'mediatised

[44] Rezzori's book is semi autobiographical and may not be the best source. A sentence of Hitler's speech cited by the author was not found in transcripts from Hitler's 1938 speech on Vienna's Heldenplatz.

performed space' is the product of mass media or media technology. I argue that the visual and audible limits of even a very large stadium still create a local audience, even though with thousands of people still a social event. Kronenburg (2012, p. 5) writes:

> Musical performance regardless of whether or not it is in association with a building, transforms the space, internal or external, into an identifiable 'place', the boundary of which is limited by the aural and visual experience of being there.

The aural boundary of some events has different limitations; at the time of writing the BBC mentioned an outdoors concert by rock band The Foo Fighters in Belfast that provoked complaints from more than 15 kilometres away.[45]

The number of people reached by Bon Jovi or Prince at one night in a football stadium is nothing in comparison to the sales figures of a popular recording or the numbers that watch 'Master Chef' or the hourly number of videos uploaded to YouTube. People, at least in the richer societies, have a choice, they can spend their money and leisure time on theatre, cinema, concerts, museums, sports or stay and home and watch TV.[46] In general a PA system only reaches one audience, gathered in a venue, in a square in a city or a sports facility. This limits the size off the 'mass' it can address, raising the question what constitutes a 'mass'.

3.8.3 Adorno, Kittler and Wagner

One particular remark by Adorno about electronically reproduced music bears some relevance: 'Thus the jukebox in an empty pub will blare in order to lure "suckers" with its false pretence of revelry in progress', in his *Introduction to the Sociology of Music* (1976, p. 45). With that remark in mind I recall the story of Joe Turner in the previous chapter, who sang into a microphone from behind the bar in a nightclub, with a loudspeaker

[45] Foo Fighters concert provokes noise complaints at Belfast's open air festival 'Tennent's Vital', 21 August. see www.bbc.co.uk/news/uk-northern-ireland-19340766 22 August 2012. <viewed 11 March 2013>

[46] I would argue such competition is desirable in a free market, provided that it is maintained by a supportive structure. The differences in (performance) art funding between for instance the USA the UK and the Netherlands show that different ways of approaching such a structure are possible, albeit with slightly different outcomes.

outside above the door addressing a busy intersection with a lot of competing nightclubs, competing perhaps in music but certainly in selling booze. Similarly Avron White (1987, p. 195) brings a story of a band playing in a bar wanting to play louder (with the doors open) at the beginning of the night in order to attract an audience.

There are presumably more reasons why Adorno had issues with Wagner, but Friedrich (Kittler 1993, p. 215) addressed Adorno's inability to deal with Wagner's operas in relation to his media theory. Kittler describes Wagner's acoustic effects and orchestrations as cultural preparation for amplification technology and amplified music. Elsa (a role in Wagner's opera *Lohengrin*) according to Kittler (ibid p. 224) is the 'first resident of [Hendrix'] *Electric Ladyland*':

> This is also why Adorno, in his fidelity to European art and musical logic, was thwarted by Wagner. Amplifiers put philosophy out of commission. They cover up traditional musical values such as thematic workmanship or polyphonic style – all these fundamentally written data- and replace them with sound.

In Kittler's analyses of media technologies music became 'sound' after the introduction of recording technology: record grooves trace sound, not music. When Bach wrote a fugue using the four letters of his name he could reverse and reorder the notes b-a-c-h (in German the letter b represents b-flat, b-natural is the letter h) as musical content. If we reverse a recording of the fugue changing b-a-c-h to h-c-a-b we hear a reversal of sounds, affecting the tonal quality and making it much harder to hear the pitches.

> The significant point here is that analog, technological media are the first to record events that transpire outside of the audible and visible realms. The real itself is saved by the phonograph, by photography, and by cinematography, it is transmitted by radio and television, and it is – at least in part – also even produced. (Krämer 2006)

This might not concern us at all looking at amplified sound if Kittler's argument did not touch on a valuable aspect of the relation between the acoustic sound and the amplified

sound. A microphone transduces an imprint of the 'real' and by reintroducing it in the same room at the same time it is bound to create confusion. A microphone aimed at a violin does not pick up a musical note, but a complex waveform that is the result of the sound of the violin, reflections from the floor or a music stand, perhaps the player's audible breathing, and 'bleed' from other acoustic sources. The transduced sound not only represents the complex waveform of the violin's sound, it also contains a trace of the local acoustics, of the particulars of the venue, that is to say: the context. The microphone was chosen and put in a certain position intentionally, with a certain result in mind. It is not a second hand version of the violin's sound that is transduced, but a new sound altogether based on the violin's sound and its context, reflecting the choices made (room, microphone, type and position). Sound matters more in contemporary popular music, writes Van Leeuwen (1999, p. 127); pop artists develop their own recognisable style and as a consequence of recording: 'become part of the language of music and be imitated or transformed by countless others'. Sound is what creates those styles, those relations, and sound (in this case) is made of a source and its transductions.

Gracyk referred to transduced and amplified sound as not-original and other authors ask similar questions of authenticity when dealing with the relation between acoustic sound and amplified sound. For electric instruments, but also rock and pop singing (or crooning), a loudspeaker is essential for creating the 'original sound' in the first place; it would not exist if it was not for the loudspeaker, how could it not be original?

Going back one step back however, to the point where the microphone transduces the acoustic sound; if we take that signal and broadcast it over the radio or record it and play it back some other time that question of authenticity or originality is hardly ever raised, perhaps only in the comments on the early crooners. Whereas in the special case of amplified sound the acoustic source is present and visible, giving less cause (one could argue) to doubt the authenticity of what is heard. This, of course, brings us to the problem that at larger venues and at higher amplification levels it becomes harder to judge whether what is heard is actually created by the actions of the performers on stage. The increased use of pre-recorded material (with the aid of click tracks) makes this distinction

even harder. I will discuss lip-syncing and the use of autotune pitch correction at concerts in the next chapter.

In many instances (Emmerson's functions come to mind), the sound transduced by the microphone becomes a new original, an intentional transformation of the acoustic sound. The crooners used the directional microphone's proximity effect to create an intimate voice and for that same reason rock musicals such as *Hair* need (directional) handheld microphones that have similar characteristics.

It is real sound that a loudspeaker produces, intentionally picked up by a particular microphone at a specific level after intentional transformations such as filtering for instance. The transformations made intentionally by one or more agents ensure the amplified sound is an original in itself.

3.8.4 Mediatisation

Auslander (2008, p. 4) uses the term 'mediatisation' after Jean Baudrillard in a loose way to describe the products of mass media and technology. He includes amplified sound but only discusses large scale, stadium events. Similar to Blaukopf's term 'mediamorphosis', Auslander's account lacks a broad operationalisation of amplified sound, which I argue is necessary to allow for different functions in relation to how (and how much) amplification is used. Auslander (ibid p. 25) writes that as soon as amplification is used an event is mediatised, we do not hear the original (live) acoustic event, but the vibration of a loudspeaker: '…a reproduction by technological means of a sound picked up by a microphone.' At a concert of amplified music we hear a *mediatisation* of what is going on on stage. Mediatised performance and live performance: 'are parallel forms that participate in the same cultural economy' (ibid p. 5). In the case of a stadium concert (where the visual is also 'amplified' by means of diamond vision or 'jumbotron')[47] I can see Auslander's point, but at smaller concerts, with lower amplification levels, where it is clear that technology is used to produce music and create the experience I find the binary notion of mediatised performance versus live performance problematic. There is a continuum from low-level amplification in a theatre or a bar to the stadium concert where amplification takes on the function of distribution, in addition to its production role.

[47] David Zemmels (2004) refers to the big screens in stadiums as 'jumbotrons'.

Wollman (2006, p. 123) in her book about the rock musical mentions the franchising of musical theatre: presenting the same highly consistent show not only night after night and from city to city but also across different productions in different countries. After (Auslander 1997) she writes that such performances take on the '…defining characteristics of a mass medium: it makes the same text available simultaneously to a large number of participants distributed widely in space.' Megamusicals have come closer to being mass media; in the way they are centralised productions, distributed globally by one and the same company. And as Wollman asserts uniform in aesthetic make-up, including electronic amplification.

Franchising of musical performance in some aspects is not entirely a contemporary phenomenon; a unified global approach to performance can also be found in the world of classical concerts as it has been for over 100 years. Concert halls are modelled on a few successful venues and in newer halls designers strive for similar acoustic goals; both the classical concert repertoire and its traditions are unified all over the world. Bruce Johnson (2000, p. 85) puts it very straightforwardly:

> The relatively rigid, text-centered and non-interactive performance convention of the mainstream art music, accustomed to regimenting the performance space to its demands rather than the reverse, produced a general resistance to a technology that required the musicians and composers to make adjustments.

However strong the franchise, instead of a global commodity, classical music performance is rapidly becoming a protected species within the performance arts.

3.8.5 Megamusicals

Julia A. Noonan (2009) in a paper about vocal *quality* in the musical *Grease* (1972), contrasts the amplified voice of the early rock musicals with legitimate singing (including the theatrical belt) that did not rely on amplification: 'As the rock musical injected amplification into the theatre, it disrupted traditional associations with the 'natural' voice' (ibid p. 187). This sentiment is also brought forward by Sternefeld and Wollman (2011, p. 114):

> While *Hair's* catchy rock score helped earn the production particular acclaim, the musical's reliance on microphones was hardly as celebrated.

It is clear that the rock musical introduced new usages of amplification technology to the musical theatre, in particular the handheld microphone as an unmistakable attribute of pop and rock singing. As Noonan (2009, p. 189) writes about *Grease* imitating 1950s rock 'n' roll: '…the rock *'n'* roll music aurally *needs* amplification to create the rock 'sound', and the presence of the microphone is characteristic to the 1950s rock *'n'* roll performer.'[48] *Hair* would not be *Hair* without amplified voices using hand held microphones (making good use of the precedence effect); it would cease to be a rock musical; the singing style requires the use of such microphones.

Both Noonan and Sternefeld & Wollman refer to an earlier publication by Jonathan Burston (1998) called 'Theatre Space as Virtual Place'. That article discusses: 'how technological means of sonic production and reproduction affect the in-theatre acoustic environments where we watch and listen to these shows.' Burston problematises the sound designs of those megamusicals becoming more like a cinematic experience as a consequence of amplification (from that perspective it is good to realise that amplification in theatres took a leap after the success of the talkies).

In a review of an impressive list of recent literature about Broadway musicals Kim Kowalke (2007, p. 709) refers to Scott McMillin (2006, p. 174) who compares the staged and the movie version of *Chicago*:

> …he notes the fundamental differences between the conventions of theatre and film: "theatre occurs in a series of events in a single space, the stage, where the vulnerability of the performers is visible, and film occurs as a series of events photographed and screened, where the vulnerability of the performers is rendered irrelevant. A film is a system of technological omniscience in the first place."

[48] In the 1950s this would have been more likely to be a microphone on a stand rather than a handheld microphone.

Burston's issue is what he calls the 'audio-visual split' (AV-split), the sound of the performer seen on stage is coming from a loudspeaker in a different location (usually to the left or right of the stage; in a cinema the centre loudspeaker(s) are at least behind the screen).[49] The term was first coined by John Corbett (1990, p. 85) describing the 'cleavage of image/sound' that first occurred (according to Corbett) with the spread of commercial recording in the second decade of the 20th century. Corbett describes attempts by the industries to overcome the split, first by adding 'more sophisticated graphic accompaniment' to records and cassettes and later with the video clip and the rise of MTV. Corbett develops an argument of 'fetishistic audiophilia' that relates to attempts to increase the AV-split by reducing noise and crackle and unwanted sounds in recordings like coughing in the audience or breathing string players; a hygiene that (according to Corbett) removes the 'grain of the recording'. Some consumers develop a fetish for the 'hardware' spending more on their HiFi system than on software (ie actual recordings). In extension of his arguments Corbett problematises recordings by 'new age' labels (he mentions ECM and Windham Hill) that abuse 'compression and echo'.[50]

In my opinion, and referring to the discussion of transduction effects (§2.14), Corbett's analysis is problematic; sound recording comes with an 'AV-split' as the obvious consequential technical dislocation, similar to radio and telephone. Another consequence of recording is the adaptation of the dynamic range to the recording medium (ie compression). From the early mechanical recording to the early microphone recordings dynamic adaptations have been made as a part of the recording process; strategies of dealing with those issues (if they really are issues) and choices made (technically or artistically) have changed and come and gone with each new technology; they are not static. The same goes for choices about recording with or without acoustics or additional synthesised reverberation or echoes.

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[49] The Sony Dynamic Digital Sound (SDDS) uses five loudspeakers behind the screen allowing the mixer to more accurately position voices to an actor's position on screen. In theatres often a number of loudspeakers (referred to as a 'cluster') is rigged in the centre above the proscenium; when aligned and positioned well it can aid in enhancing localisation of amplified sources. The left-right sound system is then effectively extended into a left-centre-right (LCR) system.

[50] Not distinguishing between echo and reverb suggests Corbett is not very well informed in these matters; since echo is a very specific acoustic reflection that we perceive as a separate auditory event. ECM changed the sound of jazz recording by adding significant amounts of digital reverberation to for instance the recordings of Keith Jarrett (who himself adds a lot of grain to his recording by humming and moaning along to his playing).

This should be of no concern in our present discussion if it were not for Burston (1998, p. 210) who translates Corbett's concepts to the amplified musical:

> The situation Corbett describes has its direct counterpart in the field of megamusical production, where new fissures between the visual and the aural have opened up with the arrival of radio microphones and, for the first time, theatregoers find themselves in circumstances where they no longer hear what their eyes *tell* them they are hearing.

I will further discuss the 'AV-split' in the next paragraph that discusses the acousmatic. I am not unsympathetic towards Burston's conclusions; he indicates – with many authors – that the dislocation of the sound source in theatre is a problem, and musicals being very loud is a problem too. But as debated in the previous chapter there are many different reasons why musicals sound they way they do, a solution would have to address more than just the sound design.[51]

An interesting aspect is that Burston (and others) focus on vocal sounds; with the orchestra in a pit (out of sight as is often the case in a musical), we do not see the actual musicians or their instruments, yet we do hear them play. The problem of dislocation or AV-split concerns the singers/actors, what Banfield (2000, p. 251) calls: '…the actorly truth of speech and the singerly enchantment of song.' One reason why this dislocation is such a big problem in musical theatre (and perhaps in normal theatre too) could be that the combination of singing lyrics (that have to be understood) and acting adding body language and facial expression makes us want to attend more to the source; to what Rick (Altman 1980, p. 74) refers to as the 'sound hermeneutic' in the context of cinema: 'The sound asks where? The image responds here!' (Connor 2000, p. 19; Emmerson 2007, p. 124). Perhaps Altman's hermeneutic is even stronger with language or sounds produced by humans, sounds we can relate to by experience, not just of hearing but also of making. Altman's theorem also brings Shakespeare to mind: Polonius hiding behind a curtain, but

[51] Burston likens the sonic experience of a megamusical to the sound of FM radio with its issues of dynamic range, which is a rather limited, and personal, comparison. Problematic therefore is that Burston's thesis pops up in many publications about musicals but also in David Horn's (2003, p. 107) entry for 'Singer' in the Encyclopaedia of Popular Music of the World.

giving himself away by crying out for help; and Hamlet killing him as a consequence (Hamlet: "How now! a rat?", act III. Scene iv. 22). Johnson (2005, p. 260), in an article that discusses Shakespeare's *Hamlet* as an acoustic experience, asks the question: 'What may be known of a thing that is heard but not seen, or seen but not heard?' He lists three important moments:

> …the voice of the ghost, the songs of the deranged Ophelia and the indecorous grave-diggers, and the final sounds emanating from Hamlet. Apart from being sonic devices, they share the fact that, although vocalisation, their expressive power exists beyond and apart from the usual characteristics of speech.

The significance of how we relate to people's voices is well documented in Serge Lacasse's (2000, p. 10) PhD thesis, referring to Sean Cubitt (1984, p. 211): 'The voice is directly of the body, of its warm and vital interior, and our voices identify us as surely as our physical presence' the voice is the instrument we share (after Allan Moore (1993)). Smalley (1993, p. 294) expresses a similar idea about the human voice (in recordings):

> We can quickly distinguish between the real and unreal, between reality and fantasy, and appreciate the passage between them. The voice's humanity, directness, universality, expressiveness, and wide and subtle sonic repertory offer a scope which no other source [...] can rival.

And Emmerson (2007, p. 118) writes about Bell's telephone: 'The human voice was the first and most important sound source, making all the more shocking its disembodiment and dislocation'.

We are addressed verbally in a language we know and we want to attend to the person addressing us. The auditory system localises a loudspeaker in an altogether different place from what our eyes tell us. This appears to be less of a problem in a church, a lecture or a conference. The tension that is created by the dislocation is a problem in (musical) theatre, unless intentionally created; but in music it is often not considered a problem, or at least by fewer people (no one bothered to write about Bob

Dylan's voice coming from a loudspeaker in 1965). And this tension can become a musical parameter in itself (as in Emmerson's functions projection and perspective). As well as in theatre: in a 2006 production of *Himmel über Berlin* after Wim Wenders' movie *Wings of* Desire by 'Toneelgroep Amsterdam' and 'American Repertory Theatre', the voices of the angels were amplified while other voices were heard acoustically. Roger Copeland (1995, p. 28) opens his article 'The Presence of Mediation' with an example of a play by Richard Foreman called *What Did He See* (1988). The audience was separated from the performers by see thru Plexiglas scrim, their voices amplified, but not for 'conventional reasons' using body mikes: '…unabashedly and rather gruesomely visible, taped to the actors' cheeks like I.V. needles that had missed their marks.' In 2009 I saw a production called *Wat het Lichaam niet Vergeet* (Beauty is only skin deep) by Dutch theatre group 'Oostpool' with a similar transparent division between stage and seating, with one microphone behind the wall, which was used by the actors for monologues. The voices were amplified with a bunch of slightly old-fashioned horn loudspeakers (the ones you see mounted on poles in the outdoors) above the centre of the division.

3.8.6 Dealing with Dislocation

There are also examples of sound system designs for musicals that minimise the number of seats in a house suffering from the problem of dislocation. Clever use of the Haas effect (which implies the amplification cannot be very loud) and well-designed systems can help in reconnecting the vocal sounds to their sources.[53] Many designers and mixers take pride in achieving an 'acoustic' sound for most of the seats in a theatre; even though amplified the sound appears to be coming from the actors. This is much harder to achieve with a producer who does not share the same goal and just wants everything louder, for maximum impact. The producer is aware (one might hope) that the performance is competing for the same 'entertainment dollars' that people spend on going (for instance) to see and hear a movie (cf Auslander 2008, p. 5/6).

[53] A simple left right system will minimise the 'sweet spot' to a few along the centre aisle (a good reason to have seats in the centre rather than an aisle), the addition of a centre cluster (flown over the stage) will greatly benefit localisation (cf Brown 2002).

3.8.7 Live Music and Recorded Music

Auslander (ibid p. 56) makes the vital point that the term 'live performance' was meaningless before recording technology and radio broadcasts. He gives ancient Greek theatre as an example, which could not have been 'live' because there was no way of recording it! Hence 'the live is that what can be recorded',[54] after Jean Baudrillard's: '…the real is that of which it is possible to give an equivalent reproduction' (cited in ibid p. 56). [55] Auslander refers to (Copeland 1990, p. 29) who connects Baudrillard's work to the amplified Broadway show:

> … Baudrillard's conception of the "hyperreal", a reality so mediated by media that we're no longer capable of distinguishing "the real thing" from its simulation (or maybe it's just that we so often seem to prefer the simulation to the real thing). Note for example, that on Broadway these days even nonmusical plays are routinely miked, in part because the results sound more "natural" to an audience whose ears have been conditioned by stereo television, high fidelity LP's, and compact disks.

Copeland's (ibid p. 28) description of the miniature microphones visibly taped to the performers' heads was mentioned earlier. Auslander (2008, p. 57) adds that the use of almost invisible tiny body mikes (much more common than Copeland's example): 'reinforces our perception of an amplified voice as 'natural'. Later he argues that Madonna uses a headset microphone (now synonymous with her name, 'Madonna-mike') to 'suppress the apparatus of reproduction', which is a bit strong given the simple argument that a head worn mike allows her to dance (arguably more vital to her concerts than her singing).

David Zemmels (2004) simplifies Auslander and Baudrillard's definition by suggestion that 'live' means not recorded (then what with a DJ or mixed music, I wonder?) He argues that: 'all electronic reproduction is recorded in some fashion, even if

[54] What can be recorded, which implies: how do we position recording? Where are the microphones, whose perspective do we choose, that of the audience? Or the technically optimised mix of the close mikes on stage?

[55] Where Kittler posed that it is the real that is saved by recording – and perfectly malleable: the real is not static, neither is the recorded (eg photographs of Lenin or Stalin with and without Trotski).

only to be rebroadcast instantly', which is problematic from the perspective of this thesis because it implies there is no difference between a concert of amplified music and a recording. There is also the problem of sound's remarkable time travel when transduced from the medium air to copper, the amplified sound arriving before the acoustic sound, unless compensated (in which case the sound is being stored for an instant in a digital memory or on a tape loop) which, theoretically might be perceived as form of recording. Gracyk's remark about 'original' sound again comes to mind in this context, but even when only looking at recording 'original' is problematic: is a familiar, recorded voice more original than an unknown voice or a synthesised one? When listening to recorded music we can still distinguish between a recorded piano, a sampled piano or a synthesised piano. One could argue the first one is more original than the other two and the second more original than the last; I would say how it is used, the intention a certain technology is used for, can be a measure for originality. Even though bearing these points in mind, with the stage becoming more like a recording studio, drier or very absorbent acoustics and increased channel separation (eg by installing plexiglass walls around a drummer) Zemmels' and Auslander's arguments, a concert becoming a repetition of a recording, become much more viable. And in extension to that, Auslander (2008, p.75) cites Steve Wurtzler (1992, p. 94) supporting his point that live performance now tends to 'recapitulate mediatised representations'. Live records are judged not by how well they represent a concert but how accurately they reproduce the studio recordings of the same act: 'Again the live is conceived as a degraded version of the recorded.'

3.8.8 The Live

With respect to a definition of 'the live' Emma Webster (2011, p. 12) looks at human intent rather than at technology (which may change or come to be used in a different way) as a defining feature. She writes: 'Live music is also defined as local music, "bound up with the social production of place", after (Cohen 1995, p. 444). Her promising definition however is a bit circular:

> An event is hereby classed as 'live' if two or more participants (artists and audiences) gather to listen to [live] music in a public place and react in real-time

> to the music being heard, whether through dancing at a free party out in the countryside, applauding at a symphony concert, or creating the music themselves at a folk session in a pub.

But she explains that: 'Unlike a physical product, then, the live music event is dependent on the successful combination of a variety of elements that have to come together at a specific place and time, hence by its nature, live music must happen in a particular locality'. Webster aims for a description of the live that includes the actions (the performance) of DJs at raves and clubs. Gracyk (quoted in Auslander 2008, p. 64) calls these, including the Jamaican sound system, 'sites for recorded music' that do not rely on live performance. Gracyk appears to argue that a DJ is not a live performer, she or he 'just' plays records, music made by others. But, apart from the act of selecting, mixing tracks and interacting with the audience, what if the DJ has a microphone and addresses the crowd, even by saying 'hey'? And what about the classic looping technique of the early house DJs with two identical records;[56] not only can that be considered performative, it also takes considerable skill. Even more so when combined with for instance scratching, in which case the turntable becomes a musical instrument, cf Katz's (2004, p. 124) chapter on turntablism as a phonographic effect.

After Van Leeuwen (pers. communication November 2011) I argue: a concert is an intensively social event, whether in silence at a symphony or jumping and singing along to a rock band. Defining the live as a function of recording, as shaped by technology, does not do justice to the social aspects. Earlier in this chapter I suggested that the intentional microphone transduction of a source in order to make it louder or modify and reproduce is what makes amplified sound an authentic sound, rather than simply a copy of an original. For the scope of this thesis I will adapt the notion of intent towards the live rather than Auslander's and Zemmels' construction of the absence of recording, which in my opinion is hard to maintain with regard to the contemporary performance arts.

[56] With two identical records on turntable A and B, both set at the start of a 'loopable' section, the DJ plays record A and at the end of the section, loops it by playing B, while quickly finding the start of the loop again on record A etcetera. This is not unlike what is called 'juggling' in Jamaican Dub and Sound Systems (cf Husse 2003, p. 263).

3.8.9 The Primacy of Recording

The suggestion that musical theatre performances have become more cinematic and patrons that have been 'spoilt' by watching TV was supported (and feared) by several authors (cf Engel 1975, p. 162). Along the same lines there are many observations about a strong reciprocal relation between recorded music and musical performance. What we hear listening to music at home (as observed by Berio earlier in this chapter) does appear to influence what we would like to hear at a concert, the ubiquity of recorded music has become a defining factor in musical appreciation and experiences. Collins (2008) refers to a quote in Katz's (2004) *Capturing Sound*:

> Mark Katz quotes John Pfeiffer, a retired classical recording engineer, paraphrasing Kipling: "A recording is one thing, a concert is another, and never the twain shall meet". Clearly things have changed since Mr. Pfeiffer stepped back from his mixer—the twains have met and seem to be getting along quite well.

Robert Philip (2004, p. 231) in *Early Recordings and Musical Style* :

> The changes in recording and the recording studio have in turn fed back into the concert-hall. If pre-war recordings are remarkably like live-performances, many late 20th century live performances are remarkably like recordings. Detailed clarity and control have become the priority in modern performance, in the concert hall as well as in the studio. […] This has led to a standard, which is in a limited sense, incredibly high. The price is that many modern performances place accuracy and clarity above all other considerations.

Peter Wicke (1990, p. 5) describes an R&B band recording in the fifties; with just one microphone in the middle of the room, surrounded by the musicians recording takes in one go (a practice that echoes mechanical recording). According to Wicke this implies that there was 'virtually no difference between the recording and the live music played on

stage'. One of the phonographic effects that Katz describes in his *Capturing Sound* is the influence that recording practice had on the use of vibrato by violinists. Chanan (1994, p. 250) observes that with the introduction of Berliner's disc the possibility of mass production separated playback from recording. Reproduction 'removed the presence of the listener […] and deprived the performer of the listener's encouragement':

> These developments had marked effects on both performance and listening. The former began to lose its spontaneity and became the art of the repeated take. The latter turned attention away from the excitement and risk of the act of performance, towards the reproduction and its surface sheen.

A consequence of early (mechanical) recording technology and the acoustically dry studios that were used for radio broadcasts in the 20s and 30s was that consumers developed a taste for classical (or acoustic) music without reverberation. Blesser & Salter (2006, p. 112) find a relation between that development and the marketing ideal of the 'Tone tests', but also remark that it managed to market a technical limitation as a 'desirable selling feature':

> Through continuous exposure to, and intense marketing of, music recorded with "dry" (deadened or suppressed) acoustics, the listening public came to accept this new concept of music quality. The same dynamic took place during Prohibition when brewed beer was no longer aged: after a decade of exposure, the public accepted this weaker beer as the desirable norm. With repeated exposure, sensory expectations adjust to what is familiar, regardless of its intrinsic attributes. Dry acoustics and weak beer both become matters of habit and custom.

Direct sound was considered more 'precise' than sound modified by spatial acoustic (which still is, as Blesser & Salter remarked, a technical modification). That notion was challenged by Bagenal (1931) but it would take until after WW-II before orchestral recordings 'with' acoustics became commonplace. James Lull (1992, p. 60) writes about the contemporary situation:

> Hi-fi opened our ears to a new appreciation of dynamic range and subtlety. By the end of the 1960s, records, not concerts, defined the "best" sound. Nowadays both classical and popular musicians have to make sure that their live performances meet the sound standards of their records. The acoustic design of concert halls has changed accordingly, and rock groups take sound checks, sound mixers, elaborate amplification systems, and these days the use of taped material to enhance their "live" performances for granted. The increasing "purity" of the recorded sound - no extraneous or accidental noises - is the mark of its artificiality.

To conclude this paragraph with a remarkable point of view in this light: Frith (1996, p. 228) cites American composer Milton Babbitt but also Adorno, both arguing that classical music is better enjoyed at home listening to a recording than at a concert hall. Music – Western classical music – is best enjoyed solitary, or in a homely family setting, in a minimal social context.

3.9 The Acousmatic: the Living Newspaper

> *To see or not see the sound's source: it all begins here, but this simple duality is already quite complex.* […] *Indeed, all the other cases or types of voices in cinema may have derived from older dramatic forms. The synchronous voice comes from the theatre; film music comes from opera, melodrama, and vaudeville; and voiceover commentary from the magic lantern shows and older arts involving narrated projections.* (Chion 1999, p. 4)

In his column 'Nature Watch' Mark Cocker[57] reminds us of the capacity of birds like nightingales and skylarks to produce disembodied music; perhaps not surprisingly Resphigi chose a nightingale to be played along to his *Pines of Rome.* With the possibility of technical reproduction creating sounds that are always detached has become viable.

[57] *Guardian Weekly*, 16 March 2012.

What we would nowadays call a 'voice-over' was referred to as the 'Living Newspaper' (Burton-Meyer & Hamilton 1959) in the theatre of the 1930s.[59] Of course off-stage voices were common in theatre before amplification, similar to off-stage 'bandas' or 'fern-Orchester' in the romantic symphonic repertoire; in a church the sound of the organ can appear to come from everywhere. In our everyday environment sounds without a visual source or sounds that are hard to localise are as common as sounds that we collocate with a visual source. Sometimes, in our perception or cognitively, we can reconnect the detached voice to a source; on an airplane we hear the stewardess's voice from an overhead loudspeaker yet some people can see her speak into a telephone horn and other cannot; but even without seeing we can (usually) distinguish between a pre-recorded message and a 'live' announcement. And not too many people are bothered by the fact that the sound (from the loudspeaker) is detached from the source (the stewardess). How we evaluate dislocated sounds and how we respond to them depends on the context, and may change over time (not a lot of people will have the connotation of a 'Living Newspaper' when they hear David Attenborough's voice over a documentary). The relation of religious/spiritual gatherings to specific acoustic spaces and disembodied voices was noted earlier; distinct sounds such as a remote church bell or a car horn carry different meaning potentials when one does not have a watch or when crossing a busy street.

Several of the authors cited in this chapter write about the tension that comes with the aural dislocation inherent to amplified sound which questions the relation between seeing and hearing at a concert. Instead of taking a decisive stance for all amplified performances, I argue in this thesis that between hearing the sound coming from the visible cause, and not seeing at all (a direct radio broadcast) or the sound coming from a loudspeaker removed from the visible source, there is a whole range of applications, in many different contexts.

[59] The Living Newspaper stems originally from Bolshevik Agitprop presenting supposedly factual information in a theatrical setting. In the USA it is usually associated with the Federal Theatre Project, a funded arts project under the Works Progress Administration in the 1930s. It is interesting to see that Burton-Meyer and Hamilton still use the term in 1959, its communist connotation had made the term obsolete in the 1940s (cf Casson 2000).

Not unrelated to the acousmatic is what is referred to as the 'ubiquity effect', as brought forward by Augoyard & Torgue, (2005, p. 130) in *Sonic Experience: a Guide to Everyday Sounds*:

> An effect linked to spatio-temporal conditions that expresses the difficulty or impossibility of locating a sound source. In the major variant of this effect, the sound seems to come from everywhere and from nowhere at the same time.

At a concert in a reverberant concert hall this can bring the interesting situation that a source (eg a violin) can be seen, but the sound source cannot be localised auditorily, when one is outside the critical distance.[60] The authors (ibid p. 131) list two major characteristics, the first being that this is an effect of space and the second that it is an effect of power: 'The uncertainty produced by a sound about its origin establishes a power relationship between an invisible emitter and the worried receptor'. This takes us back to Hall's theory of social distance: where the sound comes from is vital information: 'whether to flee, to attack, to remain motionless' (ibid).

3.9.1 The Acousmatic: Subject object

The idea that there is a relation to context in how we interpret sound and how we relate to its source resonates with the philosophical debate (or puzzle) of what sound actually is. Is sound a quality of the object that causes it; a property of the medium (air) surrounding us, or just something we hear, ie the object of hearing? By means of illustration (but at risk of evoking the debate surrounding the sound of the falling tree in the forest) I will briefly describe a philosophical debate from a decade ago about what sound 'is' (but I have no intention of joining or adding to the debate in the context of this thesis; for a more current discussion of the different positions see for instance O'Callaghan & Nudds (2009). Robert Pasnau (1999, p. 311) in an article in the *Philosophical Quarterly* titled 'What is Sound?' presents a problem with the 'common view' of what sound is (in science, in ordinary language and in the philosophical tradition):

[60] In room acoustics the critical distance from the directional source is the point at which the sound pressure level of the direct sound and the reverberant sound (cf Davis 1989, p. 59).

> Our standard view about sound is incoherent. On the one hand we suppose that sound is a quality, not of the object that makes the sound, but of the surrounding medium … On the other hand, we suppose that sound is the object of hearing.

According to Pasnau the two claims (sound being vibrations in the medium air and sound being the object of hearing) cannot *both* be true. He offers a revised account as an alternative that 'describes sound as a quality belonging to the object that makes the sound'. His argument is that sound is locational; it carries information about the object that causes it *and* about the location of that object. Casey O'Callaghan (2001) in a response to Pasnau's article outlines the problem by contrasting the 'standard view' with a 'phenomenological view':

- We do not hear sounds as being in the air (or other surrounding medium).
- We hear sounds as being at the place where they are generated

And O'Callaghan summarises Pasnau's proposed revision that he calls 'the object view':

- Sounds are the object of hearing.
- Sounds are qualities that belong to and are located at objects that make sounds.
- Sounds are identical with or supervene on object vibrations.
- Sounds are not properties of the surrounding medium.

The discrepancies between the different claims underline the problems that are brought forward in the reception of amplified music. But whether we hear the location of a sound (a nightingale in a forest, a singer on stage) depends on more parameters than a philosophical stance. One issue is that our directional hearing works differently according to frequency (Howard & Angus 1996; Moore 2003, p. 197).[61] We are very good at

[61] We binaurally perceive Interaural Time Difference (ITD) and Intensity Difference (IID). Up to about 700Hz phase differences (ITD) are leading, depending also on the attack of the sound, a trombone is harder to localise than a pizzicato cello note; from 700Hz-2k8Hz phase and intensity difference work together and above that, as a consequence of refraction, IID is leading. Above can 5kHz reflections patterns in the

localising sounds within the most sensitive frequency range of our ears, which, not coincidentally is the range in which most of our speech is articulated, similar to the range of many (melodic) musical instruments. In the great outdoors (I do not mind assuming for evolutionary reasons) we are much better at localising a moving lion rustling in the undergrowth than a cricket or cicada chirping away at full power. In a concert hall a violin, with a range (pitch and timbre) similar to speech is much easier to localise than a bass that generally produces lower frequencies. Also in a concert hall, depending on its acoustic response, we may have no problems hearing the location of a violin on stage; when we listen to that violin from the back of a concert hall it becomes much harder to 'pinpoint' or localise the source as a consequence of the reverberant sound (all the reflections from the wall make it appear as if the sound comes from 'everywhere'. With those aspects of perception in mind it would appear that a philosophical (or any) account of what sound is (pace Pasnau and O'Callaghan) will need, apart from depending on context, to be frequency dependant (ie depending on characteristics of the source), and whether we are in the outdoors or in an enclosed environment (ie depending on the local acoustics).

3.9.2 The Acousmatic: See no evil hear no evil

> *Like the telephone the phonograph introduced people to sounds that have been severed from architectural space...* (Thompson 2002, p. 236)

In his book *The Audible Past* Jonathan Sterne (2003, p. 22) makes a case for a theory of (the history of) sound reproducing technologies that begins by exploring changing ways of hearing and listening rather than from a final, fundamental stance regarding the relations between 'hearing and seeing, between technological reproduction and sensory orientation, between original and copy, and between presence and absence in communication'. With the complexity of our perception in mind Sterne has a strong case: a fundamental stance of seeing and hearing would have to be adaptable to qualities of

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pinnae (the outer ear) can create localisation cues, often related to sounds in the vertical plane. (Howard & Angus 1996, p. 96)

sound (pitch/timbre/dynamics), acoustics (as acoustician Hope Bagenal noted: somewhere between the great outdoors and a resonant cave) and context. And then adding vision, we have not even begun to look at different lighting conditions and lines of sight in theatres, concert halls etcetera.

Sterne (2003, p. 19) critiques a number of 'semiexperiential definitions of modern sound-reproduction technologies based on their power to separate a sound from its "source".' The most common term for the disconnection between what we hear and what we see or the detachment a sound from its source is 'Acousmatic'. The term has provided a lot of room for interpretation, as Jonty Harrison (1999) writes, the notion of the acousmatic, since being introduced by Pierre Schaeffer, has been 'regurgitated by just about everyone'. Schaeffer (1952) famously coined the term for the recorded, disembodied sound, after 'Akousmatikoi' ('Those willing to hear' (cf Chion 1999; Hamilton 2009, p. 153); uninitiated students in Pythagorean sects who were only allowed to attend lectures presented from behind a scrim, ensuring no visual distraction from the words. [62] The acousmatic therefore relates specifically to sounds we hear without seeing what caused them (although there are different interpretations as I will discuss later in this section). The non-visual requirement very much excludes situations in which music is electronically amplified as in most cases the sources can be seen.[63] Nevertheless a study of amplified sound can benefit from observations made in relation to the acousmatic, and other treatments of it, as they share the same technical transduction processes.

Chion (1994 p. 72) wonders:

> What can we call the opposite of acousmatic sound? Schaeffer proposed "direct," but this word lends itself to so much ambiguity, we shall coin the term *visualized* sound – i.e., accompanied by the sight of its source or cause.

[62] According to Chion (1999) the writer Jérôme Peignot called the word Acousmatic to Schaeffer's attention. Historical sources (again from Chion) include a poem *Acousmate* by Guillaume Appollinaire and the book *Stromateis* by Clement of Alexandria can. 250 BC.

[63] That also suggests that for a Schaefferian definition of the acousmatic, microphone transduction is not enough, it should include some form of recording to exclude electronic amplification.

This gives to think that the situation of amplified sounds is very much like sound cinema, where the sound comes from the general direction of the screen, which holds true at higher levels of amplification (although, as mentioned before, in a cinema, the loudspeakers are actually behind the screen, instead of to the left and right of a stage). But it is important to stress that in live performance, as opposed to cinema, there is no binary such as acousmatic or visualized; there is a gradual process of severance depending on the level of amplification and the local acoustics. In retrospect sound cinema has a relation to the reverberant concert hall (or a church), the acoustic reflections make it hard to precisely localise a source making it come from the general direction of the stage, the organ or the alter (and in a cathedral not even that).

Current literature offers us a choice of synonyms when describing or critiquing the problem of detachment: severance, separation, divorce or dislocation (of time, place and mechanical causality). John Corbett writes about visual-lack (quoted in Sterne, 2003 p.20) and in the publication mentioned before about the Audio-Visual split (ie Corbett 1990). Raymond Murray Schafer (1977) and Barry Truax (1984) approach technologically detached sound as an aberration of an acoustic source. They propose the term 'schizophonic' for a dislocated condition, hinting at the nervous tension between original and copy suggesting how we value the authentic over the replicated.

Sterne (2003, p. 20) problematises the acousmatic and schizophonic approaches to dislocated sounds in the way they contain prior assumptions about the fundamental nature of sound. He objects primarily to the suggestion that face-to-face communication and bodily presence are the main parameters of auditory evaluation. Sound reproduction – by any means – is doomed to be considered inauthentic, disorienting and decontextualizing sound from its 'proper' interpersonal context. According to Sterne the acousmatic assumes that: 'at some time prior to the invention of sound reproduction technologies, the body was whole, undamaged, and phenomologically coherent'.

In this thesis I will use the word 'detached' to describe the situation where the sound of an acoustic source under amplification is gradually (with increasing amplification level) localised as coming from a loudspeaker rather than from the acoustic source.

3.9.3 The Acousmatic: Reduced Listening

Important in Schaeffer's treatment is the reduction of listening to an appreciation of the abstract 'concrete ' properties of sounds detached from their physical cause: concrete sounds allow for what Schaeffer called reduced listening. In the words of Brandon Labelle (2006, p. 27):

> Reduced listening repositions the listener away from an interpretive and culturally situated relation so as to direct attention to the phenomenal, essential features of sound and the musical work.

Andy Hamilton (2009, p. 154) makes a nuance towards the visual aspect: 'Strictly speaking, reduced listening should not be equated with listening without seeing; rather, it is listening that is enhanced by not seeing'.

The recording media in Schaeffer's days (first on discs, later magnetic tape) allowed for a materialization of the recorded sound into a solid concrete object. Materialised in a much more immediate way than digitally recorded sound nowadays, records and tape allow for direct manipulation. This may not sound like a big deal, but let's not forget, Schaeffer drew up this theory in the 1950s, when the possibilities of generating sounds and using them for musical purposes were limited. By modifying the grooves on a disk 'closed grooves' could be created that will repeat the same section over and over again, something that became easier, first with magnetic tape and much easier later using digital sampling; nowadays much (pop) music production is based on the creation and organisation of such 'loops', or repetitive samples of music.

Working with the grooves of a record is indeed a very concrete interaction with sound, but how much we can reduce our listening to concrete sound becomes a question of how these sounds are reproduced; in a performance situation when acousmatic music is played back in an auditorium with a certain acoustic using loudspeakers with certain characteristics will place the sounds in another context, with that re-contextualisation undoing part of the reduction. Emmerson (2007, p. 147) reminds us that the loudspeakers themselves are not neutral either:

> The loudspeaker has character and sound systems are judged 'good' or 'bad' as are any performance ensembles. Sometimes we conceal the system (and immerse the listener), as in the cinema and in some club venues, and sometimes we reveal it for all to see, as in the concert hall. Not only that, it can become part of an audio-visual spectacle, dominant, as at a large open air rock concert, or integrated but omnipresent, as in many sound installations.

Luke Windsor (2000, p. 9) but also Hamilton (2009, p. 155) dig deeper into the complexity of cognition and auditory perception by describing Schaeffer's: 'etymological and structuralist notion of *les quatres écoutes*' in more detail. The first two different ways of listening are related not to the sound itself, but what it can refer to:[65]

1. Indexical: concerned with the identification of the events that are responsible for the emission of sound;
2. Symbolic: sounds as signs;

What presumably fell out of Schaeffer's scope is the iconic, completing the typology of signs (indexical, symbolic and iconic) as found in the semiotics of Charles Peirce. This could include recognising Roosevelt's voice when hearing a recording of one of his speeches, or Marlon Brando's voice as Don Corleone in *The Godfather*.

The other two ways of listening in the Schaefferian approach are related to the sound itself:

3. Naïve reception of a sounds occurrence: 'there is traffic going on outside my window but I pay no attention to it'.[66]
4. And referring to a quality of the sound: 'What a dull sound!'.

[65] Windsor uses 'modes of listening', I will talk about modes in the next chapter.
[66] This description was suggested by Simon Emmerson.

3.9.4 The Acousmatic: Ecological Approach

Acknowledging different ways of listening is an important aspect of ecological approaches to sound or rather to hearing. Windsor cites the work of Bill Gaver (1993a, 1993b), who is a strong advocate of an ecological approach to auditory perception in a Gibsonian sense. Earlier work in that field was done (eg Vanderveer 1980; Warren 1987; Warren 1984) but Gaver points out that research on auditory perception thus far, in 1993 has concentrated on musical sound and has largely neglected everyday sounds. Currently research into the subject is still limited (cf Bonebright 2001; Dubois, Guastavino & Raimbault 2006).[67] Gaver (1993b) quoted in Windsor (2000) makes a strong distinction between musical sound and everyday sound:

> Musical sounds are not representative of the range of sounds we normally hear. Most musical sounds are harmonic; most everyday sounds inharmonic or noisy. Musical sounds tend to have a smooth, relatively simple temporal evolution; everyday sounds tend to be much more complex. Musical sounds seem to reveal little about their sources; while everyday sounds often provide a great deal of information about theirs. Finally, musical instruments afford changes of the sounds they make along relatively uninformative dimensions such as pitch or loudness, while everyday events involve many more kinds of changes – changes that are often musically useless but pragmatically important.

The interesting aspect of Gaver's important point is that the typically non musical sounds have ended up in music since perhaps as early as Russolo's *Intonarumori* or in Antheil's *Ballet Mécanique*, which does not mean that Gaver's distinction is invalid, but it does support the notion that it, again, depends on the context whether we attend to them musically or not. (We do not go running out the concert hall fearing for our lives when we hear a siren in a piece of music).

The observation that we can attend musically to everyday sounds suggests that we attend to everyday sounds non-musically in our everyday environment. One aspect of this

[67] For an overview see the chapter 'Everyday Listening: an Annotated Bibliography' in Rocchesso & Fontana (2003).

difference it that we attend to our surroundings not just with our hearing but with all our senses (one use of the term multimodal). We can still negotiate our way, walking on a busy street our hearing blocked by the earplugs of a Walkman; attending a concert with that Walkman playing, even though we can see the performers, possibly feel the very low frequencies, without hearing we do not experience the music made by the performers. One problem with researching the perception (rather than from an interest in the synthesis) of everyday sounds is that in most cases we do not attend to them singularly, they are part of a larger soundscape with a field, figure and ground (see Schafer 1977, p. 157; Van Leeuwen 1999, p. 16) and as such part of our everyday perception, seeing, smelling, touching, hearing, tasting.

Although I can appreciate the philosophical project of the debate between Pasnau and Callaghan cited above, I argue in this thesis that sound is the object of hearing, *and* caused by changing objects *and* in the medium around us. For us to hear sounds these sounds will have to be generated and transmitted before we can perceive them. Stephen Handel (1989, p. 3) begins his book *Listening: the Perception of Auditory Events* by writing: 'The study of listening must take place within the context of the environment in which listening evolved, since it is a product and reflection of that environment.' He divides his book into two parts, sound production (technical acoustics, environment of sound, sound generation) and sound perception (identification, phonemes, grammar, rhythm, and physiological fundamentals).

3.9.5 The Acousmatic: The Transducer as Artefact

For the (historical) scope of his book Sterne (2003, p.22) 'takes a ride on Ockham's razor' to avoid having to 'posit a transcendental subject of hearing', by reducing the definition of sound reproduction to the application of transducers. In this way Sterne avoids the complicated arguments regarding the nature of sound and reduces it to how sound technology is used, focusing on human intent, inquiry and discovery. Sterne's reasoning is supported by his remark that in addition to: 'turning sound into something else and that something else back into sound', transducers are cultural artefacts. The importance of transducers as artefacts and their cultural connotation is demonstrated for instance by the fact that pop stars (in their capacity as singers), from Bing Crosby to

Freddie Mercury are usually portrayed with a microphone at or in hand, even Rudy Vallee was often pictured with a megaphone (which actually is not a transducer but certainly an artefact).[68] And even when these pop singers pretend to be singing, they cling on to their microphones (lip-syncing on TV shows for instance). A similar observation can be made for the transducer on the other end of the line: guitarists in rock bands need a stack of Marshall amps:

> …the Swedish heavy-metal guitarist Yngwie Malmsteen once boasted that there were two structures visible from space: "the great wall of China and my Marshall amplifiers". However, even in the mid-1970s, arguably the days of peak rock indulgence when Kiss were touring with up to 18 stacks, it was a closely guarded secret as to how many of them were actually switched on. (Hickling 2012)

The switched off, or even empty Marshall cabinets remind us of the ubiquitous, not connected, classic ribbon microphones on the desks of TV talk show hosts. Whichever connotation these prop artefacts try to invoke; it suggests that they are a meaningful ornament, perhaps related to 'liveness' or other subliminal measures of authenticity.

By directing the discussion at the use of transducers Sterne also hints at the idea that the much debated 'split', the 'liberation of hearing from seeing' is not something that takes places in our perception but rather the opposite. Our perception brings hearing and seeing (and touching, smelling, tasting) together. If we want a split, at a concert we can isolate hearing from seeing by closing our eyes, regardless of whether the music is amplified. Hearing a sound coming from a loudspeaker rather than from an actor or singer on stage can be problematic as pointed out by the reviewers cited earlier, but in other cases, a stadium concert, a sermon in a cathedral it is not. With Sterne, rather than looking at a fundamental problem in the relation between seeing and hearing (again I would like to stress that the difference in propagation speed and the different workings of hearing and seeing create an inequality), I will look at the context in which the musical

[68] More iconic use: singer Roger Daltrey swings his microphone around by the cable, which therefore is securely taped to the mike (cf Abelson 2011, p. 18).

sounds are produced; detachment may occur and may or may not be problematic but it will be different in every situation and evaluated differently by everyone in the audience.

3.9.6 The Acousmatic: Scruton's Take on the Acousmatic

> *As a matter of fact, those who maintain that they only enjoy music to the full with their eyes shut do not hear better than when they have them open, but the absence of visual distractions enables them to abandon themselves to the reveries induced by the lullaby of its sounds, and that is really what they prefer to the music itself.*
> Igor Stravinsky (1936)[69]

Even though for the scope of this thesis I argue for a perspective that includes the context in the analysis of music, there is also an unmistakably non-contextual aspect to music. Whether performed for 74 million TV viewers on the Ed Sullivan show, live at the Shea stadium (although few could actually hear them), on a recording at home, or whistling while cleaning the windows 'Love me do' is 'Love me do'. The song stays the song even though every experience of it may be different. This is a highly personal dimension of music that guarantees its subjectiveness (as it guarantees us we'll be writing about it for ever). I'll discuss philosopher Roger Scruton's acousmatic thesis, which puts the Schaefferian reduction at the centre of musical experience. In his *The Aesthetics of Music* (1999, p. 2) Scruton claims that in order to experience music as music the relation to the visual (and the context) is not relevant: 'we spontaneously detach the sound from the circumstances of its production, and attend to it as it is in itself'. The acousmatic experience is 'what is exploited by the art of music'. In the words of O'Callaghan & Nudds (2009, p. 6):

> Appreciating the independence of sounds from sources, according to Scruton, is critical to understanding distinctively musical experiences: hearing music requires the ability to experience sounds as independent from their physical causes.

[69] In support of what Stravinsky suggests there is recent empirical work that looks at how seeing a performer plays a part in musical experience (cf Thompson, Russo & Quinto 2008; Vines et al. 2005).

Scruton adds: 'what we understand, in understanding music, is not the material world, but the intentional object: the organisation that can be heard in the experience', with the intentional object being musical tone. Organising (ie the intention) sound by pitch, rhythm, melody and harmony makes musical tone. Perceiving musical tone without reference to its cause makes for an 'acousmatic experience'; in Scruton's philosophy crucial for perceiving sound as music. Scruton's thesis, by necessitating a tonal system, strongly favours Western art music and a strict reading of it excludes other musics (which Scruton contests, see his response to Hamilton's (1999) review).

In Western art music works of music consist of a composition, presented as a (finalised) score; the score prescribes the formal (melodic, harmonic and rhythmic) relations between the tones that we experience as music, reduced from the pitched sounds we perceive; for Scruton timbre plays no role here.[70] It is easy to see how this makes sense in something as crucial to Western art music as J.S. Bach's piano works: I can refer to them as piano works even though they were originally written for instruments from his period, the clavichord or the harpsichord (Bach didn't always specify). Of course there is something to be said that these works should be performed on a period instrument but more often they are performed and recorded on the modern piano.[71] In both we can perceive the same compositions, unmistakably Bach.

Two authors, Hamilton (1999, 2007, 2009) and Rob van Gerwen (2008, 2012a, 2012b) discuss Scruton's thesis and although they agree with it on points they both reject it as a consequence of its rigidity. Rob van Gerwen's (2008, p. 25) objection is that Scruton's thesis ignores the performance of music and excludes a performer's expressiveness, which is perceived in the way a composition is delivered in minute detail of timbre, timing and dynamics (or indeed the choice of harpsichord or piano):

> The way the musician interacts with his instrument – how he attacks the tones, strikes the strings, hammers the keys, his breathing, his fingering techniques, and so forth – are not heard in the music. Hearing the performer in listening to music

[70] Scruton's musical aesthetics very much comply with what Tagg (2013) refers to as 'absolute music'.
[71] The modern piano was developed much later, in the 19th century.

> is essential for perceiving the expressiveness of that performer's rendition of a work or improvisation.

Hamilton (2009, p. 150) discusses Scruton's thesis and its difference from Schaeffer's use of the term acousmatic:

> It is essential to recognize that the acousmatic thesis is a claim about how musical sound is *experienced—viz.,* without reference to its physical cause—and not about how it is known to be produced.

An alternative, twofold thesis is proposed by Hamilton:

> … both acousmatic and non-acousmatic experience are genuinely musical and fundamental aspects of musical experience. While the acousmatic thesis is ultimately unpersuasive, however, the concept of the acousmatic places an interesting interpretation on traditional debates.

The tension between the acousmatic and non-acousmatic: 'expresses an important dichotomy in terms of which the experience of music can be understood' (ibid p. 151). The non-acousmatic sound describes a literal experience of sound: 'involving a practical or technical interest' (ibid p. 159). By not making the acousmatic and non-acousmatic mutually exclusive Hamilton allows for a less rigid approach; we attend to the recording of a concert acousmatically. In the concert hall we experience music both acousmatic and non-acousmatic. Hamilton continues to develop his argument making the acousmatic 'uni-modal' and the non-acousmatic 'bi-modal'; that is the acousmatic is an auditory experience only, the non-acousmatic combines seeing and hearing. This dichotomy is important from the perspective of this thesis; an acousmatic treatment of music allows music experienced as detached sounds coming from loudspeakers, amplifying instruments that can be seen on stage; our perception psychology (and possibly cognition) reconnects (or tries to) what we see to what we hear, even if the sound comes from a loudspeaker that is not in the same spot as the source we attend to musically. Hamilton

(ibid 177), after Nudds (2001, p. 200, 218), supports his argument not with an example of a loudspeaker, but of a dog:

> When we see a dog bark and hear the sound it makes we do not just hear a sound as coming from the same place we see the dog barking; we perceive the dog to be producing the sound that we hear . . . We never simply *hear* something as producing a sound because we cannot hear the sources of sounds apart from hearing the sounds that they make.

3.10 The Acousmatic: The See-thru Curtain

> *The amplification system raised a kind of aural scrim between the music and the audience, allowing one to follow contours and silhouettes but swallowing details into mere shadows*. Midgette (2002), from a review of an outdoor concert.

Loud amplification drowns out the acoustic sound and we hear only the loudspeaker, yet we do not turn to look at the loudspeaker, we look at the performers on stage. At a low amplification level, if we can still hear the acoustic sound, assisted by the loudspeaker, sound is not fully detached (the sound is non-acousmatic, there is no AV-split it is not schizophonic or dislocated). As I have argued in the previous chapter the amplification level creates a continuum with different consequences for the relation between what we see and what we hear. As a final thought on the relation of the acousmatic and the problem of amplified sound I like the idea of a flexible acousmatic curtain that moves between see-thru and solid. What the metaphor implies is that detachment in the case of amplification is not a matter of binary opposition but a severance along a continuum, from very little amplification to extremely loud.

3.10.1 Wagner's Cats

> *The possibility of a kinship between sight and sound was a matter of great interest to the late nineteenth-century Romantic artist, in the quest to heighten the sensory impact of his work*. (Forsyth 1985, p. 165)

Jon Frederickson (1989) in 'Technology and Music Performance in the Age of Mechanical Reproduction' looks at the relation between musical performance and technology. He operationalises the concepts 'Social Technology' and 'Machine technology'; social technology considers patterns of cooperation (including hiring), artistic conventions of the Art world (in Howard Becker's sense); and as an example for machine technology Frederickson (ibid p. 194) writes:

> …in some musical shows the machine technology includes a recording studio, microphones, a digital computer, a sound system, and television monitors coordinated by a sound engineer.

As an important development of Social Technology the author draws a line from Wagner's choice to make the orchestra invisible (in his 'Festspielhaus' opera theatre in Bayreuth),[72] via the orchestra disappearing all together (ie to a different room) in the 1980s musical *Cats*, to ultimately the replacement of theatrical orchestras and bands with pre-recorded material.[73] From the Baroque opera theatre with the orchestra seated on the floor in front of the stage ('orchestra' in ancient Greek) to the sunken orchestra pit (which was covered almost completely by Wagner) and the orchestra being piped in from another room altogether (which first became viable in the RCMH):

> If the audience cannot see the orchestra, its live presence is not necessary since it has become merely a soundsource to be submitted to rational principles of organization. (Frederickson 1989, p. 195)

One of the problems of course is that people cannot very well distinguish whether it is the sound of an actual orchestra playing live or a recording that is being 'piped in' (unless

[72] The 'mystical abyss' between stage and audience (cf Forsyth 1985, p. 175; Kittler 1993). According to Forsyth (ibid p. 112-5) Wagner's transformed pit was pre-echoed in a theatre in Besançon (1778-1784) and in the 'Schauspielhaus am Gendarmenmarkt' Berlin (1821) which was damaged in WW-II and rebuilt as the 'Konzerthaus' in (1979-1984).

[73] From this perspective it is interesting to mention that Chion (1994, p. 80) refers to 'pit-music' to nondiegetic music in cinema.

something goes wrong). Piped in, perhaps from a sound studio, or more recently, for the 2012 revival of musical *Carrie* (1988): '…a tiny, L-shaped third-floor room with water-stained ceilings and dirty grey carpeting that served for decades as a dumping ground for old props' (Healy 2012). Or in the case of *Spiderman* (2011): '…windowless rooms in the basement of the Foxwoods Theater; (ibid).

The first musical to ban the band from the auditorium all together was *A Chorus Line* (1975) but the example of *Cats* (1981) is more famous, since in the West End production the musicians were literally in a different building across the street. I have only come across anecdotal explanations for this choice; one is that it allowed for an extended stage and set (specifically in the roller skate drama *Starlight Express* (1984) which had ramps extending into the auditorium). Another obvious reason is increased revenue (no orchestra pit means more seats to sell). From a perspective of sound design it completely takes away the 'bleed' of acoustic sound (and monitoring) allowing more control over the mix; mixing the orchestra becomes more like mixing a recording or even better a radio broadcast (maintaining the live aspect). Engel (1975, p. 161) in his discussion of amplified musicals suggested covering the orchestra pit completely, with a glass bubble for the conductor, to ensure separation of acoustic and amplified sound. The piping in of music from another location is not limited to Broadway shows. Opera Australia performed Erich Korngold's Opera *Die Tote Stadt* in 2012 with the orchestra playing from another venue within the Sydney Opera House because the required orchestration needed more room than available in the opera theatre's pit. An interesting aspect was that rather than reproducing the sound as if coming from the pit or from the stage, a surround sound system was installed and the mix was created specifically for that surround system (Meacham 2012; Taylor 2012).

The ultimate question is, why bother if no one is going to see the musicians and most people do not hear the difference? There appears to be a simple answer, in most cases (in the Anglo-Saxon countries) producers are bound to employ musicians by union agreement. Productions of megamusical (such as *Cats*) in other countries are often produced as a copy of the Broadway or West end production.

3.11 To Review

The first two chapters argued that there is no simple before/after the microphone in the history of live music and that there is no simple binary amplified/unamplified music. When looking closer at different musical practices this chapter made apparent that in existing literature few authors look beyond these dichotomies. Performances of music using amplification are more similar to acoustic musical performances than they are similar to recorded music. In some instances an amplified concert can become more like a recording, for instance when using recording studio techniques with increased acoustic separation, or when music is piped in from a different location. And when recorded music is used, for instance to mime to, other issues can be raised around lip-syncing and authenticity which I will discuss in the next chapter.

A number of important points are resonant throughout this literature review, points that I will develop further in the next chapter. Very prominent is Emmerson's overview of the different functions that amplification can be used for. Two additional points show a very strong redundancy in musical sound (and speech), first: even though technical transductions change the musical experience they do not change the music, unless intentionally transformed. And second: social distances encoded in sound are left untouched and become an important parameter (most prominently the sound of intimacy in the close miked voice, but also of musical instruments).

Several authors, as a consequence of the dislocations of transduced sound perceive a sense of loss in relation to the sound's source. I argue that this raises questions about the relation between the live and the recorded and that it is the intention of transduction that makes an amplified sound an original sound of its own.

Instead of losing something, I argue something is added. Also I argued that the detachment of sound (ie it coming from a loudspeaker rather than from a visible source), takes place in a continuum depending on the amplification level; in some traditions (eg Broadway musicals), this problem appears to be bigger than in other traditions of musical performance. Apart from it not being a problem in rock and pop music I suggest that in contemporary practices it also becomes a musical parameter that can be used expressively.

Many authors have written about the problem of mass media in a predominantly capitalist world, and increased commodification of the performing arts. Even though the use of amplification is beneficial for the 'franchising' of not only Broadway musicals but also in creating a unified aesthetics for rock and pop concerts, electronically amplified sound is only one aspect of that tendency. Modern concerts take place in a complex with other mass media for ticket and recording sales, in a mass globalised industry. In general I argued that electronic amplification should not be considered a mass medium.

Adorno's project, which I understand as social enquiry through music, remains valid even after technological mediation; currently there is a very strong focus on the technological dimension of music, which cannot come as a surprise given contemporary society's obsession with technology.

Finally, even though possibly the antithesis to this project, I find it important to include Scruton's take on the acousmatic in the discussion. Having approaches to music that allow us to discuss music excluding the way it is produced or reproduced and excluding the social is crucial to come to an understanding of what music is. Ultimately we also experience music in our head, intentionally singing to ourselves, or unintentionally being stuck to a tune or a fragment thereof (eg an earworm).

4 Social Semiotic Multimodality and Amplified Music

4.1 Technology as Extension

> *If I agree with Marshal McLuhan, and I do, that what has been invented, in our days, is not the wheel, but rather an extension of the central nervous system – through electronics.*
> John Cage in an interview with Jack Kroll (Brockway 1969, ca 24'10").

McLuhan (1964) in his *Understanding Media: the Extensions of Man*, describes the wheel as an extension of the feet. Along that line we can consider musical instruments functioning as extensions of (musical) expression. Amplification, with its synchronous bidirectional transductions (ie microphone in, loudspeaker out), simultaneously extends a performer's expressive range and an audience's (possible) perception. It allows zooming in aurally, into a finer grain of our soundscape or the instruments we use to create (musical) sounds with, while at the same time enlarging sound, supporting it, enhancing it or blowing it out of proportion. It is not just sonic expression that is amplified, the interrelation between that expression and the local acoustics (or lack thereof) is equally enlarged; louder sound means more reflections and an increased response of the acoustic environment.

Daniel Jones et al (2012, p. 175), in a book chapter about the use of generative algorithms in (computer) musical composition write:

> One of the distinguishing features of human society is our usage of tools to augment our natural capabilities. By incorporating external devices into our activities, we can render ourselves more quick, powerful, and dexterous, both

> mentally and physically. We are effectively extending ourselves and our practices, temporarily taking on the capabilities of our tools in a transient hybrid form.

The authors discuss a class of tools that, thanks to increased flexibility and autonomy of computational technology, might be considered creative agents in their own right. References in their article to indeterminacy, randomness and chance remind of the works of Cage; and more specifically in relation to this thesis, to Tudor's version of *Variations II* (see §2.2). In Tudor's interpretation the extended instrument consisting of piano, transducers and acoustics became a complex system whose 'behavior can never be totally predicted: the amplification of the piano made it: to some degree, an uncontrollable instrument' (Pritchett 2004, p. 11). Jones et al refer, in addition to McLuhan, to Bruno Latour's (1994) 'On Technical Mediation' and to a paper by Andy Clark and David Chalmers (1998) entitled 'The Extended Mind'. Clark and Chalmers explore the division between the mind and the environment and argue for a philosophical debate that, instead of separating the mind from the body and its expressive and perceptive capabilities, allows for an inclusion of the technological extensions of our cognition and expression. In Chalmers' preface to Clark's more recent (2008) *Supersizing the Mind* he presents the question of that thesis straightforwardly: to what effect is our cognition extended by our mobile or smart phones that 'have replaced part of my memory, storing phone numbers and addresses that I once would have taxed my brain with' (ibid p. iv). Clark describes usages of technology as being coupled with the environment in a 'cognitive loop': '… the relevant parts of the world are in the loop, not dangling at the other end of a causal chain' (ibid p. 223). This notion of a loop is reflected in sound amplification practices by the requirement of proper monitoring (see §2.12.3); if the loop is not 'closed' by sufficient foldback (an alternative name for monitoring) it is very hard for the amplified musician to perform.[1] For the production of, for instance, the close-miked pop and rock singing voice, music performance relies on electronic amplification to realise those vocals, it would be a different music without it. Similarly in the classical concert halls, symphony orchestras can barely perform without the specific acoustics of those halls, they need the

[1] Of course there are also performance practices where monitoring is less essential, depending on the function of the amplification.

reverberation to hear themselves, their group and everyone else play; it is an essential part of how that orchestral music and its specific performance spaces evolved together.

The amplified performer, although perhaps the object of attention at a concert is not always an exclusive agent in what Clark (ibid p. 31) calls an 'agent-world circuit'. In the most common concert situation a mixer in the audience area controls how the sounds, produced by that amplified performer, are heard; performers hear monitors which not necessarily reproduce the same sound heard by the audience. In *Entangled*, Chris Salter (2010, p. 203) writes about Munkacsi's (see §3.7) role in Philip Glass' ensemble of the early 1970s:

> Munkacsi was given an even more prominent position on stage than the musicians: dead center at a mixing desk (which had become an instrument in and of itself) where the on-stage monitor mix for the musicians as well as the acoustic-electric mix for the audience could be continually adjusted as part of the performance.[2]

This set-up, where performers and audience are in the same electroacoustic space, often surrounded by loudspeaker systems (eg quadrophonic), instead of flanking a podium, makes matters of balance, and who is controlling it, less opaque. This matter, and other, questions of agency at concerts of amplified music, is taken up in chapter five. In this chapters I address the way music amplification can be seen as an extension, not just of the sound but also of musical expression.

4.2 Music and Meaning

> *As critics from McLuhan to Kittler have pointed out, changes in the nature and structure of our communications technologies fundamentally alter the meanings of what is transmitted by, for example, determining the context of reception or by*

[2] In the liner notes by Tim Page for for the 1996 recording (Nonesuch 79324) of Glass' *Music in Twelve Parts* (1971/4), sound designer/engineer Munkacsi is referred to: '…as considered in every way a full member of the group.' http://www.philipglass.com/music/recordings/twelve_parts.php <viewed 5 March 2013>

> *selecting certain material as significant and thus preventing 'viewing outside the frame'. It is no longer innovation in material but the context in which that material is used or experienced that determines what it might mean.*
> (Waters 2000, p. 70) referring to Kittler's (1990) *Discourse Networks* and McLuhan's (1964) *Understanding Media*.

The sources presented in the preceding chapters have been brought together to support the notion that electronic sound amplification of music interacts with what is amplified; it is not a neutral 'channel'. Amplification does more than just making things louder; amplification, through its interaction with acoustics, implies an interaction with the context music is performed in, or it can even be defining for such a context. It changes, amplifies or adds meaning and potentially has an impact on how such meaning is being made. Much has been written about the contextualisation of musical at concerts and performances, with Christopher Small's (1998) *Musicking* as one of the prime texts. An ethnographical approach to 'music and the city' is found in Sara Cohen's (2007) *Renewal and the City in Popular Music Culture: Beyond the Beatles*. She discusses (p. 2) the question why music would be 'perceived as the expression of a city's soul?' Referring to Schafer's *Tuning of the World* she presents a parallel between the coming of an industrialised soundscape and electronic amplification:

> Schafer (1977: 108) argues that increasing urbanization was paralleled by a growth in the size of orchestras so that they could compete with factory noises and reflect "the thicker densities of city live" (ibid.: 104), but when the electric revolution arrived the amplifier and rock and pop began to replace the orchestra in order to match the increase of urban noise.

Cohen's (ibid p. 4) objective was a consideration how 'particular popular music practices are connected to social, cultural, geographical and economic characteristics of the city, to its "citiness"'. In the language of Schaferian soundscape studies, usage of the electroacoustic technologies becomes a metaphor for industrialization, and perhaps for the current growing technologisation of life.

The objective in this chapter is much more limited than those examples; here I consider the specific role or roles electronic amplification plays in the contextualisation and sometimes recontextualisation of music; in other words how it sets the 'soundstage'. A Mozart opera, normally performed in an opera house, is still a Mozart opera when it is performed outdoors in a park, amplified for a large crowd, the 'text' and the performers are the same but the context has changed significantly. Altman (1992, p. 16) discusses three concerts of Mozart's *Eine Kleine Nachtmusik*, in a well-upholstered salon, a large concert hall and in a park:

> I am in one sense hearing the "same" music three times, that is, music that is represented by a single, identical score. Yet how different are the sounds that reach my ears during the three concerts!

With amplification, potentially, instead of an audience of 2,000 an audience of perhaps 20,000 can be addressed. In the latter situation people may be listening in a different way, opening a bottle of champagne, looking after a toddler, sending a text, or talking on the phone, directing a friend to said bottle. Being on the phone (or even sending a text) in an opera house, during a performance would be unthinkable in light of the traditional etiquette of opera attendance. Listening takes place in silence; coughs are saved up for appropriate moments (to some that means when the music is really quiet, others wait until the music is really loud); applauding happens after particularly impressive vocal stunting in arias (often written to that effect). The big discharge for the audience takes place after the end of the opera: standing ovation, cheering, and calls of 'bravo!' (brava, bravi), etcetera.

4.2.1 Philip Tagg's Semiotics of Music

Small (ibid p.3) suggests that the question 'What is the meaning of music?' has no possible answer. Yet, to say that music is meaningless would be an equally impossible position to maintain. More rewarding, or at least more informative, is a discussion of possible meanings, or what is referred to in social semiotics as meaning potential.

There is a wide variety of semiotic approaches to music, but instead of a unified theory to musical semiotics a range of 'semiotic projects' can be identified, as Philip Tagg (2013, p. 145) writes in his 'state of the art' study *Music's Meanings*, referring to Nattiez (1975) amongst others. Tagg reports that many of these projects take the musical text, often scores from the Western European ('euroclassical') canon, as the locus of their studies, as such confined to the domains of classic musicology. Studying just the syntax of a musical text suggests that there is a way of treating music in a similar way to language.

The relation between language and music, speech and song, has attracted spectacularly different hypotheses, from Steven Pinker's (1997, p. 534) notion of music as a by-product of language, to Steven Mithen's (2006, p. 138) music as predecessor of language (see for a commentary Potter and Sorrell (2012, p. 15)).[3] Classic semiotic and other logo-centric approaches to musical meaning have often focussed on language-like universals, or rather the lack thereof. Potter and Sorrel (2012, p. 2) put that problem in an ethnomusicological perspective:

> If there are no universals then it becomes impossible for one culture to hear another culture's music as music. We even go outside our own species and find song among the birds and whales. At the same time the warm embrace of such perceptions leads to obstructive fallacies, perhaps the most familiar of which is the notion of music as a universal language.

Similar to Small in *Musicking* Tagg questions the rationale behind the primacy of the musical text over performance or recording, with little interest in context and as such in the social usages of music; which both authors maintain is where music's meaningfulness is least hard to find.

[3] Music cognition professor Henkjan Honing (2011) blogs about Pinker's assertion that music is 'auditory cheesecake'; which may be more valuable than expected: 'music affects our brains at specific places, thereby stimulating the production of unique substances that have a pleasurable effect on our mood'. Honing refers to recent research (Salimpoor et al 2011) that shows that music can arouse feelings of euphoria and craving, as if eating cheesecake (provided you like cheesecake).

4.2.2 Music and Language?

> *In short, precision of musical meaning can never be the same as precision of verbal meaning. Music and language are not interchangeable sign systems: if they were, they would not exist separately*. (Tagg 2013, p. 171)

In Tagg's (ibid) argumentation musical categories of meaning are not logogenic but 'alogogenic'; that is to say, a sign system that is not conducive to expression in words. Tagg lists the three main (historical) semiotic interests in music:

- Syntax: aspects of signification bearing on the temporal relationship of signifying elements within a given mode of communication;
- Semantics: the relation between such signs and what they stand for;
- Pragmatics: cultural and social activity relating to the production and interpretation of meaning.

Regardless of ideas about the relation between music and language, most semiotic work in music, warns Tagg, focuses on the first, the syntax. As a consequence academic interest is often limited to what Tagg (ibid p. 148) labels as 'absolute music', a limitation to the euroclassical repertoire, a fixation on the avant-garde composition and a dependency on notated music as the main object of analysis (an example of which can be found in Scruton's musical aesthetics, discussed in §3.9.6).

The problematic consequence that Tagg (p. 119) identifies is an absence of 'aesthesic' learning and study in the academe, which begs a further explanation. Departing from the semiotics of Charles Sanders Peirce, Tagg discusses different possible knowledges of music. The analysis of the construction of a *sign* is what Tagg labels as 'Poeïtic', ie techniques/materials used to produce such a 'meaningful musical structure or element'. On the receiving end, 'Aesthesic' qualifies the sign, as it is perceived, using descriptors that describe the experience, not the production of the sign. Thomas Turino (1999, p. 222) contrasts the (more) flexible, experiential approach of Peirce's works with the structural linguistic approach based on Saussurian semiotics. Peircian semiotics

extends from a basic triad consisting of: a *sign* ('something that stands for something else to someone in some way'), an *object* (the something else) and an *interpretant*, or the effect that is 'created by bringing sign and object together in the mind of a perceiver'. Tagg (p. 116) describes a *sign* – the meaningful musical structure or element – as representing the sign's *object*, ie 'whatever is encoded by a composer, performer, studio engineer, DJ, etc', and that what is decoded by a listener as the *interpretant*.

Cause and effect may be unclear, but either as a consequence of the significant academic focus on syntax, or the other way around, musical education and enquiry is often centred around 'creating, originating, producing, composing, arranging, performing, etc' rather than on 'recalling, recognising, distinguishing musical sounds, as well as their culturally specific connotations and social functions.' This 'epistemic problem', with music is twofold, writes Tagg (p. 120):

> Firstly, knowledge relevant to music's production and structural denotation has been largely separated from that relating to its perception, uses and meanings. […] Secondly, the virtual absence of aesthesic learning […] in official education has meant that, compared to analytical metalanguage used with visual or verbal arts, relatively few viable aesthesic denotors of structure exist in musical scholarship.

This lack of 'useroriented terminology' is, according to Tagg, what prevents musicology from dealing with the semantic and pragmatic aspects of musical expression. Tagg extends his argument to include the visual arts, arguing – again – in contrast with language:

> Whereas the ability to understand both the written and spoken word (aesthesic skills) is generally held to be as important as speaking and writing (poïetic skills), aesthesic competence is not held in equal esteem when it comes to music and the visual arts. (ibid p. 118)

It is this incongruence that Kress and Van Leeuwen (1990) address systematically, with regard to imagery, in *Reading Images*, an approach that was applied to the sonic by Van Leeuwen (1999) in *Speech Music Sound*.

Because amplification can be applied to many, perhaps all,[4] musical performances, regardless of musical syntax, a study into how music's meaning potential can be enhanced (amplified), reduced or changed by using this technology, should focus on the semantics and pragmatics of music performance. I will call on Van Leeuwen's work looking at the 'modality' of sound, which, in addition to a move away from the syntactical, warrants inclusion of the tension that exist between the acoustic and amplified sound source.

4.2.3 Theoretical Approach

After the broad history and literature review of the first three chapters and before moving towards the more theoretical, semiotic, abstraction of this thesis' subject, the scope of that subject needs narrowing down. This thesis looks at the use of electroacoustic transduction technology at performances of music, or more straightforwardly: an instrument being played, its sound being picked up by a microphone, amplified, and reproduced by a loudspeaker in the same acoustic space. This, and the next chapter, will enquire that simplified process. The thesis takes a narrow focus on musical contextualisation, ie how amplification emphasises the acoustics of a performance space. In a similar vein, the sections on modality and multimodality will take a narrow understanding of authenticity; later in this chapter when discussing authenticity and modality it is the elementary process of amplification that is studied, questioning how an amplified sound relates to its acoustic source; in how far is the reproduced sound experienced, or considered, as 'true', 'real', 'original' or 'authentic'.

Rather than Tagg's, or more traditional approaches to semiotics I will use Social Semiotic Multimodality as a guiding framework to look a the complexity of musical performance, amplification technology and the questions of agency that surface when looking at their interrelations.

[4] In the mid 1990s, at a concert at the Institute of Sonology at the The Hague Conservatoire, I attempted to amplify a pipe organ in order to balance it with a saxophone and electronic sound sources.

Social semiotics, which I will describe in the next paragraph, stem from a tradition of linguistics, a background that can be interpreted as problematic. As pointed out earlier, Tagg thoroughly questions the treatment of music as a language and the dominance of syntax in musical semiotic projects, which, in turn, prompts the question whether an approach rooted in linguistics is warranted. For instance, Robert Walser (1933, p, 36) in his *Running With The Devil*, discusses the problem of adapting analytical models for the 'study of musical structures, musical grammars and musics as symbolic systems.' He cites ethnomusicologist Steven Feld (1974) who wrote that in the 1970s 'linguistics craze' little theorising was going on 'as to the *relevance* of linguistic models for the study of music.'[5] Walser continues: 'Formalist prestige' was found in 'abstraction of musical structures out of the richness and social complexity of musical practices.' Social semiotics, regardless of its linguistic background, aims at the opposite: looking for meaning in how it is made by people, in full sight of the social context. The linguistics base can be considered a strongpoint because ultimately language is what we are most familiar with when it comes to meaning making, or, making sense of our (sensory) communicative experiences. Scholarly interests in meaning, whether musical or not, make use of language to develop, research, debate and disseminate findings, ideas or opinions, all referring to experiences that are hard to quantify, if not unquantifiable.

4.3 Social Semiotics

> *Social semiotics is not 'pure' theory, not a self-contained field. It only comes into its own when it is applied to specific instances and specific problems, and it always requires immersing oneself not just in semiotic concepts and methods as such but also in some other field. […] It is a form of enquiry. It does not offer ready-made answers. It offers ideas for formulating questions and ways of searching for answers.* (Van Leeuwen 2005, p. xiii).

The choice to use a social semiotic approach to multimodality was made because, instead of constructing or upholding 'grand theories', it encourages looking at specific practices.

[5] See also Bruno Nettl's (2005) *The Study of Ethnomusicology*, pp. 308-11.

It can be used to address the extensions in inter-human communication that are afforded by, in this case, technology. These extensions cannot just be described by the technical abstractions in use (eg frequency, decibels, voltages, bits, filters, systems etcetera), because they rely on users, performers, and an audience for its application and reception.

The analytical framework in this thesis aims to interrogate this notion of extension in relation to musical meaning potential; asking questions that inform debates and problems with regard to the use of this technology. Two aspects of social semiotics are of particular importance: firstly its aim to offer a multidisciplinary perspective and secondly the emphasis on multimodal signification, which allows considering amplification as (additional) mode, in relation to concurrent modes.

In this thesis, multimodality refers to a strand of semiotic enquiry that emphasises the plurality of meaning making, independent of language. In the words of Gunther Kress (2010, p. 2), multimodality is: '…a theory that deals with meaning in all its appearances, in all social occasions and all cultural sites.' The prime example of a multimodal text is the medieval manuscript, with one page containing, in addition to language, images, elaborate handwriting, colour and layout, with imagery not confined to equally spaced rectangles.

From a perspective of 'social semiotic multimodal analysis' electronic sound amplification becomes an additional mode with a specific set of resources that rearticulate what is amplified. For a discussion of social semiotics and how it is rooted in 'classic' semiotics and linguistics, see for instance Robert Hodge and Gunther Kress' (1988) *Social Semiotics*, or Rick Iedema (2003, p. 33), who gives a broad overview of the background of multimodality and its roots in the work of Michael Halliday:

> The term multimodality was introduced to highlight the importance of taking into account semiotics other than language-in-use, such as image, music, gesture, and so on.

From a historical perspective Halliday's work has put an emphasis on the inclusion of context in semiotic analysis, which goes back to the work of anthropologist Bronislaw Malinowski. In 'Language, context, and text' Halliday (1985) refers to Malinowski's

(1923) article 'The Problem of Meaning in Primitive Languages', which discusses Malinowski's experiences on the Trobriand (now Kiriwina) Islands. Malinowski describes how understanding Kiriwinian needs reference to the 'context of situation' and the 'context of culture' in which that language is used (see also Lee 1950). Halliday (1985, p. 6) adds that this is: 'language in action, in which it was impossible to understand the message unless you knew what was going on…'

Halliday (1985, p. 12) applies 'context of situation' to a conceptual framework of: 'three headings, the field, the tenor, and the mode'. These concepts serve to interpret the social context of a text, the environment in which meanings are being exchanged.'

Field of Discourse:	What is happening, the nature of social action;
Tenor of Discourse:	What is the nature of the role and relations of the participants;
Mode of Discourse:	What part is language playing: 'the symbolic organization of the text, the status that it has, and its function in the context, including the channel (is it spoken or written or some combination of the two?)'.

Halliday's use of mode is still strictly related to linguistics, however as Iedema (2003, p. 31) points out:

> Halliday's work moved linguistics from a focus on the sentence (as was de rigueur in the Chomskian tradition) towards a focus on 'text'. Rather than purely and simply an analytical object, text, in Halliday's conceptualization, constituted first and foremost a *mode of social action*.

An important aspect of social semiotics and the Hallidayian approach has been a move away from the idea that meaning is related to something referential. Meaning making became an activity by recognising it as essential part of interaction. The emphasis that is created by adding 'social' to semiotics results in different questions becoming central: how signs are *made*, by whom and to achieve what?

Kress (2010, p. 54) writes that humans use different means and different modes to make signs, with form and meaning in a motivated relation:

> They are the expression of the interest of socially formed individuals who, with these signs, realize – give outward expression to – their meanings, using culturally available semiotic resources, which have been shaped by the practices of members of social groups and their cultures. (ibid p. 9)

That social semiotic multimodal enquiry is finding momentum can be seen in the richness and diversity of a rapidly growing body of work, for instance in *Analyzing Multimodal Interaction: A Methodological Framework* by Sigrid Norris (2004), and *Introducing Social Semiotics* by Van Leeuwen (2005). An overview looking at music is given in Gall and Breeze (2005), the *Routledge Handbook of Multimodal Analysis* edited by Carey Jewitt (2009b), and a recent publication further developing the field by Kress (2010). Each of these publications underlines the lack of a rigid theory and a certain freedom of applying the terminology, however working from the same social semiotic assumptions (ibid p. 54):

- Signs are always newly made in social interaction;
- Signs are motivated, not arbitrary relations of meaning and form;
- The motivated relation of a *form* and a *meaning* is based on and arises out of the interest of makers of signs;
- The forms/signifiers used in the making of signs are *made* in social interaction and become part of the semiotic resources of a culture.

With the focus shifting from signification to meaning making, the contexts or the 'environments and circumstances of use' (ibid p. 62) in which something happens become much more important. As I argued before, analysis of amplified music should be made inclusive of context, of the event of which it is a part, and with what function in mind the amplification is used. In addition to performance of music and the application of technology Hallidayian social semiotics allow us to position the venue and the audience:

they are not passive observers, they participate in the social action. The focus on sign making makes questions of agency important: questions of agency that include audiences, which is the topic of the next chapter.

4.3.1 Multimodality

The term multimodality has gained in popularity in the past two decades. It is used in different ways in different traditions, potentially causing confusion in situations where an overlap can be identified. Even though this can be problematic, it is a good thing; it means that there is growing interest in dealing with the complexities of multisensory perception and multimodal expression, human (computer) interaction and communication, with or without language. In this section I will give a brief overview of two different approaches: first, a philosophical realisation that the senses work in concert and second, from a perspective of human interactions with technology.

Sensory multimodality, referring to perception using more than one modality, was brought up in the previous chapter. Its relevance to amplified sound has come about in the discussion of the relation between what we see and hear, and the tension that can be experienced as a consequence of the detachment of amplified sounds. The issue of auditory and visual integration was briefly discussed in the introduction. O'Callaghan (2012) gives a broad overview of the current state of research into perception and multimodality, from a philosophical perspective. He starts out by remarking that: 'Philosophers and cognitive scientists of perception by custom have investigated individual sense modalities in relative isolation from each other.' This has, in the past, led to a visual dominance in cognitive and philosophical approaches to perception.

> Despite their differences, the senses work in concert. Perceiving frequently occurs in a multimodal context, among sources that collectively or individually stimulate more than one sense. Sensory organs and pathways are not activated entirely in isolation. (ibid p. 3)

O'Callaghan (ibid p. 19) cites Stephen Handel's *Perceptual Coherence* (2006) while discussing how we should understand the nature of perception:

> Perceiving is about solving *correspondence problems* through the detection of contrast and change. A correspondence problem is one of identifying an individual or feature, either at a time or over time, given sensory information that varies from location to location and from moment to moment.

As noted in the previous chapter these correspondence problems are multimodal. And as O'Callaghan asserts: 'Perceiving involves determining that what you hear is what you see, that the object you feel to be in your hand is the one you see, or that what tastes bitter is what you feel on your tongue'. I will not pursue that particular discussion here, but it is obvious that the consequential dislocation when amplifying sound provides us with such a correspondence problem.

Apart from the problem of causal dislocation, the relation between perception, cognition and transduction technology is full of pitfalls. As emphasised earlier, a microphone lacks the psychoacoustic discrimination of our auditory perception, and perhaps more obviously, a loudspeaker is hardly comparable to our speaking apparatus.

There is a rich body of work looking at multimodal and cross-modal perception of which O'Callaghan gives an overview. From the perspective of this thesis it is notable that the senses normally work in concert, not just hearing and seeing but touch and kinaesthesia (in relation to movement) become involved in a dancing crowd; at louder concerts the sound may become an altogether physical experience, feeling the bass thumping as one external heartbeat in a mass of people.

In Human Computer Interaction (HCI) and Interaction Design, multimodality is used to emphasise that we not only perceive using different sensory modalities (we hear someone talk but also observe body language and facial expression), but at the same time we express ourselves addressing different sensory modalities simultaneously using different expressive modalities (cf Bongers & van der Veer 2007; Gaver 1989; Schomaker, Nijtmans & Münch 1995). In interaction expression and perception is never one way; there is always a feedback loop to take in account (which again is multimodal).

There is an overlap between social semiotic multimodality and how it is used in HCI, in the way it is used to analyse interaction, albeit with different aims. Where HCI is

looking to develop and improve our interactions with and through technology, the social semiotic strand of multimodality studies (existing) interactions and ways of creating meaning potential, centring on human agency and communication.

4.3.2 When is Mode?

> *Mode is a name for a particular way in which human beings have arranged the particular use of a semiotic resource; and devise some sort of semi-abstract system for doing so.* (Van Leeuwen, personal communication, 11 November 2011)

Several of the social semiotic authors discuss the 'semiotic resources' of a mode; Jewitt (2009, p. 22) calls them: 'the actions, materials and artefacts people communicate with'. Björkvall (2009, p. 243) discusses the observable features of a mode that have been: 'drawn into the social and cultural process of meaning making'. Meaning can be made: 'when a semiotic resource is put to use it realises semiotic potential or meaning potential.'

The terminology (mode, modal, modality) is used in different ways in various academic disciplines, but in linguistics it shows a move away from mono-modal approaches to perception, interaction and meaning making. In the case of social semiotics there is no fixed definition of what a mode is; Jewitt (2009, p. 22) writes:

> The purpose of multimodal investigation is to understand the principles of use and modal resources available in a multimodal representation (a multimodal text) or the situated communicative moment rather than to seek to establish a universal inventory for a mode. What is considered a mode and interaction between modes is inextricably shaped and construed by social, cultural and historical factors.

Kress (2009, p. 54) opens his chapter 'What is mode?' with a similar description: 'Mode is a socially shaped and culturally given resource for making meaning. *Image, writing, layout, music, gesture, speech, moving image, soundtrack* are examples of modes used in

representation and communication.' Comparing the modes 'writing' and 'language' Kress (ibid) remarks that we have to accept that modes 'consist of different bundles of (highly diverse) features'. Kress proposes two approaches to the question 'what is mode?', one focussing on the social aspects (what a community takes to be a mode) and the other on formal aspects: the requirements for a social semiotic approach to communication. The formal aspects refer to three 'Metafunctions' that echo Halliday's framework of field, tenor and mode. The 'ideational', 'interpersonal' and 'textual' functions are held (by Halliday) to correspond neatly to distinct grammatical systems represented as systems of binary opposites. Van Leeuwen (1999, p. 189; 2009) has argued that not all semiotic resources can be modelled in this way, and that some are best modelled as parametric systems, systems of simultaneously present continua. Rather than using the metafunctions to construct a 'grammar of amplification', I will explore Van Leeuwen's parametric approach. Addressing simultaneous parameters is more suitable to the performative nature of how technology is used, the specifics of which I will discuss later in this chapter.

As explored in the previous chapters, amplification is not always considered a mode; rather it is evaluated as a technology that makes other modes eg 'speech' or 'music' louder, neutral to meaning potential. The object of this chapter is to make apparent that this technology – the complex of miking, mixing and amplifying of live music, does more than making things louder. It provides semiotic resources and as such has the potential of making, changing and enhancing meaning. The semiotic potential of sound technology is widely acknowledged in recorded music (for instance in the work of Théberge (1997), Moylan (2002) or Lacasse (2000)), but is something of an oversight with regard to electronic amplification. As a consequence of the co-presence of the sources the processes of miking and mixing can be significantly different to the same processes in the recording studio, in addition to the temporal, real time, aspect of musical performance.

4.3.3 Meaningful Music?

The move away from a logo-centric approach to meaning allows us to focus on meaning potential that can be made and re-made over and over again, rather than meaning that is

interpreted as static and referential. Van Leeuwen (1999, p. 193) stresses: '… if there are fixed meanings, it is because people fixed them, even if we cannot always trace the path back to the moment of fixing'. The question of how music can (or, more often, cannot) have or make meaning, or how music can be (naturalistically) representational has been discussed in many accounts of music (Tagg 2003; Van Leeuwen 1999).

The inadequacy of music when it comes to representation and (linguistic) meaning is easy to see and an argument that denies music such capabilities is hard to refute. On the other hand, to me and I suspect to many others, music in any form is never without meaning. As stated by Van Leeuwen (ibid p. 165) in his discussion of musical naturalness:

> It should be clear from everything I have said about music in this book that I find it more rewarding and enriching to listen to music as socially meaningful in a variety of ways – cognitively as well as emotively, representationally as well as interactionally, concretely as well as abstractly.

Writing about poststructuralist Roland Barthes' work, Van Leeuwen (ibid p. 128) warns against a reversal of two polarities: the structures of language on one side and the affective connotations of sound productions on the other. This becomes much clearer in vocal production, what Barthes famously called 'the grain of the voice':

> Sound never just "expresses" or "represents" it always also, and at the same time, affects us. The two cannot and should not be separated and opposed to each other […] There is always both the social and the personal, both meaning and pleasure –or displeasure. The difference lies in how we *value* the social and the personal, or meaning and pleasure, and in the degree to which we acknowledge their unavoidable interconnections.

This experiential aspect – how hearing sounds affects us – present as much in music as it is in speech, can be taken to new extents when amplification is used. The sonic affect of

social distance comes to mind, common sound qualities that we have learned to recognise and can produce ourselves.

Amplified sound can equally affect us on a tactile level, for instance the lowest sounds in the spectrum at raves and house parties; often bass and bass drum (an actual instrument or a drum machine) thumping out the beat can be felt at such occasions. Equally at rock concerts very loud amplification can be a pleasant, essentially musical experience to some, while at the same time off-putting to others. A complete immersion in sound is not limited to a particular musical genre; it can equally occur at a classical concert hall during a loud section in a Mahler or Bruckner symphony. Or, a similar sonic experience can be had on the dance floor of a club, surrounded by loudspeakers.

A multimodal approach, that includes context, allows us to discuss in what ways music can make meaning, ie how music has *meaning potential*. Discussing meaning potential rather than meaning emphasises the subjectivity and neither suggests claims to universality, nor a desire to identify such universals.

Kress (2010, p. 57) describes what questions a social semiotic approach can ask:

- Whose interest and agency is at work in the making of meaning;
- What meaning is being made;
- How is meaning being made;
- With what resources;
- In what social environment;
- What are the meaning potentials of the resources that have been used?

As I have suggested earlier, the significant point of this thesis is that amplification rearticulates and creates meaning potential. In the previous chapters I have already identified how loudspeakers and microphones (on a stage at a concert, or in images) have meaning potential as artefacts. Other ways of meaningfulness follow from the functionality of amplification, or what its use affords. Loud amplification allows an audience to dance, sing along, scream, yell and jump around while still hearing the music, in a way the entire context is amplified: the whole building shakes and people express

themselves energetically (with the 'mosh pit' as an extreme form of that energy).[8] And as such it has changed the listening experience, liberating in terms of freedom to jump around and sing along; and restricting at the same time by taking away from the concentrated listening to music, or experiencing music 'as music' (but there is a place and a time for each one of these and some people enjoy both).

4.4 Modal Logic and Social Semiotics

Within social semiotics there is another, potentially confusing use of the word modality, which goes back to modal logic. For logicians modality is about the likelihood of a proposition being true or false. In linguistics language has *modality* related to meaning; it refers to 'degrees of truth' that can be assigned to a sentence, ie modality can be 'high' or 'low', or rather how much truth a speaker or writer assigns to that sentence (Van Leeuwen 1999, p. 156, 2005, p. 160). Auxiliaries such as *may, will, must*; adverbs like *likely, maybe*; and nouns (eg *probability*) are resources for this linguistic modality. As an example compare: 'I know this is a really good bottle of wine' to 'I think this is a really good bottle of wine'. Or in a similar way, calling something 'real' or 'original' in a sentence, means assigning high modality to the subject of that sentence. Social semioticians have made a point of how this use of modality extends beyond language, initially referring to the importance of non-verbal communication (Van Leeuwen 1999, p. 159). A child (or anyone) can say 'no' but look 'yes' when caught in the vicinity of the cookie jar.

Modality theory is based on how the means of expression of a mode come together; applying it to amplified music brings to the fore what the means of expression are and how expressiveness can be accomplished.

To demonstrate this, Van Leeuwen uses modality in relation to food: the modality of food can be expressed through words like 'organic' and 'natural' in contrast with 'artificial'. In the post logo-centric era the logical use of modality becomes 'multi' as well. It is no

[8] Keith Negus (2008, p. 153) in his Bob Dylan biography, reports audiences singing along to Dylan at recent concerts; Negus suggests, that this singing along can express a form of collective freedom. Mosh pits occur at the 'heavier' kinds of concert (metal, punk rock etcetera) when excited fans take jumping around to the extent of hurting each other (or just beating each other up). Not to be confused with the much more polite and socially cohesive 'crowd surfing' or stage diving. For a discussion see Johnson & Cloonan (2009, p. 80).

longer just language that has modality; other modes can express it similarly. For instance a remark made in a sarcastic tone, or a photograph of a tank on Tiananmen Square compared to a tank in a newspaper cartoon; both images make different claims to the trueness of the represented tank. A similar account can be made about the work of a courtroom sketch that tries to be as 'true' as can be, in absence of a photographer. Finally in relation to images Hodge and Kress (1988, p. 121) remark: 'Everyone knows the camera cannot lie, but sadly photographers and users of photos can and do', an example that explains the title 'Social Definitions of the Real', of the chapter the authors dedicate to 'a general theory of modality'.

Van Leeuwen (2005, p. 160) opens the chapter about modality in *Introducing Social Semiotics*: 'Modality is the social semiotic approach to the question of truth. It relates both to issues of representation – fact versus fiction, reality versus fantasy, real versus artificial, authentic versus fake…' It is also a matter of social interaction, what is regarded as true for one group of people may be a heresy for another group.

After Halliday Van Leeuwen explains that modality not only has different *degrees* of truth but also different *kinds* of truth:

- Subjective (I think it will…)
- Objective (It will…)
- Probability (Maybe it will…)
- Frequency (Every day it will….)

Truth is a heavily laden word, as Van Leeuwen (ibid p. 158) points out: '…true must always be true to something'. But he argues that words like real and true (and let me add original and authentic) are very common in our language, in relation to many things, including sound. Van Leeuwen continues:

> … "truth" is, in the end, "true to the values held by the group whose truth it is", rather than "true to some kind of objective reality". Far from being a descent into total relativism, this brings values back where they belong, in the forefront of the

> discussion, where we can negotiate whether or not they can give us a sound basis for judgement and action.

Hodge and Kress (1988, p. 147) relate modality to levels of control over the reality of representations. Their approach emphasises the strong political dimension, social control, of modality:

- Social control requires the control of modality systems. Modality factors are therefore a major focus of semiotic activity and struggle.
- Primary targets in strategies of modality control are a single incontestable version of reality, and a single classification of categories of semiosic agents as legitimate or illegitimate.[9]

Truth and realistic representation is in the hands of whoever controls modality. Hodge and Kress (ibid) bring up the example of 'Doublethink' from George Orwell's *1984*:

> "Doublethink" is the general condition of knowing that a statement is both true and not true, both true to experience and true to "the word", to the social definition of reality.

As a metaphor 'doublethink' might be apt to describe the question that arises when an instrument is detached from its acoustic source when amplified; which sound is the 'true' sound, the acoustic sound emanating from the instrument, or the amplified sound coming from the loudspeaker? And what if only the amplified sound can be heard?

Control of amplified sound becomes social control, in the control over balance and levels bestowed upon a sound engineer at a concert. The mixer is intermediary between performers and audience and as such holds power over what people hear but also over what the performers sound like to the audience, that is their presentation (which I will further discuss in the next chapter).

[9] Hodge and Kress (1988, p. 5) discuss the *semiosic* process: '… the social process by which meaning is constructed and exchanged'.

An interesting aspect of Hodge and Kress' argument targets single versions of reality, echoing (albeit much less political) the discussion of real and original sound versus reproduced sound, which is sometimes perceived as not original or even not real, as brought forward in the literature review. Hodge and Kress (ibid p. 122) describe 'reality' as secure:

> "Reality" is the description by the participants of that part of the system of classification which is held to be "secure" and which is at play in the interaction.

'Secure' is an interesting term in this context; we can feel more secure if we refer to existing or older traditions when thinking about the value of 'truth', 'reality' or 'originality'.

This thesis studies music as social action; making music is making meaning, over and over again. Transduction and reproduction are used in many ways to make music and are used so intentionally. As such electronic amplification can be perceived as a mode that adds meaning potential to the very making of music. I will continue describing the social semiotic use of modality and how it can be applied in the context of music. I will return to questions of meaning making in the next chapter looking at the different agents involved in the process.

4.4.1 Modality and the Authenticity of Amplified music

Performers seeking to recreate baroque or 'early music' music (used to) make strong claims about the authenticity of their performances by using period instruments (or copies) and focussing research and performance solemnly on a certain era or even on one composer. I argue that, by way of example, a performance of a Bach violin partita on a period instrument (and in a period tuning) has higher modality than a similar performance on a modern instrument.[10]

Authenticity can easily be suggested in discourses that are still current, in well-defined practices, such as romantic opera or symphony orchestras. Or practices that came

[10] The sharp edges have come off this debate; rather than referring to 'authentic' performance it is now known as Historically Informed Practice (HIP) (cf Davies 2002; Scruton 1999, p. 444; Young 2002).

into being in the 20th century: (early recordings of -) country blues; or for instance The Beatles: we know in great detail how their songs were recorded and produced thanks to books like Ryan and Kehew's (2006) *Recording the Beatles* and Lewisohn's (1990) *The Beatles Recording Sessions.* About the use of technology at Beatles' concerts, other then the choice of guitars (and guitar amplifiers) and other gear that can be recognised in images and films, very little is known.[11] Tribute bands that specialise in The Beatles' repertoire attempt to be as 'authentic' as possible (which is interesting given that the original Beatles were often inaudible at concerts). Shane Homan (2006, p. 74) observes how contemporary stage technology might be 'too good' at a Beatles' tribute concert in Moscow: 'attention to detail, perversely, can work against them, in producing a performance that is too polished, and in which the earlier limitations of amplification and sound clarity are neatly erased.'

Allan Moore (2002) in his article 'Authenticity as Authentication' discusses the attribution of authenticity to music as a social construct, as something that is 'ascribed, not inscribed'. He departs from the assumption that:

> …authenticity does not inhere in any combination of musical sounds. "Authenticity" is a matter of interpretation which is made and fought for from within a cultural and, thus, historicised position. (ibid p. 210)

Moore differentiates between first person, third person and second person authenticity (in that order); not asking what (piece of music or activity) is authenticated, but rather 'who?' (ibid p. 210):

> *authenticity of expression,* or what I also term 'first person authenticity', arises when an originator (composer, performer) succeeds in conveying the impression that his/ her utterance is one of integrity, that it represents an attempt to communicate in an unmediated form with an audience.

[11] See for instance the 'who was the Beatles live sound engineer?' thread on the dmbeatles forum, a fan-site created by Dimitry Murashev. www.dmbeatles.com/forums/index.php?topic=8989.0 <viewed 1 March 2013>

The third person refers to authentication of broader traditions: a 'performer succeeds in conveying the impression of accurately representing the ideas of another, embedded within a tradition of performance.' (p. 218) And second person authenticity occurs 'when a performance succeeds in conveying the impression to a listener that that listener's experience of life is being validated' (p. 220). Of those three perhaps the first one is most related to the use of amplification. In his paper Moore lists a number of different aspects of first person authenticity, first of all, after Timothy Taylor (1997): authenticity as primality: 'an expression is perceived to be authentic if it can be traced to an initiatory instance', of which examples can be found in different notions eg: *purity of practice* or *honesty of experience*.[12] Amplified sound can, from that perspective, hardly be considered inauthentic, as the initiatory instance can still be traced, at least visually (with the acoustic source in sight). After Feld (in Feld & Keil 1993, p. 296), Moore writes: 'authenticity only emerges when it is counter to forces that are trying to screw it up, transform it, dominate it, mess with it . . .' which is much more an issue of traditional acoustic ensembles performing amplified than it is with pop musics, although it hints at the issue regarding Bob Dylan's electric coming out and 'authentic folk music'. In that context and directly relating to amplification, Moore writes after Walser (1993):

> ….that this is one of two clear types of 'authenticity' that can be observed in rock in general, wherein technological mediation (whether a reliance on signal modifiers, ever more powerful means of amplification, and even technical mastery in many spheres) is equated with artifice…

When it comes to the use of amplification at concerts from some perspectives it can be seen as 'cheating', (the early responses to crooning, for instance) or in other cases as an unwanted interference with the acoustic experience, as found in Burston's (1998) discussion of Broadway shows. From a perspective of first person authenticity (but also modality), the notion of 'unplugged' (see §3.2.6), is very informative, even though instruments and voices are amplified, an acoustic, unmediated performance is suggested.

[12] For 'purity of practice' Moore refers to Bohlman (1988, p. 10) and for 'honesty of experience' to Grossberg (1992).

In an earlier paper Moore (1998) evokes James Jerome Gibson's (1966, p. 81) use of affordance:

> With respect to the act of listening Gibson suggests that a "wavefront is specific to the direction of the source … [it] affords orientation and localization [while a] train of waves is specific to the kind of mechanical disturbance at the source … [it] affords discrimination and identification"

With the amplified sound detached from its source this is an element of authenticity connected to sound, in terms of 'where is the sound coming from'. This thesis explicitly includes the sonic as an aspect of authenticity; it looks at interpreting the authenticity of musical sound as produced at a performance of music, of the amplified reproduction related to an (acoustic) original or in relation to the detached amplified sound, as a question of copy or original. How is what we hear in relation to what we see being produced on stage authentic? Or in terms of modality, how 'true' of what claim to 'trueness' is made in the production of the sounds we hear?

A judgment of musical experience at a concert can be informed or coloured by what we have heard earlier, listening to recordings of the music that is performed. Again this brings forward the primacy of recording: Auslander (2008, p. 75) cites Wurtzler: '…the live is conceived as a degraded version of the recorded'. Auslander, in that instance, discusses live recordings that are judged by how well they compare to the studio recordings of the works that were played at the concerts that were recorded for the live album. In another publication Auslander (2003, p. 161) refers to Frith (1988, p. 124):

> …for an increasing number of rock fans the meaning of 'live' performance, the look of music 'in reality' [. . .] comes from its ubiquitous simulation [. . .] a concert feels real only to the extent that it matches its TV reproduction'.

Auslander (ibid) referring, in addition to Frith, to Wurtzler and Connor summarises: 'live performances are now frequently reproductions of mass-produced, mediatised performances'.

4.4.2 Fidelity

To further clarify the use of the word authenticity I associate it with the term 'fidelity'. When amplification in its function as a reproducing technology is used, the primacy of recording comes to the fore again. 'Fidelity' is an important criterion with regard to the modality of recorded music and how it is played back. There is a certain hi-fi, sound quality aspect but generally fidelity is about naturalness, the degree of exactness of a reproduction: does this recording sound as if I am present at a performance of this music? With regard to the modality of amplified music, fidelity is the degree to which the amplified sound matches the (seen) acoustic source. Similarly, a phenomenon that can equally relate to authenticity and amplified sound is sensoriness, or the degree to which the (musical) experience is affective, the actual experiencing of sound. The sound at a rave has to be loud; you have to 'feel' the beat. A last aspect of authenticity is related to the technology in use (or appears to be in use). Technologically fidelity refers to the impact the use of technology has similar to a connotation of authenticity that is suggested by black and white photos or early cinema newsreels, the static crackle of vinyl or the sonic deformations of old cylinders; it has as such a historic component as well. Perhaps new technologies are 'more convenient' but older ones were/are 'better' (one reason for the ongoing popularity of vinyl). In a similar vain there is the argument that Beatles' tribute bands should not sound too good and Broadway musicals should not have the fidelity of FM radio (as argued by Burston).

Recordings in general can be considered as having high modality, something has happened 'for real', and the recording bears witness. That is obviously ignoring all mixing and editing common to contemporary music recordings (perhaps that is why older recordings can have a relatively higher modality). Not just in the recording studio, on the pop and rock stage 'authentic' instruments and amplifiers are very popular (and have been for a while). Andrew Goodwin (1990, p. 269 cited in Auslander) recalls the rock band Queen proclaiming 'no synthesizers' on their 1970s albums, as if to say 'only real sounds in use'. But already in the 1990s playing analogue synthesisers had become 'a mark of authenticity' (and Queen took to using them as well). Twenty years later analogue synths and other 'gear' (classic tube microphones, tube guitar amps or a Roland

‘Space Echo’) have become vital in music production (see for instance Shepherd 2010). The presence on stage of a Hammond organ (with a ‘Leslie’ rotating loudspeaker), a Fender Rhodes or Wurlitzer piano gives credibility to an act (rather than using a digital keyboard that plays samples of the ‘real thing’). These electric pianos may be out of tune, humming or otherwise malfunctioning, but such audible disturbances or rather infidelities can still be considered technically authentic.[14]

With the primacy of recording, and several authors in the literature review emphasise this point, the recorded sound has become the authentic sound: recorded music has high modality (see the previous §). This is where an overlap between modality and the decorum of a concert – how we are supposed to behave at a performance – can be observed. Halliday (1970) distinguishes between modality and modulation: modality is ideational – the degree of truth (of whatever kind) of a representation; modulation is interpersonal – the degree of obligation attached to a represented action. Linguistically they are intertwined, for instance in English the same auxiliaries are used in both expressions:

> You must do this (high obligation);
> It must be true (high truth value).

In music a similar mix of what we deem ‘true’, and the norms that regulate our behaviour in musical events can be observed. If an acoustic performance, unamplified, unrecorded, live and ‘real’ is regarded as having the highest possible musical truth, it will also come with a normative decorum: it has to be experienced in silence (a problem extensively addressed in Small’s *Musicking*).

4.5 Authenticity of Amplified Music

At a violin recital in a small hall there is no reason not to believe what is heard. Some doubts may arise at a stadium concert where the sound is detached from its visible source, and with seeing and hearing often out of sync as a consequence of the distance, whether

[14] Humming refers to the presence of a 50Hz (60Hz in the USA) rumble in the signal, caused by bad system design (a so called ground loop) damaged equipment or the use of unbalanced or unshielded signal cables.

further enhanced by jumbotron screens or not. Is that singer really singing or just moving his or her lips in sync with a pre-recorded track? Does that singer actually sing in tune or has some pitch correction been applied? At higher amplification levels and increasing detachment more is possible in terms of technological processing and use of pre-recorded material, often unnoticeable, but at the same time creating more spuriousness.

Similar problems can be found with Broadway musicals (eg *Cats*) where the music is piped in from a different location, and you cannot see the band: apart from a perspective of job numbers, does it really matter whether they play live or not? The presence on stage of authentic artefacts adds to a performance's claim to authenticity and *liveness* (lip syncing pop stars on *Top of the Pops* were always filmed with prop microphones, keyboards with unused power cords, disconnected guitars and muted drum kits). Auslander (2008, p. 57) adds another layer to the microphone as artefact, its incorporation in movement (although in his book he puts emphasis on the 'remediative' function of the transducers):

> …consider its central role in Elvis Presley's performance style, the microphonic acrobatics of James Brown and the way the Supremes' and the Temptations' choreography revolved around the positioning of their microphones.

The singers of the 50s and 60s were of course bound to their microphones, until wireless hand held microphones and 'Madonna' headsets came into fashion. Potter and Sorrell (2012, p. 243) mention the disadvantage of a (pre-wireless) microphone in the way it restricts movement. Al Jolson sang and danced in the aisles all the way to the exits and he even used a ramp into the auditorium, which Potter and Sorrell call prophetic, it being quite common now (with radio mikes and in-ear monitors).

I do not intend to use modality as a way of prescribing 'true', 'original' or 'authentic' music practices. The use of technology allows modality to become something that can be modified, it has become a parameter that can be used (or abused to some) in music performance, a parameter that can be played with and allows for play in reception and interpretation. In this thesis modality is used to interrogate practices and identify meaning potential. Britney Spears may not really sing but she does really perform, for a

real audience of real people who paid real money for a ticket, who were really looking forward to *seeing* Spears perform and who were (possibly) really enjoying themselves. These sorts of events should not be evaluated using older value systems, or by isolating aspects of performance. In a different domain of the entertainment industry actors in drag, lip-syncing to recordings by female vocalists, have elevated lip-syncing to an art in it self, for instance as portrayed in Stephen Eliot's classic Australian road movie, *The Adventures of Priscilla, Queen of the Desert* (1994).

4.5.1 Lip and other Syncing

There are several famous cases of 'live' lip-syncing that have attracted scholarly interest. Steve Wurtzler (1992) has written about Whitney Houston in a book chapter called: 'She Sang Live, but the Microphone was Turned Off'. Houston sang 'The Star Spangled Banner' during half time of the 1991 Superbowl. There have been quite a few Superbowl lip-syncing incidents attracting different levels of controversy. The USA football league requires performers to have a back up track to minimise performance risks, but the artists can elect to sing live, according to an article on the ABC news website (Fisher & Marikar 2009).

Jaap Kooijman (2006, p. 127) writes about Michael Jackson using lip-sync in complex dance routines (as Spears does and allegedly Madonna):

> This is not to say that sound was no longer important, but that the live performance of sound had become seemingly irrelevant. That Jackson lip-synched 'Billie Jean' is, in itself, not extraordinary, but the fact that it did not change the impact of the performance is extraordinary; whether the performance was live or lip-synched made no difference to the audience.[17]

Playing along to pre-recorded material is not limited to pop and rock concerts in stadiums or TV appearances, sometimes artists with very credible reputations as performers end up making compromises. At Barack Obama's inauguration in January 2009 Cellist Yo-Yo

[17] Auslander (2008, p.73) spends a whole chapter on the 'Milli Vanilli' affair in the late 1980s (although I consider that story more interesting from a perspective of marketing studies).

Ma, violinist Itzhak Perlman, pianist Gabriella Montero and clarinettist Anthony McGill decided to play along to a recording of a rehearsal made two days earlier because of the cold in the outdoors.[18] The decision to mime the performance appears to be one of risk limitation, similar to the Superbowl anthems; at such large-scale events; the risk that comes with music performances becomes secondary to everything going according to plan.

Lip-syncing, whether just a singer, a whole band or a whole orchestra is the ultimate way of making a performance into the mirror of a recording. Another digital technology aids in achieving that goal (if that is indeed what is going on): 'autotune' or pitch correction. Since a few years ago digital processing has been fast enough to achieve this in real time, making pitch correction available to live performances. For most pop songs it suffices to enter the key of a song and as long as there are no unannounced modulations or sudden segues from major to minor or vice versa (both rare in pop and rock music), the autotune will correct the pitches of the vocalist, inaudibly (as long as the difference is not too big). However, it does not miraculously turn each and everyone into a great singer (there is obviously more to singing than hitting the right note). When the speed of the autotune is lowered to avoid portamento in the shift, the 'wobble', 'gerbil' or 'Cher' effect can be created, and as such becomes a production tool. It first came to fame in Cher's hit *Believe* and has been used (and still is) in many pop records (see Frere-Jones 2008). Real time pitch shifters have been around for much longer but never as responsive as the autotune systems of today.[19]

4.5.2 No singer at all

From different acousmatic viewpoints one very interesting option is the complete absence of an actual singer at concerts of vocal music. The Orchestre National de Jazz (ONJ) from France recorded an album called *Around Robert Wyatt* with British musician Robert Wyatt in 2009. He could not come along on tour (Wyatt is paralysed from the waist down) so when performing those works the ONJ plays along to his recorded voice (and

[18] Italian tenor Luciano Pavarotti, at his last public appearance, lip-synced Verdi's 'Nessun Dorma' at the closing ceremony of the 2006 winter Olympics in Turin (Kington 2008).
[19] The Eventide harmonisers were able to, more or less in real time, change the pitch of sounds and synthesise harmony to an audio input, the first models became available in 1975.

the recorded voices of others, while some songs are sung by guest vocalists who are actually present). Musicians playing their instruments live on stage accompanying a singer who is not present (to lip-sync to his own voice).

At the first ever, performance of all the parts of Stockhausen's opera *Sontag aus Licht* in Cologne, the input signals of all microphones and other sources were recorded separately at all rehearsals and performances. When for the two last performances one of the two singers was unable to sing, a solution was found in using a recorded version of that singer's role. As a consequence many fine performance details (tempi, micro-dynamic) had to be synchronised to the recorded track. In this case it was an enormous challenge for conductor Peter Rundel, who in his headphone heard a mix of the recorded ensemble and the singer's voice in order to sync the same ensemble playing live to the recorded voice of the singer. In rock and pop this is made much easier by the option of using click tracks that musicians or a conductor can hear in their in-ear monitors. Conductors of classical ensembles commonly do not wear headphones or in-ears for the simple fact that they are maintaining an acoustic balance, just as much when mixed with amplified sounds or electronic sources. Instead of the injured singer a dancer performed the mise-en-scène, again without miming or any reference to the 'lost voice', which was announced pre performance.[21]

4.5.3 Disappearing Performers

Damon Albarn of Britpop band Blur and comic book artist Jamie Christopher Hewlett created the 'virtual band' called Gorillaz in 1998. It was virtual in the sense that their presence in all visual media is entirely given shape by (animated) cartoons. The cartoon characters can be seen performing the music, which is recorded by actual musicians (cf Richardson 2005). At some of their concerts the actual musicians stay out of sight while the audience watches clips of the cartoon characters performing.

One step further are performances by 'virtual idols' accompanied by human instrumentalists. Very popular in Japan but also globally is virtual pop idol Miku

[21] *Sonntag aus Light* by Karlheinz Stockhausen, Cologne Opera, Ensemble Musik Fabrik, musical direction: Peter Rundel and Katinka Pasveer, scenography by La Fura dels Baus, Cologne April 2011. Again the sound design and projection for this performance was in the hands of Paul Jeukendrup, personal communication June 2012.

Hatsune, whose singing is brought to life by voice synthesis software.[22] Her original, or perhaps initial, 'looks' appeared just once, on the package of a commercial vocal synthesiser package. Soon it became the rage to create pop songs and video clips using that particular synthesised voice and animations of the idol's image (Hamasaki 2008; Kenmochi 2010).[23] Fascinatingly, using multiple projectors[24] the animated character started performing live, backed by a band with real musicians (whether they really played live seems less relevant in this context, but it sounded to me like they did) with a first performance in August 2009.[25] In footage from a concert in Los Angeles (July 2011) the singer is animated on stage, using a handheld or a headset microphone (which again shows what an important artefact that is, clearly not having a technical function here), backed by a band and a (amplified) string section, again appearing to be playing live. The addition of the acoustic string instruments seems to enhance the liveness of the event and at the same time the contradiction between classical and contemporary performance.

4.6 Modality in Speech, Music, Sound

> *...modality is not restricted to language but is a multimodal concept. All means of expression have modality resources. The question of truth emerges in all of them, even if the kinds of truth they allow and the ways in which they express degrees of truth will be different.* (Van Leeuwen 2005, p. 165)

In *Reading Images* Kress & Van Leeuwen (1990) develop a methodology by applying the notion of modality to images. In relation to an image the higher or lower modality is related to the degree of truth than can be assigned to a representation. They provide a set of 'articulation parameters' or 'modality cues' for the analysis of images, looking at how

[22] Yamaha's 'Vocaloid2'
[23] In May 2010, an album with tracks by different users (ie of this particular software) titled *Exit Tunes Presents Vocalogenesis feat. Hatsune Miku* topped the Japanese (Oricon) charts.
[24] Multi projector screen-less animation is often referred to as a 3D Hologram or volumetric display, technology that has not been realised at this point in time. Entertainment technologist John Huntington (2012a) asserts in a blog post, even though Holograms can be seen at work in *Star Wars*, we'll have light sabres (weaponry of choice in the *Star Wars* movies) before we'll have Holograms!
[25] See for instance: http://youtubeseyrenlk.blogspot.com.au/2011/10/hatsune-miku-concert-in-los-angeles.html <viewed 16 February 2012>

certain elements or modality cues, are articulated in 'modality configurations' and 'coding orientations'. Depending on how these parameters are articulated a modality is established (in analogy to the degrees of truth in modality). Some of the parameters are the 'articulation of detail', 'articulation of background', 'articulation of colour' or the articulation of 'light and shade'. The level of articulation of these parameters can be graded from high to low, amplified or reduced, cuing *modality judgements*.

In addition, Kress and Van Leeuwen describe different *coding orientations* that express, for instance, the difference between the cartoon showing a tank and the photo of a tank. The latter has a *naturalistic modality orientation* and the former an *abstract modality orientation* (Van Leeuwen 2005, p. 162). 'Coding orientations are sets of abstract principles which inform the way in which texts are coded by specific social groups' state Kress and Van Leeuwen (1990, p. 53). A *technical modality* can be found in, for instance, a technical drawing or a flow chart.

In his book *Speech Music Sound*, Van Leeuwen (1999, p. 1) focuses on the communicative use of sound, exploring: 'the common ground between speech, music and other sounds.' Van Leeuwen (ibid p. 156) discusses the modality of sound from a broad perspective, whether speech, music or other sounds. He builds on the approach in *Reading Images* and presents a system network that organises modality 'cues' and orientations of sound. A system network is a taxonomic diagram that lays out semiotic choices, or as (Jewitt 2009a, p. 17) describes: 'a style of diagramming' that can be used to 'map the metafunctional meaning potentials of modes'). In a later publication (Van Leeuwen 2009, p. 74) the author differentiates between system networks and parametric systems; the latter show only simultaneous choices while the former can identify both binary and simultaneous choices. Parametric systems (for instance the one Van Leeuwen (1999, p. 151; 2009, p. 75) describes for voice quality) have a number of parameters that are articulated simultaneously, ie ranging from soft to loud, high to low, rough to smooth etcetera. An approach that looks at parameters resonates well with the notion that the use of amplification is not a binary, but a continuum of amplification levels in relation to functionality.

Van Leeuwen explains his approach by means of an analogy with an imaginary instrument that allows a player to operate a range of simultaneous parameters, not unlike

an organ or a harmonium that has different 'stops', which can be put in position to influence the timbre. The positions of the different stops form the 'modality configuration' with each of the stops representing one of the following articulatory parameters or modality cues:

- *Pitch extent* is a scale that runs from monotone to a maximally wide range of pitches. Classical music typically uses a wide, rationalised range of pitches; country Blues often uses a pentatonic scale with a range sometimes smaller than one octave. As noticed by Grant (2004, p. 14) and others, in comparison to classical music, the pitch extent of popular music is (much) smaller.

- *Durational variety* runs from a single standard length or as found in Morse code, two different lengths, to a large number of different lengths of individual sound events. In comparison, in speech we vary duration to accent or exaggerate keywords: 'fantaaaastic!'. Van Leeuwen mentions the tradition of singing 'whole notes' in Dutch protestant churches (but also in protestant churches founded by the Dutch in North America and South Africa); each note in a sung hymn is equally long, perhaps when dictated by the words varied with a note of half that length. A too rhythmical singing style could be considered frivolous.[26]

- *Dynamic range* forms a scale from a single loudness level to a maximum dynamic range; as we can read in Bob Katz's (2007, p. 113) mastering bible *Mastering Audio*: 'The term dynamic range refers to the difference between the loudest and the softest passages of the body of music; it should not be confused with loudness or absolute level'. Romantic music uses a wide dynamic range for enhanced expression. Katz distinguishes between Microdynamics and Macrodynamics (ibid) with the former referring to '…the music's rhythmic expression, integrity or

[26] My mother (personal communication 2012), who went to a protestant church every Sunday through the 40s, 50s and 60s remembers that the display showing the psalms and hymns for that service would have the letter 'r' after some of the selections indicating it would be sung rhythmically. But she adds that the habit of singing really long, slow notes was long gone. She recommends a book on this subject: Maarten 't Hart's novel *Het Psalmenoproer* (Psalms and Riots) from 2006 (in Dutch, translated into German, Swedish and Serbian).

bounce' or the difference in dynamic properties between a bass guitar and a snare drum, and the latter to '…the loudness differences between sections of a song or song cycle'. In classical music the macrodynamics would refer to the range between the softest and the loudest part of an entire composition. As a consequence of the so-called 'loudness wars' current popular music has a minimal macrodynamic range which as a result often badly impacts on the microdynamics of a recording (ibid p. 168).[27]

- *Perspective depth* This parameter stems from Murray Schafer's division of sounds in 'Figure', 'Ground' and 'Field' and comparable divisions in 'radiophonics' and movie sound tracking. It runs from no aural background at all to a convergence of possible layers. Sounds can be foreground, background, maximally differentiated or flat. We can listen to rain while we sit indoors, we can discern individual drops on the window or a resonant body as a figure against the ground of many raindrops in the field of the indoor/outdoor soundscape (a storm might be going on, your dishwasher (or computer's hard drive for that matter) may be humming in the background.

- *Fluctuation range* runs from a steady sound to a maximum fluctuation range. Eg the use and range of vibrato in a singing voice. This is actually a multidimensional parameter as it modulates a sound's pitch to a certain depth and at a certain speed. Not just pitch can be altered; amplitude can be modulated as well, which is usually referred to as *tremolo*.[28] Fluctuations in our speaking voice can express emotions and metaphorically we can experience tremolos, ie in shaky grounds, trembling or shivering from cold, fever or fear. The use of vibrato in classical music of different periods has attracted a lot of debate, for example

[27] Some prefer loudness 'race' over 'war'. See for instance: http://dynamicrangeday.co.uk/about/ <viewed 3 March, 2013>

[28] The term tremolo in notated music refers to the 'rapid repetition of a single note' (cf Augoyard & Torgue 2005, p. 130). The music technology use of the terms refers to 'A fast pulsation characterizing the diffusion of a sustained sound, in the form of multiple repetitions articulated in discontinuous frequencies. Tremolo actually cuts a signal into square signals, whereas vibrato leads it into a sinusoidal movement (ibid).

conductor Roger Norrington favouring the 'pure tone' without vibrato, with others disagreeing (cf Hurwitz 2012; Norrington 2003).

- *Degrees of friction* scales roughness from the smoothest of sounds to a very rough sound. Roughness derives its meaning potential from our association with rough and unpolished (eg the stereotypical voice-over of action movie trailers or distorted guitars). Smooth and soothing sounds can be found in, for instance, the voice-overs of beauty products ('Because you deserve it') and in the use of meditative bowls and gongs (although the bowls go through a rough sounding phase before they start 'ringing' caused by the friction of the wooden stick 'scraping' the bowl).

- *Absorption range* this is a scale that ranges from dry (outdoors) to maximally reverberant, which using digital technology can be extended ad infinitum. Similar to there being an endless number of possible spaces with different reflective surfaces, in digital reverb there are many different parameters that allow for the design and endless amount of different sounding spaces, what Blesser and Salter (2006) refer to as 'aural architecture'.

  Degree of directionality forms a range from non-directional to maximally directional. Directionality is an equally complicated parameter dependent on acoustic and timbral parameters. But nevertheless we can judge whether a sound can be pinpointed to a source or if it is ubiquitous.

4.6.1 Coding orientations

With regard to the modalities in imagery Van Leeuwen identifies three coding orientations: abstract-sensory, naturalistic and sensory. Rather then 'coding orientation' I will refer to them as different modalities, similar to Van Leeuwen in *Introducing Social Semiotics* (2005). In both books Van Leeuwen (1999, 2005) the author compares three different ways the sound of a (steam) train can be represented, by means of illustration. In the abstract-sensory coding orientation there are some musical examples, Van Leeuwen

mentions Arthur Honegger's *Pacific 231* (1923). The articulation of what is represented is reduced, suggesting an abstracted train; we can hear a train in the sound or music yet it does not sound like one. Similarly I can pretend to be a train to entertain my two-year-old godson making noises that create rhythm, low rumbling and a whistle (so much more rewarding to be a steam locomotive); even though rather different from a real train, a train is suggested, not just to the two year old.

In the naturalistic modality a recording of an actual train suggests a similar realism to a photo (but like a photo a recording can be edited or enhanced). In the movie industry, the soundscape of a scene that is shot is often completely recreated by a Foley artist in a way that complements the scene and enhances or supports the mood that is desired. If that scene has a train some aspects of that train's sound may be enhanced or reduced to increase emotive effect. Van Leeuwen provides the example of a heroine tied to the tracks, the train closing in, enhancing suspense; in the sensory coding orientation the parameters of the train's sound are enhanced for maximum emotive effect: the whistle screaming, the breaks grinding or the noise of steam escaping under pressure.

Kress and Van Leeuwen propose one more coding orientation in *Reading Images*, a technical modality as found in technical drawing, highly abstract drawing but rich in representation: 'Visual truth is based on the practical usefulness of the image' (Van Leeuwen 1999, p. 161). In *Speech Music Sound* Van Leeuwen has not proposed a technical modality but a good candidate could be data sonification. For instance in oil and gas exploration, sound can be used to interpret the (massive amounts of) seismological data, sound parameters can be programmed to change according to changes in the data (see for instance Frohlich et al. 1999).

On this page Van Leeuwen's system network is depicted, the parametric cues form a system with an either/or option of modality (coding orientation in other texts).

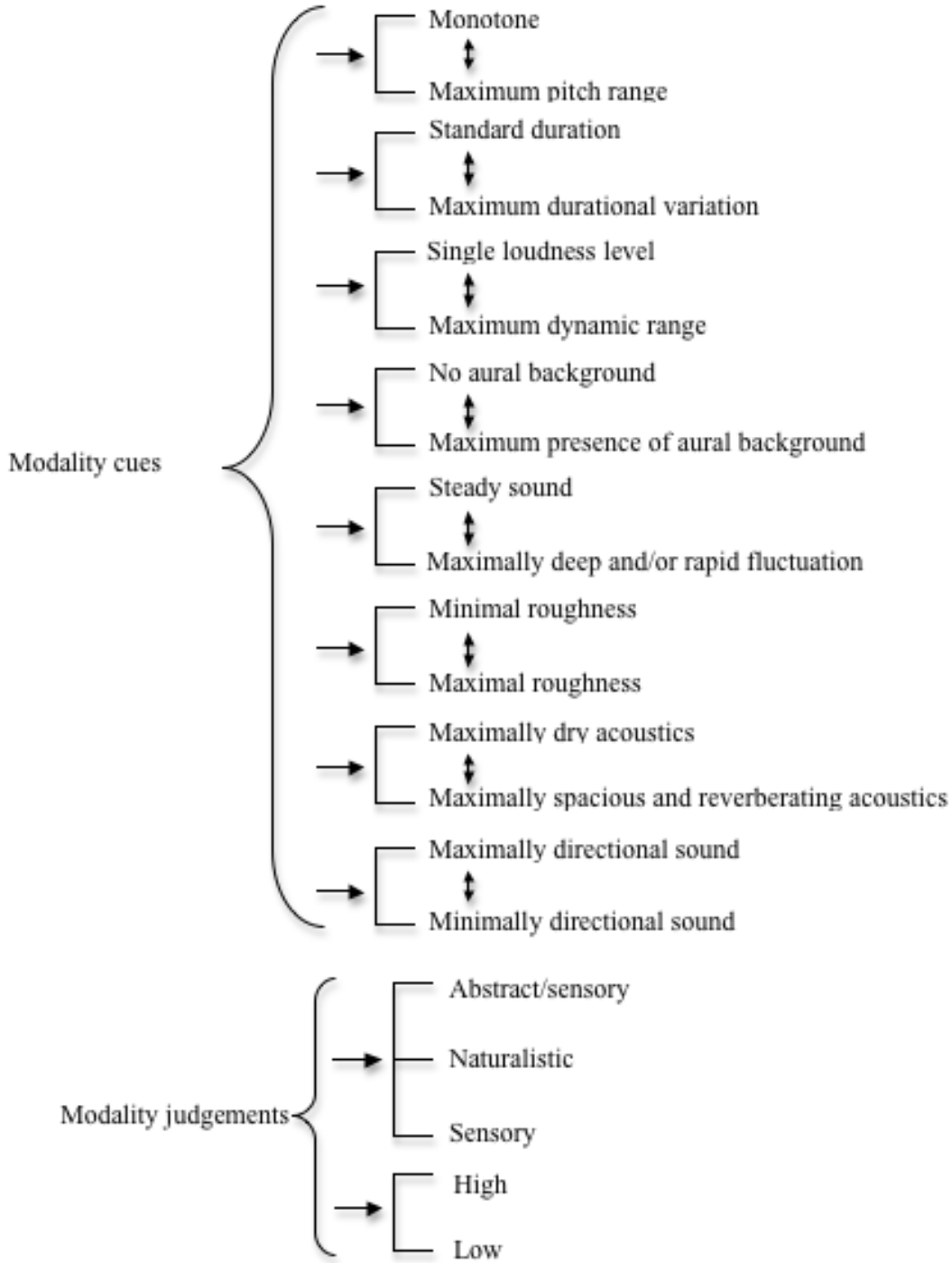

Table 5 System network for modality cues after Van Leeuwen (1999, p. 182)

4.7 The Acousmatic Modality

Electronic amplification gives performers a means to rearticulate the sounds that are produced as part of a performance. A way of analysing this is a discussion of how amplification rearticulates the modality cues proposed by Van Leeuwen. To provide for such a discussion I will introduce one more modality (in its meaning of coding orientation), the *acousmatic* modality. The orientation of this modality needs some discussion. As I described before, higher modality suggests a stronger claim by the utterer for an expression to be true. Regarding this modality that includes a range of performance options, from acoustic, unamplified to very loud amplification, a choice for which aspect of the range is 'true' is always ideological. As we saw earlier, the use of electronic technology could be considered as cheating, an argument supported by the high regards for acoustic (classic) performance; equally found in the suggestion of 'honest' acoustic music at 'unplugged' concerts. If a binary can be identified, it appears not to be so much in amplified versus unamplified but in the use of acoustic versus electric (electronic) instruments, as came forward in Bob Dylan's electric coming out. From that perspective an acoustic performance in a concert hall with a silent audience can be considered 'truest', whereas a performance that needs the aid of electronic technology cannot be very true at all. The values of the euroclassical concert tradition and its well marketed suggestion of class, appear to be finely embedded in Western culture, even though fewer people every year actually attend such performances, learn to play its instruments or listen to its recordings.

An additional point refers, again, to the primacy of recording: amplified performances are becoming like re-enacted recordings, or at least that is suggested. From that perspective we could argue that with increased use of amplification stronger modality claims can be made (a singer can pretend to sing, or have his or her singing brushed up by an autotune). In this way the acousmatic modality ranges in parallel to the level of amplification and to how much the amplified sound is detached from the acoustic source. Because of the lack of transduction effects (ie no microphones and loudspeakers in use) an acoustic performance has low modality; it is furthest away from a recording (even though as discussed in the previous chapter classical performances, for instance,

have an equally reciprocal relation with recorded works). A performance with authentic instruments and historically informed playing styles can have a higher modality, as I proposed in an example earlier, but for different reasons; the 'acousmatic modality' is aimed at technically transduced sound.

Judging from the responses to lip-syncing anecdotes, when it comes to live performance there is a strong preference for someone actually singing, someone engaging with the risk of performance to demonstrate his or her abilities, over someone lip-syncing. From a perspective of modal logic, we are looking at the credibility the utterer bestows on an action. In language, 'always' in the sentence 'I am always right' shows that I proclaim that statement to have a high degree of truth, it has high modality. Both the lip-syncing artist (usually) and an amplified singer (always) use a microphone, for the latter essential, for the former a claim to a higher modality. The singing (not lip-syncing) singer can do something similar; when the repertoire consists of Elvis' songs he or she can use a 'period' microphone instead of a contemporary one. It will look sound, and to the performer even feel different.

One of Moles' key arguments is (cf Eco 1983, Chanan 1994, p. 266): 'There is no real difference between signal and noise except in intent'. From that perspective I argue that the realness or the originality of a reproduced sound is dependent on what you do with your intention, your claim to realness, as that is what is expressed in modality. In contrast to recorded music, sounds produced at a performance and their effects on the experience of musical performance remain ephemeral, making it much harder to analyse. When analysing recorded music we can refer to an existing recording or a publication may come with a CD or a link to a sound file on the Internet.

4.7.1 Rearticulation

Rearticulation implies a process of transformation, in the context of amplified sound some parameters are articulated as a consequence of transduction, others become parameters that allow for a certain amount of new choices. In the next section I go through Van Leeuwen's system network again, outlining in what way these parameters can be rearticulated when electronically amplified. This discussion of rearticulation aims

to offer an inventory of amplification's means of expression. This thesis focuses on music but most of the rearticulations will have a similar effect on speech or sound effects.

These rearticulations take place in what I have called the acousmatic modality. Higher modality implies the performance is more like a recording in a technical sense, ie through the use of lip-syncing or pre-recorded material, autotune etcetera. Low modality can be found when the technology is used with minimal impact, often at lower levels of amplification, or when the performance space is incorporated as a musical parameter by positioning loudspeakers around the audience.[31]

At this point I would like to stress that this methodology is not a goal in itself; it is a means of investigating the relation between music and the application of amplification technology. This is an inquiry into semiotic resources and not about establishing notions of 'truth'.

4.7.2 Rearticulation: Pitch Extent

Pitch can be rearticulated using autotune as explained earlier, the pitch correction technology can be used to enhance a vocalist's performance or to create expressiveness using pitch processing like the 'Cher' effect. Pitch can be 'followed' and used as a parameter; in sound synthesis for instance, this is used in the Vocoder (see Dave Tompkins (2010) book *How to Wreck a Nice Beach*). Another example is what is known as a 'Talk Box' (famous from Peter Frampton's hit 'Show me the way' (1975): a rubber tube connected to a small loudspeaker relays the sound (for instance of a guitar) into a performer's mouth, who can then filter the harmonic content dynamically by changing the shape of the mouth cavity.[32] The resulting sound is picked up by the performer's vocal mike (that usually has the tube taped to it) (see ibid p. 131). A guitar sound modified by the mouth cavity gets a 'talking' quality, hence the name.

[31] Surround sound can be achieved at home of course, but the quadrophonic HiFi systems of the 1970s never caught on. Very few titles that actually use a system such as Dolby 5.1 for playback of spatial compositions are available as commercial releases. Many home surround systems are optimised for enjoying sound effects when watching a movie.

[32] Another instrument using the mouth as a flexible resonator is the jaw (or jew) harp, also known as a mouth harp.

4.7.3 Rearticulation: Durational Variety

Sound can be rearticulated using time stretching ie changing the playback speed of a sound while not changing the pitch. One particular sound engineering technology, which can influence the length of sounds, is the use of so-called 'gates'. They are essentially in use in recording and live sound to reduce bleed into microphones that are used to pick up sources that are not played all the time. They are commonly used on the tom-toms in a drum kit; often these drums are not played as regularly as for instance a snare or a bass drum. When the gate's input comes below a set threshold the output is muted, until that threshold is reached again (ie when a tom is hit). They can be set to respond quickly, closing the 'gate' after a short time, limiting the length of the sound being recorded or amplified.

4.7.4 Rearticulation: Dynamic Range

Dynamic range is always altered as a consequence of the scaling that comes with the transductions. The range from the softest to the loudest note that can be achieved at a performance in a concert hall, with supportive acoustics and a silent audience, is very large. A similar performance on an outdoor stage, with amplification, will not have the support of the acoustics and there will be much more background noise, getting in the way of the softer sounds. An orchestra will have to adapt its dynamic playing at the lower end. The mixer will bring up the total mix when the orchestra plays quietly (and perhaps, if needed, bring down the loud passages, further limiting the dynamic range). A rock or pop band usually has a much smaller dynamic range; often dynamics are created in arrangement, adding layers, for instance by distortion to a guitar. Very soft sounds are hard to realise, there is simply too much other sound going on (audience, air conditioning, moving lights, wind etc).

Still, the person at the mixing disk can actively maintain, increase or reduce the dynamic range. As observed in the second chapter, at a rock or pop concert the minimal level dictated by the sound of a band's backline and monitoring often implies the lowest level is the level at which the amplified sound overcomes the sounds produced by the band on stage, to allow complete control over the balance by the person at the desk.

4.7.5 Rearticulation: Perspective Depth

Similar to the dynamic range, the perspective as created on stage can be changed, enhanced or reduced by amplification. Outside of the classical concert hall new layers may be added, an audience can listen in silence or add another layer by singing along, yelling and screaming. A string quartet playing outside in a pavilion on a sunny Sunday morning will be in the perspective of birds singing in the trees, cows mooing in the distance and depending on how idyllic you picture this scene, planes flying over or a nearby highway humming. In the late 1990s the City of The Hague organised a series of concerts of 'tape music' in the atrium of the city's town hall. The works by famous electronic music composers such as Jan Boerman were accompanied by the alert beeps of the many elevators coming and going, offering a great perspective on the size and acoustics of the venue.

Amplification can also allow us to zoom in, to enter into the physicality of sound producing objects. I recently witnessed a hydrophone (underwater microphone) in a small rectangular aquarium that was being played with the sounds of the microphone digitally transformed.[33] Nicolas Collins, the author of the book *Handmade Electronic Music*, created a video installation called *Tall Poppies* (2009); on four screens it shows sparklers burning with the sound waves in the sparkler's rod, transduced and amplified, and played back.[34] Such an application of amplification allows for zooming in sonically on the material of the rod, not unlike Cage's use of cactuses. Near the end of the clip the sparklers have burned out and the cooling down of the rod can be heard, spectacularly sounding the reactions in the metal.

Legendary Dutch composer and sound artist Dick Raaimakers' work *Twelve ways to silence a microphone* (1992) is an even more literal example of a microphone's perspective. Amplified microphones are destroyed in twelve different ways, while 'reporting their own doom through loudspeakers' (Brouwer & Mulder 2008), zooming in on the actual microphone.

It is not uncommon to place microphones, for recording or amplification, inside certain instruments, either to achieve a desired sound: for instance inside percussion

[33] Diffuse concert series 2, Bon Marche Studio Sydney, 31 May 2012, hydrophone: Sophea Lerner, digital sound transformations: Jon Drummond.
[34] Clips can be seen an heard on www.nicolascollins.com/tallpoppies.htm <viewed 3 July 2012>

instruments like a kick drum, or a cajón. Or, sometimes, in loud environments (string sections with a rock or pop band) microphones are put inside instruments to transduce with enough gain in comparison to the bleed of other instruments. To allow piano players to have sufficiently loud monitoring, without feedback, microphones can be 'stuffed' in the round holes in the sounding board.

4.7.6 Rearticulation: Absorption Range

Absorption range in performance has two aspects, the acoustics of the space the performance is in and virtual acoustics that can be added. In some rock and pop idioms a vocalist's voice is supposed to be as dry as possible, 'in your face'. As we saw before, classic rock and roll needs specific echo(es), a soulful ballad is often enhanced with the sound of a large reverberant room (a room response that may have nothing to do with the actual room a performance is in). Some performers want to be in control of their 'own' effects, like guitarists. For instance Casper Clausen, lead vocalist of the Danish band Efterklang uses his own little effects unit at his feet, so he can select and turn the desired reverb or echo (or combination) on and off.[36] That example points particularly to an important bit of live sound craft, as soon as a song is over the mixer usually mutes the signals going to effects units (eg reverberation, echo), to allow the vocalist to make whatever announcement, without echo or reverb that will conflict with the intelligibility.

4.7.7 Rearticulation: Fluctuation Range

Fluctuation range is not a very common parameter to work with in amplified sound, although it is very well imaginable to add Low Frequency Oscillation (LFO) to a mix or part thereof. LFO essentially mimics vibrato by generating a low frequency waveform that slowly modulates a sound. It is used selectively in pieces that use ring modulators, it can be added to synthesised and sampled sounds, and it is a parameter in many digital reverberation units and plug-ins.

The so-called Leslie Cabinet or 'The Leslie Rotating Tremolo Speaker System' (after its inventor Donald Leslie) is famous in combination with a Hammond organ but has been used with many sources, for instance on the vocals of 'Tomorrow Never

[36] I saw Efterklang at the SOH, with the Sydney Symphony Orchestra 26 May 2012.

Knows' on The Beatles' 1966 album *Revolver*. 'Leslie' connoisseur Clifford Henricksen (1981) writes:

> First and foremost, the Leslie Rotating Speaker is designed as *a sound modification device*. It is not a "Hi-fi" speaker, but rather a part of a musical instrument. You buy a Leslie to *change* the sound of an instrument, not to reproduce it.

In a Leslie two horn loudspeakers are rotating combined with a stationary low frequency woofer with a spinning rotor to direct the sound. The moving sound sources create a tremolo but the Doppler (see §2.7.1) effect as a result of the moving sound sources creates a modulation of the frequency (although distinctly different from vibrato). The speed of the rotations can be set, changing the rate of the effect.

One of the projects of Bongers' and Impett's 'Meta Orchestra' (see Harris 2004; Impett & Bongers 2001) took place in the old tweed mill at Dartington College of the Arts (Devon, UK) in 2000. All the sounds produced by the performers were routed to a digital mixing desk and from there directed to a number of loudspeaker systems in different rooms. Impett suggested using the motion of the old but functional water wheel of the mill to modulate the volume of all the inputs, which also looked very nice with the 'flying' (ie automatically moving) faders of the mixing desk moving up and down at the pace of the wheel.

4.7.8 Rearticulation: Degrees of Friction

Friction is one of the ways of generating sound in addition to for instance blowing air, hammering and plucking; the friction of a bow on the strings of a violin is what generates the vibrations of the string. Although the sound of a violin can be smooth, pressing down harder with the bow emphasises the friction and creates a rougher sound. In amplification a choice can be made to aim a microphone, or bring it closer to, where the bow touches the strings, to pick up more of the friction's sound. This parameter has a certain direction: it is very easy to make a smooth sound rough; the other way around is much harder.

Perhaps it can be realised in the digital domain, but it would require serious computation to achieve in real time (currently available computing power may not be sufficient).

Distortion as a source of roughness can be added to a guitarist's sound but it can also be added at other stages and to other sources. Some singers have two different microphones set up, a regular 'clean' mike and a 'dirty' mike, for instance, singer David Edwards of the band 16 Horsepower. The dirty mike can be a perfectly ordinary working microphone that is being distorted further down the line, or an older microphone that easily distorts or otherwise sounds very particular. It allows vocalists to switch between a clean and a distorted (or a distant) sound when they feel like it, or as per usual for a certain song. Edwards in an interview in Belgian Newspaper 'De Standaard' (24 September 2002) states:

> In front of him are two microphones, one of which is designed for mouth-organs, which sounds like a distant phone call. Edwards: "It is a microphone from the 40s. A friend once bought it for ten dollars at a jumble sale. I love working with the close-remote contrast. Depending on the mood I'm in, I bring in a different emotion and bend towards another microphone. We often bring different versions of our songs, acoustic or electric ones, using different instruments." [37]

4.7.9 Rearticulation: Degree of Directionality

As emphasised earlier, loudspeakers have a very different relation to an acoustics from a musical instrument (what caused Philippot to call them point sources). They are more directional, like a trumpet, funnelling most of the sound in one direction. Modern line array loudspeakers are much more directional (but as with all transducers, becoming omnidirectional for lower frequencies).

An acoustic ensemble or an orchestra is much less directional, relying on the room's acoustics. For instance in some concert halls audience members may be seated in the 'choir stalls' behind the orchestra, where the balance may be slightly different, but by all means acceptable, even with vocal music. At amplified concerts these places are very problematic, for instance because these people are seated behind the loudspeakers

[37] Translated citation from www.16horsepower.com/destandaard240902.html <viewed 1 July 2012>

addressing the people in the auditorium, only hearing low frequency sounds (loudspeakers are omnidirectional for the lowest frequency range).

Loudspeakers flanking the proscenium (if there is one) emphasise the surroundings that are suggested around the stage by creating what could be called a sonic frame. When there is no proscenium the location of the loudspeaker, left, right and sometimes above the centre stage may be perceived in the same way, suggesting a frame that produces the sound. Such a sonic frame, when compared with an acoustic ensemble, is much more two-dimensional with the loudspeakers in one plane. Serge Lacasse (2000, p. 42) suggests that in the classic Greek theatre dimensions were limited as well: 'Because of the distance and the shallow stage, the Greek audience had the impression of looking at a carving in relief'. Barthes starts his essay *Diderot, Brecht, Eisenstein* (Barthes & Heath 1978, p. 33/4) by writing that 'status and history' have linked mathematics (here in the sense of geometry) and acoustics since the ancient Greeks. The act of cutting out (ie creating a frame) is, according to Barthes, one of the foundations of representations, although he excludes music:

> The scene, the picture, the shot, the cut-out rectangle, here we have the very *condition* that allows us to conceive theatre, painting, cinema, literature, all those arts, that is, other than music and which could be called *dioptric arts.* (Counter-proof: nothing permits us to locate the slightest tableau in the musical text, except by reducing it to a subservience to drama; nothing permits us to cut out in it the slightest fetish, except by debasing it through the use of trite melodies).

The two-dimensional frame, can be described in a metaphorical sense as the acousmatic curtain, as Luke Windsor (2000, p. 31) observes:

> … the acousmatic curtain does not merely serve to obscure the sources of sounds. Indeed, it can be seen to intensify our search for intelligible sources, for likely causal events.

This brings Altman's 'Sound Hermeneutic' to mind: 'the sound asks where and the image says: here!' When the amplification is loud enough and drowns out the acoustic sounds, adding sonic dimensions will have to be done with the loudspeakers as a reference (ie panning, reverberation etc). The 'framing' of amplified sounds brings interesting consequences, for instance, in an opera with reinforced voices (ie at a low level), which may sound very natural when all goes well, but when a performer turns around to face another direction the balance between acoustic and amplified sound may change with the localisation now going to the loudspeaker, accentuating the use of amplification.

From a perspective of modality I would argue that louder amplification creates a stronger frame, creating a 'more cinematic' sound and as such a 'more recorded' sound with higher modality. The sonic frame becomes like the strict formal layout of the imageless textbook, in comparison to the freer, organisation of the medieval manuscript.

Multi channel amplification, with loudspeakers surrounding the audience can be used to enhance dislocation, creating spatial effects that may fool (or confuse) hearing and seeing. There are many works for (amplified) on stage ensemble with multiple channels of loudspeakers around the auditorium, but often these loudspeakers are used for electronic material that contrast with the instrumental sounds (eg Stockhausen's *Kontakte*). In Stockhausen's *Michaels Reise* the sound of the trumpet (the prominent soloist) is at times played back through the surrounding loudspeakers; six microphones are set up in a semi-circle, each routing the sound to one of the six surrounding loudspeakers. When the trumpet player plays into one of the microphones his sound comes out of the corresponding loudspeaker. The instrument is seen (and to an extent heard) being played on stage with the sound coming from a loudspeaker outside of the visual 'frame'. As prescribed in the score (Stockhausen's scores are meticulously detailed regarding the use of sound technology), the microphones for the ensemble are routed to one or more (neighbouring) loudspeaker systems. At one section of the opera ('Halt!') the notes of certain chords are divided over the instrument groups and passed on in such a way that, as a consequence of the routing, chords appear to be rotating around the loudspeaker systems. This works best when there is sufficient separation, more sound coming from the loudspeakers than from the sources on stage. Also as mentioned in the discussion of mixed music (in chapter two), techniques like this work better in positions

that are equidistant to the surrounding loudspeakers. Seats closer to one loudspeaker system offer a reduced sonic experience of the concert.

With spatiality becoming a parameter and with the added potential of the play between visual source and dislocated sound, surround loudspeaker setups can add to the complexity of musical performance. This may provide an explanation for such explicit dislocation only featuring in 'art music' and not so much in other musics. One notable exception is the quadraphonic Pink Floyd concert at the Queen Elizabeth Hall in London, 1967. Two extra loudspeaker stacks were set up in the left and right rear corners, forming a four channel, quadraphonic system with the FOH stacks left and right of the stage. A control device incorporating a crude joystick was build by Bernard Speight, one of the engineers at London's famous Abbey Road Studios. The device was dubbed the Azimuth Coordinator, it could dynamically route a single sound input to four (or six) outputs that were sent to the loudspeakers. With the joystick in the centre the sound would come from the four channels equally loudly, positioning it in the centre of the room, moving the controller to the top left corner would 'pan' the input sound to only the front left loudspeaker etcetera. The sources I found only mention pre-recorded material being used in addition to Rick Wright's keyboards; Wright also controlled the Azimuth (Calore 2009; Thanasis 2004).

According to Kittler such moving sounds do not just add to complexity but refer to straightforward brain damage (Kittler 1984, p. 145) after the Pink Floyd song 'Brain Damage':

> The lunatic is in my head. The lunatic is in my head... Zu deutsch: der Hirnschaden ist angerichtet und ein Azimuth Coordinator am Werk. Wenn Klänge, durch den ganzen Hörraum steuerbare Klänge von vorn und hinten, rechts und links, oben und unten auf taugen können, geht der Raum alltäglichen Zurechtfindens in die Luft. Die Explosion der akustischen Medien schlägt um in einen Implosion, die unmittelbar und anstandslos ins Wahrnehmungszentrum selber stürzt.

> …the brain damage has been done and an Azimuth Coordinator is at work. When controllable sounds appear everywhere in the listening space, front and rear, right and left, top and bottom; one's bearings are lost. The explosion of the acoustic media turns into an implosion, which falls directly into the centre of perception itself… (My rough translation)

Kittler's article discusses the madness of Pink Floyd's initial member Syd Barrett who left the band in 1968, but he is also referring to the estranging experience of moving sounds without a visible moving cause (the lack of a Doppler effect may add to that as discussed in §2.7.1). The three verses of the song, for Kittler, refer to three stages of reproduction technology, mono, stereo and multi channel: 'The lunatic is on the grass', 'The lunatic is in the hall' and finally 'The lunatic is in my head'.

In other situations a sound system may be designed to become directionless, for instance in a discotheque or at a rave where the aim is to immerse an audience in sound (see Emmerson 2007, p, 161).

4.7.10 Complexity

I want to propose one more parameter that can be used to express the tension of detached sounds: the *level of complexity*. It is of interest here because the use of amplification can increase the complexity of a performance, for instance as a consequence of intentional dislocation and the estranging effect of performative sound not coming from the central direction of vision. Complexity can be added as an extra element to Van Leeuwen's system network. Levitin (2007, p. 234) describes the inverted U that is the curve of our musical appreciation; we appreciate music up to a certain (obviously subjective) level of complexity, if it gets more complex we stop liking it, and our appreciation goes down (cf Berlyne 1971). In a two-dimensional diagram with complexity on the x-axis and appreciation (provided one can agree on it being quantifiable) on the y-action, the latter takes the shape of an inverted U with increasing complexity, Levitin (ibid):

> The inverted-U hypothesis is not meant to imply that the only reason you might like or dislike a piece of music is because of its simplicity or complexity. Rather,

> it is intended to account for this variable. The elements of music can themselves form a barrier to appreciation of a new piece of music. Obviously, if music is too loud or too soft, this can be problematic. But even the dynamic range of a piece – the disparity between the loudest and softest parts – can cause some people to reject it.

Other authors have looked at the relation between music and complexity; Moles (1966) famously approached musical aesthetics from a perspective of information theory. Umberto Eco (1989, p. 63) commented in his *The Open Work*:

> He (Moles) clearly accepts the notion that information is directly proportional to unpredictability and sharply distinct from meaning. What intrigues him most is the ambiguous message – that is, the message which is at once particularly rich in information and yet very difficult to decode.

Complexity can be found for instance in music with large pitch ranges or multi dimensional spatial presentation. Unfamiliar ways of organising pitches (twelve tone music for instance, or alternative tunings such as found in the work of American composer and instrument maker Harry Partch) can add to complexity as well. A large dynamic range can equally add to complexity (but not in the way Philippot suggested as discussed in the literature review), a concert with occasional very soft sounds (eg a late romantic symphony) needs a different, more introverted listening strategy than the smaller dynamic range of a pop concert. I am adding complexity in this context to analyse the complexities that sometimes come with the use of amplification. There is the matter of the detachment that may be estranging, but in some specific cases intentional dislocation is used in compositions, which I will in the next sections.

4.7.11 Balance

Besides the parameter perspective Van Leeuwen did not include the balance between instruments or other sources in his system network. One of the most obvious things that can be done when amplifying music is a rearticulation of the balance that is made by

performers on stage. Even when there is just one performer the amplification rearticulates the balance between the acoustic sounds, the amplified sound and the natural acoustics. Balance is always more than a number of sound sources being equally loud; it is always intertwined with matters of timbre and musical functions (our hearing, musical instruments, room acoustics and transducers all display non-linearity). A polyphonic musical perspective is common: accompanying 'voices' may be softer than voices creating a dominant melody. Mixing can be approached by working 'up', turning up sources that are not loud enough; instead, mixing craft is recognising which instrument can be made softer so balance is restored or maintained. In the latter strategy, ultimately subtle adjustments can be made in the timbral aspects of individual sources (ie filtering), in the former lies the risk of increasing the amplification level in trying to maintain a balance, the concert will end much louder than it started.

I will further discuss this aspect in the next chapter, looking at agency in relation to balancing rather than what can be expressed through balance in itself.

4.7.12 Rearticulation and Modality

Van Leeuwen's articulation parameters make up a comprehensive list of semiotic features of sound, which I have adapted here to capture the meaning potential of amplification. In addition to having meaning potential the parameters can be examined to discuss the modality of sound; they cue modality judgements. I reused the list of parameters in the specific context of amplified sound suggesting a new coding orientation, the acousmatic modality. Again that list of rearticulated parameters combines meaning potential with modality judgements, now incorporating the added dimension of authenticity. As mentioned, questions of authenticity arise with reproduced sound, and with the primacy of the recording even more so in the special situation of amplification: reproduction in the presence of the reproduced source. Not surprisingly one of the most important articulations particular to amplification is what it does to directionality, given the dislocations that come with its use.

4.8 To Review

In the previous paragraphs I have described a social semiotic approach to identifying and analysing the ways in which amplification can make meaning, or how amplification becomes a semiotic resource. The social semiotic notion of meaning making as an activity, in relation to, as argued in chapter three, the intentional use of the technology, raises questions of agency, which are further explored in the final chapter. The rearticulations of Van Leeuwen's modality cues give a perspective on how amplification becomes a parameter in relation to the music itself. The most valuable consequence of this multimodal approach is the light it shines on the versatility of the use of this particular technology. Instead of a notion of contrariety, amplified versus unamplified, a whole gamut of applications and networks of choices can be identified. The multimodal rearticulations are discussed in the light of an acousmatic coding orientation that incorporates the consequential dislocations of electroacoustic technologies, and the primacy of recorded music, which is as such maximally dislocated (of space, time and causality).

5 Agency

5.1 Agency

> *Multimodal social semiotic theory deals with meaning and meaning making; with sign-making and signs. 'Making' implies a 'maker'; hence agency is central. Making has effects; and the various effects need naming.'* (Kress 2010, p. 107)

Earlier in his book *Multimodality* Kress (ibid p. 66) invokes the social aspects of agency: 'I stress the agency of socially formed individuals acting as sign-makers out of socially shaped interest with socially made resources in social interactions in communities.' The use of amplification at musical performances, as I have argued in the previous chapters, is not something black and white, it is not either amplified or unamplified, a simple matter of flicking a switch. And even if it were, there would have to be an agent with the authority, or who created consensus, to flick that switch. Amplification adds to music; it is a mode that adds meaning potential to performances of music. There are many different ways and reasons to use amplification incorporating different sets of stakeholders at each occasion. Each of the stakeholders, but some more than others, can be a decision-making agent in relation to how and why amplification is used.

5.2 Semiotic Choices

The multimodal rearticulations explored in the previous chapter describe several expressive parameters that can be used in electronically amplified musical performance. The rearticulations can be a specific goal of a design, whether a score or a plan for a loudspeaker system. To achieve certain rearticulations a number of choices have to be made specific in a design. To achieve pitch correction the amplification has to be loud enough to drown out the acoustic source (and with it the initial pitch that needs to be corrected). For a multi channel set-up surrounding an audience there has to be room to do so safely, without losing too many seats etcetera.

As I argued in the literature review, in the discussion of authenticity and originality of the transduced sound the intention of transducing a sound and the choices made in relation to that transduction make the reproduced sound into a new, original, sound. Looking at agency in amplification practices will allow teasing out matters of intent: what is the function of the amplification? For instance in the light of Emmerson's functions, or, who decided that a particular concert should be so loud?

In the previous chapter I argued that many parameters related to the amplification of music hold semiotic choice. I identify three crucial parameters in which agency, and as such intention, plays a big role:

1. Choice of venue; apart from many other (location, transport etcetera), two factors are important in this context:
    a. Acoustics: from dry to reverberant; including possibilities of adapting the venue to the functionality of amplification (ie moving panels/curtains/ electronic resonance systems etcetera).
    b. A choice of venue is also a choice for of decorum, which can equally be appropriated; pop in a concert hall, a rave in a church, a string quartet in a nightclub.

2. The sound system design, in accordance with the desired functionality and amplification level. This can be very straightforward, using the system available in a venue (the 'house PA') or a very detailed plan made particularly for a performance. Loudspeaker choices can be subdivided:
    a. Directionality: very directional, offers some control over acoustic response.
    b. Position: from local amplification (loudspeaker very close to acoustic source) to a 'frame' surrounding the proscenium or a multi channel set-up.
    c. Visibility: prominent or kept out of sight.
    d. Power dimensions, in relation to the desired amplification level.

3. Microphone choices
    a. Microphone directionality (or contact microphones).
    b. Position and distance, close miked or further away.
    c. Visibility: prominent or kept out of sight.
    d. Acoustic isolation of sources (eg a drum kit surrounded by plexiglass to prevent bleed into other microphones).

Microphone (typology) options are often dictated by the loudspeaker choices and acoustics, and accordingly, loudspeaker choices are often dictated by size and shape of a venue. In an ideal world, for every concert an ideal venue could be chosen with the other options filled in following the desired function of the amplification. But the choice of venue for a particular event is usually a question of size and availability. Or if the concert is initiated by the management of a concert hall the venue is a given, unless one organisation has different venues.

These resources are given shape by a repertoire of options, most concerts within a certain tradition, with its own decorum, are very much alike, and the choices offer few surprises. Both the resources and the repertoire can be added to, with new or changing technology. Sometimes a composer or performer makes new, possibly daring combinations reinterpreting or reshuffling resources.

Before discussing these three semiotic 'moments' in relation to agency I will describe three groups of stakeholders. Then I will focus on a vital stakeholder, the audience; they are usually excluded from decision-making in the three semiotic moments I listed, and their agency is not always considered. Even though as a stakeholder audiences are crucial (no audience, no performance, but also in terms of critical reception) their agency is very limited.

5.3 Stakeholders

The stakeholders in this particular debate are different parties with an interest in the use of electronic amplification and its results at a particular event. The list can possibly be extended; here it is limited to those directly interacting and participating in concerts of amplified music. The first group of stakeholders is directly involved in realising concerts

and directly benefits from an event's success. They are directly, actively or passively involved in matters of amplification but may have different or even conflicting agendas.

Stakeholders	**Interest, role**
Audience	They are ultimately the consumers, and as such the client. If the sound is 'bad' or too loud patrons may not come back to a venue, or stop endorsing the performers. They are not usually represented as a stakeholder, but can complain as individuals afterwards and sometimes during a performance.[4]
Musicians	They are the providers of acoustic, electric and sometimes only gestural input. They are marketed as the 'product'; they also have to be empowered to perform well. Often represented by a tour manager and/or agent, or at times a musical director.
Venue (management)	Can take up the additional role of promoter. Usually represented by a production manager and or technical staff. Responsible for programming, which is strongly linked to that venue's marketing strategy and decorum. Have to protect a reputation, are often bound by regulations or possible liability.
Promoter	Sometimes a venue acts as promoter. External promoters can act as middlemen between artists' agents and venues, participating in the financial risks (and obviously gains).
Sound engineer(s)	Mixer, monitor and system engineer are mediators between the other stakeholders. They can be representatives of the performing musicians, of the venue or an external sound hire firm (or a combination of those).

Table 6 Primary stakeholders

A secondary group is formed by commercial organisations that supply amplification technology, crew and often transportation. They hold lesser stakes but decisions regarding equipment and personnel choices can influence the outcome of the concert. Decisions are made on logistic and budgetary grounds; ie the top-notch gear may be in use at a different venue, or not fit the customer's budget.

[4] 'Bad' sound is not easily defined, but excessive loudness or imbalances in the tonal spectrum (eg 'too harsh' as in too much treble) are regular problems.

Stakeholders	Interest, role
Sound hire (Venue)	A sound system can be provided by a third party, represented by a system engineer and other 'local' crew. In some cases the system engineer takes on the role of mixer. In other cases the system engineer assures the mixer (a 'guest') complies with technical guidelines (or rather 'best practice') and sound level maxima.[5] It is a very competitive business particularly at reputable venues. The firm needs to maintain good relations with a venue, at low prices.
Sound hire (Tour)	At other times sound hire companies can provide a complete or partial (ie only monitors and backline) sound system and staff for a number of concerts (ie a 'tour').

Table 7 Secondary stakeholders

The third group is only indirectly involved but can be influential over longer periods of time. A city council may decide to develop a (reverberant) concert hall that is very good for orchestral music, or a very dry (absorbent) room that is great for bands. Alternatively, multi purpose venues that try to provide for both, either accepting a compromise with regard to acoustics, or aiming at acoustic flexibility with adaptable systems (ie electroacoustic systems, moving panels and ceilings etcetera).

Neighbours	People living in the immediate vicinity of a venue who can be inconvenienced by noise leaking into their private domains. In the case of open-air events this can add up to a large number of people.
City councils, local government	May be inclined to create rules regarding noise pollution or hearing-loss prevention. Additionally they may be involved in developing venues through subsidies or with commercial partners.
Broadcast, recording	In the case of a live recording or broadcast, particularly in reverberant halls, loud amplification can have a negative influence on the sound quality. Microphones

[5] A role commonly referred to as 'baby sitting'.

	are shared which can complicate the microphone choices.[6] In the pre-digital era 'splitting' the input signals could lead to audible technical problems (eg rattle and hum)
Critics	The newspaper critic's (a professional writer on a payroll) role has changed significantly, now that anyone can review anything on the internet. But traditionally newspaper reviews often only referred to amplification when it was considered bad.
Ticketing companies, booking agencies	In the contemporary model concert, museum and sports tickets are sold by big, almost monopolistic organisations, a business model strongly supported by the internet. Through liaisons with booking agencies they can play a dominant role in promoters and venues' programming options.[7]

Table 8 Tertiary stakeholders

In this chapter I limit the discussion to the first group of stakeholders, for a close examination of the use of this technology and matters of agency.

5.3.1 The Audience as Stakeholder and as Agent

> *an early '70s performance in a (sic) Queens park was interrupted by a man banging on Glass' keyboard and shouting: "How can you call this music?!"*
> Kurt Munkacsi quoted in Hermes (2008)

The notion of the audience as stakeholder at (amplified) concerts is looked at from two perspectives; beginning with the audience as agent, or individual patrons as agent, followed by the different sets of rules that come with the decorums of venues and concert traditions. An observation by Goffman (1981, p. 138), is also relevant to the situation of the audience: when compared to people engaged in a conversation, an audience has 'given up the floor'; but they have gained the right to observe directly. Different from

[6] On the up side, radio and recording crews usually bring microphones of much higher quality (and value) when they come to record a concert; which live sound crews are usually more than happy to use.
[7] For instance the global booking agency Live Nation merged with Ticketmaster in 2010 forming a global monopoly that met some resistance from antitrust and competition regulatory bodies (see Van Buskirk 2009).

‘listeners’ or ‘viewers’ of a broadcast audience (on radio, TV, internet), who can always consider changing the channel, live witnesses ‘are coparticipants in the social occasion, responsive to all mutual stimulation that that provides.’ The idea that the audience ‘gives up the floor’ is interesting at amplified concerts where performers have given up control over how they are heard, underlining the intermediary role of sound engineering. At rock and pop concerts however, the audience has given up the floor to a lesser extent, as they can sing and dance along and express themselves almost to their hearts’ desire.

Audiences have no say in the loudspeaker system design or the choice of microphones and only in rare cases do they express their opinion about amplification levels or balances. It is common for people to wear earplugs at rock and pop concerts when they experience the amplification (or the other screaming patrons) as too loud, or fear for hearing damage (sometimes disposable earplugs are provided at pop and rock venues). Wearing earplugs reduces the audible frequency range, diminishing sonic fidelity; that suggests that hearing what is going on is not necessarily more important than other aspects of the experience: seeing what is going on, singing and/or dancing and simply being present. Additionally, in the world of fandom, being in the same space as an idol might be an essential aspect as well.

The audience has no say in the complex compromises a mixer makes in terms of musical balance. This is complex on different levels: dealing with acoustics, the relation between performers’ foldback and the front of house level, but also as an intermediary between the performers (for whom it is very hard to judge what exactly the audience hears) and the audience. An interesting but theoretical exception is the Clair Brothers personal PA system for which that firm acquired a patent.[8] For every patron there is a set of small loudspeakers (or headphones) with controls for volume, equalisation and time compensation with regard to the distance from the stage.[10] Although this system does not offer a say in the balance, each station receives the same mix, individual audience members have some control over what they hear, on an individual level to some extent.

[8] ‘Enhanced Concert Audio System’ Clair Bros. Audio Enterprises 1999, patent nr. US RE38,405E. I am not sure if it has ever been installed and used. Clair Bros. is a well-known sound hire firm and loudspeaker producer from the USA, operating globally.

[10] Equalisation most likely in the form of the Bass and Treble controls such as found on many HiFi installations.

A concert review in the *Guardian* (Beaumont 2012) of a recent Lou Reed concert in London's Royal Festival Hall, opens with a rare example of (attempted) agency: 'One song in, a foolhardy masochist dares to commit heckler's hara-kiri. "Louder!" he shouts at Lou Reed', who replies: 'Not loud enough for ya, asshole?' One other rare example occurred at a Lou Reed concert at the Concertgebouw I witnessed as system engineer, in the early 2000s. All went well; the amplification levels were low so as to not trigger the reverberant acoustics. The drummer had setup in a see through enclosed drum booth, and Reed had urged his band to keep it down (and turned down his own guitar amp) reducing the backline and monitoring levels. Unfortunately, in my role as system engineer, I had failed to convince Reed's mixer that using a sub low in abundance is not a very good idea at that venue, drowning parts of the audience in resonating low frequency bass sounds.

During the show, a patron in the front rows decided not to take it anymore and unplugged the subwoofer (loudspeaker) that was standing on the floor in front of the stage, a daring act of agency. The concert hall was not designed with loudspeaker systems in mind, leaving very few options to position loudspeakers without blocking sightlines. Usually loudspeakers are physically out of range or reach from the audience, but when they are it occurs that patrons take control, turning the speaker to face another way, turning it down when that option is available, or unplugging the lead(s).

Audiences have very few options when they are discontented with the audible result. Patrons may walk out, but in a concert hall, sometimes the constrictive arrangement of the seating makes it impossible to do so unnoticed or without disturbing other visitors. Lee (1998, p. 72), as part of the Dylan saga, mentions people walking out at the beginning of the second, 'electric' set (before the intermission Dylan played on his own on an acoustic guitar): 'There were a lot of people who quite deliberately and conspicuously walked out as soon as the musicians walked onstage after intermission. Like they'd sat through the intermission so they could make this walk out protest thing.' Walking out is often a demonstration of disagreement, and in addition to the possible hindrance to others, effectively communicating that sentiment. Occasionally people approach the mixer at the desk with complaints, or even suggestions, which is a direct way of breaking with the notion that the audience has no voice in matters of the balance and amplification level. In turn disturbing the mixer in his task may cause him or her to

not respond well to what can be perceived as criticism of their work, which hints at an overarching problem: audience response should be valuable feedback in the process, they were not allowed in during the sound check after all. The mixer has been accorded the 'power of the balance' including the overall level, by the artists on stage and by the organisers of the concert.

Perhaps this is a step that the vocal and direct Dutch people take more easily, but particularly working in the Netherlands I have been approached by people venting their spleen, usually during an intermission. An anecdote: during the interval of a concert by Bulgarian folk musicians (who insisted on performing amplified) I was approached by a patron who started the conversation by stating that I had to 'understand that she was particularly knowledgeable about this music and that the balance she was hearing was wrong, the violin should be louder.' I tried to give an explanation of the long sound check and discussions with the ensemble's musical director before the concert, but my indirectly questioning her (self proclaimed) authority rather offended her.[13] At a concert of this type it is very hard to find a compromise of reinforcement without the result being too loud (which in turn would result in complaints), while maintaining the balance between one single violin and the rest of the ensemble, a darbuka in particular.[14]

Alternatively patrons may complain to ushers who can relay issues to the mixer or a production manager, and ultimately customers can complain afterwards, in person, by phone or in writing. In my archival research for my Masters' thesis looking at a history of jazz concerts in the Amsterdam Concertgebouw I came across several interesting examples, some of them very detailed in describing their experiences and as such valuable documents in the history of amplified music. One more anecdote underlines the multifaceted problem of having several stakeholders with not only different ideas of what constitutes the best result, but also having different agendas. Again at the Concertgebouw, but a common feature of concert halls, there are seats behind the orchestra facing the audience, usually referred to as 'choir stalls'. As remarked earlier, at

[13] Rather than trying to offer disappointed patrons an explanation there is a long standing tradition of acknowledging their concerns, promising to change something and then not doing it, even to the point of leaning over the mixing desk pensively and turning a random (not assigned) dial, uttering 'here this should fix it.'

[14] The darbuka is a goblet drum that balances very well with any other instrument, when played outdoors. Playing it in a reverberant concert hall helps that instrument (like many percussive instruments) so much that it is complicated to balance it with anything else.

orchestral concerts, or rather at unamplified concerts, this is not a problem, not even when it comes to vocal music, when patrons are watching the singers' backs. Some people prefer to sit in those sections so they can see the conductor frontally. At amplified concerts, having loudspeakers face in an opposing direction to the main loudspeaker system is problematic, at least in such a reverberant space. The additional loudspeakers address the extra seats but at the same time create more unwanted reflections from the walls surrounding the stage. Those walls play an important role in the acoustics at unamplified concerts, but the reflections are undesirable for amplified concerts (which can be diminished by rigging curtains or drapes covering the wall). For a mixer to find a balance between what patrons in those sections hear, without actually being able to monitor during a concert, is not always straightforward. At a sold out concert of Miriam Makeba and her band the choir stalls were packed. The band travelled without a mixer so as system engineer it was my task to mix, which was obviously a great and rare opportunity with an artist of such stature. I was very pleased with the results, her band was very experienced and recognised they had to keep the levels down on stage, leaving room for dynamic range. That made it easy to create a mix at a low amplification level, not triggering too much response from the famous concert hall's natural reverberation. Several people came to the desk afterwards to say they appreciated the low level and thought it sounded great, which of course made me feel very good about the evening. That feeling was thoroughly diminished the next day when I heard there had been a complaint from a patron in the choir seats, who was very dissatisfied with the sound. My strategy to keep levels low had backfired, resulting in imbalances for patrons in the problematic seats. As a sound engineer aiming at 'good' sound at adequate levels with no complaints I would (and did) argue that it would be much better not to sell any of those seats, from a technical perspective a good argument. But a few years later, working at the same venue as a production manager, ie as a different stakeholder, and familiar with more aspects of running a concert hall, made me change my stance. 'Bums on seats' is vital, more available seats means more tickets to be sold, changing the way I would evaluate compromises between perceived sound quality and optimal distribution.

5.3.2 Concert Rules

Electronic amplification at a concert affords dancing, singing along, screaming and other noisy signs of appreciation. But as described in the practice of amplifying music the audience is not an influential agent. As Goffman (1974, p. 128) writes more generally:

> The iron laws of stagecraft apply: the audience can only be asked for their attention, considerateness, and a fee, and the actors have the right to stage the whole thing again before the next night's audience.

Patrons are required to abide by a number of rules, in line with the decorum of the relevant tradition, for instance: arrive before a concert starts; put coats in a cloakroom; sit in a designated chair; do not take photos, or make recording, switch off mobile phones etcetera.

Obviously there are also rules for the other stakeholders; most venues, unless structurally supported by external funding, have to abide by market laws to stay in business. Similar to other technologies there are many rules and regulations that need to be followed. In the entertainment industries there are rules (and procedures following those rules) to ensure the safety of audiences and creating safe environments for the working professionals involved. Such rules can limit or enforce the options for loudspeaker stacking and rigging positions, which may not be optimal for a specific system design.

Opera houses and theatres have a long history of burning down, particularly before the invention of electric light, but it is not a thing of the past; in 2003 mismanaged pyrotechnics caused a fire leaving 100 people dead and 230 injured at the Station Nightclub in West Warwick, Rhode Island (cf Feuer 2003). Joe Boyd (2006, p. 101) writes about the 1965 Newport Folk festival where he was involved in stage management. He tells an anecdote about that afternoon when rain poured down on the show of the Paul Butterfield Blues Band:

> The stage was sheltered by the barest of cloths, designed to protect one singer with a guitar. Butterfield performed with a metal harmonica and microphone held

> to his mouth. We turned off the amps and covered them with tarpaulin. The group was devastated but it was far too dangerous to play.[15]

In recent years a number of incidents have occurred at open-air events as a result of severe weather raising questions about weather warning systems and event management (cf Huntington 2012b).

On a different scale, players in orchestras are subjected to dangerous levels of sound pressure (for example woodwind players sitting directly in front of the brass), new occupational health and safety rules (OH&S) are being put into place in some countries to offer protection. That offers an interesting contrast with the high sound pressure levels on stage at rock and pop concerts, it might take a while before occupational health and safety guidelines appear for rock musicians. Rules in relation to maximum sound pressure levels at concerts, or rather the problems of such regulations were discussed in the introduction. At pop and rock concerts patrons may subject themselves to high and potentially dangerous levels of amplification. Arguably they choose to subject themselves, provided it is considered as common knowledge that hearing damage may occur. A similar problem arises from the use of earphones with portable music players; sustained use is another possible cause of hearing loss.

Designing, installing (rigging) and operating a sound system needs a certain amount of training, although, apart from rigging, very little official certification is in place.[17] Common faults that occur are: no sound at all, humming systems or a high amount of electrical noise, distorting sound or very loud feedback. If there is no electricity, or if there is faulty wiring the devices may not work, or in some cases be damaged or in extreme cases catch fire (although modern electrical equipment is very well protected against such faults). But when it comes to the actual practice of amplifying sound there are few rules and 'best practice' may differ considerably from person to person, theatre to theatre or firm to firm.

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[15] He adds about Lomax, not an advocate of amplification: 'I imagined Lomax somewhere, snorting with satisfaction.' In those early days the risk of an electric shock through microphones in improperly connected systems was quite common, very dangerous in wet conditions.

[17] A 'rigger' is a certified professional who selects and prepares rigging points in a supportive structure, eg a building. From these rigging points loudspeakers, or lighting facilities can be suspended or 'flown'.

One anecdote regarding rules and agency comes from a trip to St. Petersburg, Russia with a big theatre show in 1994. We were largely self-sufficient, all set, light and sound came with us on a truck (to our astonishment we could still rely on no fewer than 14 residential sound engineers). To connect our electric distribution (aka power-distro) we had brought an 'open ended' connector that would adapt to the local standard (the electric specifications are the same as in Europe). I connected the five big copper leads to the rather large power plug the venue had provided and tested it. To my surprise one of the local engineers who had been standing by took it apart straight away and put it back together in exactly the same way! It turned out that I had done this person's job; at that moment there was no translator at hand and the man had no way of telling me I was doing his job. I had not broken any technical procedures or safety rules, I had accidentally bypassed the designated agent. At that time, for me, such a focus on roles rather than on results, on jobs being done was hard to fathom; after working in more countries outside of The Netherlands I learned that is was not such an exceptional situation. This example underlines the problem of agency and stakeholder-ship when there is no dialogue, in this example obviously because of the language barrier. In the case of amplification things are often left to the 'proper agent', missing out on opportunities to identify shared goals.

5.3.3 Decorum

> *The impression of a sacred space is reinforced by witnessing the indignation of those classical music lovers who see their hall being let, perhaps by a management desperate for income in the straitened times of vanishing subsidies, for rock concerts and other kinds of events in which the rules of symphony concert decorum do not apply*. (Small 1998, p. 24)

One particular aspect that emerges in any discussion of live music is the difference in social rules that audiences and performers conform to at musical performances. These social conventions are very much rooted in the different contexts of musical performance, including the use or absence of amplification: being silent at a classical concert and singing along at a pop or rock gig as a broad generalisation. But in other situations the

rules, or the 'decorum' can be more ambiguous. At a jazz club the audience may be seated at tables perhaps eating a snack and having a drink; are they supposed to eat in silence while enjoying the music, or can they be chatting while enjoying their food, with the musical performance as an accompaniment or even as background music?[18] As such the decorum is related to a venue's acoustics and consequentially the use of amplification. That relation can be made more explicit, through people's experiences, what they (have come to) expect when going to a concert. From that perspective the notion of decorum is not intrinsic to context or acoustics, but to usage and conventions: decorum is about concerts as social activities. But it can equally be broadened to the use of music in supermarkets, parking garages or as a background to dinner parties, underlining that music is social action. As much as referring to concert traditions it contains notions of style and identity, about what to wear and how to behave in relation to certain music, but also to certain venues. Audiences usually behave differently at a rock concert in an ancient concert hall than at a venue that is famous for its rock concerts.

To ground the notion of decorum I adapt Goffman's (1973, p. 2) use of the term in his *The Presentation of Self in Everyday Life*. Goffman analyses interpersonal communication from a perspective of performance, using several theatre-related metaphors. Performances usually take place in highly bounded regions:

> A region may be defined as any place that is bounded to some degree by barriers of perception. Regions vary of course, in a degree to which they are bounded and according to the media of communication in which the barriers to perception occur.

Boundaries of time are added to the region and so the region of a performance depends on whether it can be seen or heard and the time slot it takes place in.[19] In Goffman's approach decorum relates to a particular set of standards that a performer maintains at a

[18] Not long ago at a concert at a jazz club I asked two people, in a very friendly manner, to stop talking when the musicians were playing, which may very well reflect on my personal preference to enjoy music without too many external sounds going on. On the other hand the other 150 people at the club were indeed listening in silence, bar this couple that did not quite get (or care) that they could be perceived as disturbing.

[19] Goffman distinguishes front and back regions but that is, at this point, of no concern for this discussion.

performance; I will extend decorum to include standards that audiences are held to at performances. Such standards can be divided into two subgroups or requirements: those that are ends in themselves and those that are not; Goffman proposes 'moral' for the formal and 'instrumental' for the latter. The instrumental requirements are related to what are essentially practical matters, or what Goffman describes as duties; have a valid ticket, sit on the designated seat (if applicable) etcetera. The moral requirements, and this is what Goffman (ibid p. 108) means by decorum, presume: 'rules with regard to non-interference and non molestation of others, rules regarding sexual propriety, rules regarding respect for sacred places, etc.' This is where different concert traditions come into view: audiences are required to listen in silent contemplation at some occasions. At others it is okay to talk, sing and jump, or even bash into each other (a common feature in 'mosh pits'). Obviously there is an overlap between the moral and instrumental: not being allowed to record sound or take pictures has a purpose; whether we stick to it can be considered more of a moral question.

Decorum is rich in meaning potential; it reveals attitudes and values to music, to what sort of concert is going to happen and what is to be expected. And sometimes when something goes wrong interesting situations can occur. The particular seating arrangements in many concert halls do not leave a lot of room for standing or dancing. At occasions where particularly dance worthy music is played an interesting schism can occur, some people stand up to dance, blocking the view for the people behind them, who may insist on remaining seated, urging others to sit down.

5.3.4 The Audience and the Rules

In *Introducing Social Semiotics* Van Leeuwen (2005, p. 53) writes about semiotic rules. Those rules are not objective like laws of nature, or 'as procedures hardwired into a technology. They are made by people, they come in different kinds, and they change over time.' Instead of rules related to the technology of sound engineering, I discuss the semiotic rules in relation to audiences and how their behaviour and desired behaviour has (and still is) changed as a consequence of the use of amplification, and how meaning making at performance of music is changing along with it.

‘Silence is the rule!’ writes Dennis Kurzon (2010, p. 32) after Susan Sontag, as I cited in the previous chapter. Kurzon discusses ‘situational silence’ referring to the silence before a classical music performance commences, such an essential trait of the concert hall’s decorum. Kurzon cites Mark Twain who travelled to Bayreuth and witnessed a Wagner opera in 1891, who described the silence in between the opera parts as if sitting: ‘with the dead in the gloom of a tomb’ (ibid p. 34). Not applauding in between parts of a work, the ‘Wagnerian hush’, in Kurzon’s words, took, like many traditions, a few years to travel to other concert halls and opera houses. The developments in Bayreuth after 1872 (the year Wagner’s opera theatre opened) were exemplary for the modern audience, writes Cas Smithuijsen (2001, p. 95) in his book (in Dutch) about the emergence of the silent audience convention. The silent tradition is a history of rules: Smithuijsen (ibid p.61) describes how a music society in Prague in the 17th century ordered its members to not talk during the music. To accommodate this special ‘talking breaks’ were introduced where religious and political topics had to be avoided. In the same book Smithuijsen (ibid p. 89) refers to letters Mozart sent home during his travels. The composer describes different experiences ranging from noisy audiences to empty halls. Back in his hometown Viennese people listened in silence but would at times shout bravos during the performance. The tradition of listening in silence is not very old, even though it is very strongly embedded in the Western European (or euroclassical after Tagg (2013)) music tradition. Perhaps the generic term ‘classical’ is doubly misleading in that sense, as if wanting to express a sort of maturity.[23] Smithuijsen (ibid p. 96) quotes Max Kaplan (1989, p. 160) who underlines the international aspect of the tradition: ‘…an international sense of decorum as a whole that has brought the mores of acceptable concertgoing to a comparable standard.’[24]

Kurzon refers to the notion of the frame as introduced by (Goffman 1974, p. 10):

> I assume that definitions of a situation are built up in accordance with principles of organization which govern events – at least social ones – and our subjective

[23] I say doubly misleading because ‘classical’ music usually denotes composers from the era between the Baroque and the Romantic. Michael Chanan (personal communication 2013) comments: ‘Essentially it is a very slippery term’.

[24] In the same chapter Kaplan gives a worthwhile reading of visiting a concert through the eyes of someone from the Tobriand islands, after anthropologist S.Q. Janus.

involvement in them; frame is the word I use to refer to such of these basic elements as I am able to identify.

Kurzon extends the performance frame from the social setting of the concert hall to include the silence before a performance begins. The silence frames the boundary or the limit to the performance. With silence being the musical matter in Cage's *4'33"*, as Kurzon points out, framing a performance by silence does not seem logical. But as Ed de la Fuente (2009, p. 131) suggests in relation to the work: 'Cage made the rules and framing of the experience of musical listening all the more evident.'

5.3.5 Broken Rules

Using silence as frame makes no sense at a pop concert. Silence returns when it is all over, the audience has left, the stage has been cleared and swept, the truck loaded and the crew having a beer. Pop and rock audiences broke the rules of the (short) dominant classical concert tradition; not so much creating a new decorum but reconnecting with older, less formal, performance traditions from Shakespearean theatre to Music Hall, where there were no rules of silence, singing along was normal and dancing possibly the prime reason for there being a performance at all.

Lionel Hampton came to Europe in the 1950s and people brought the houses down; the performer was removed from the stage at the Concertgebouw in 1956 when the crowd had gotten in a state of excitement never seen before on those premises (cf Mulder 2008, p. 34 (in Dutch)).

There are other examples of instances where the rules were broken; think for instance of the famous 'succès de scandale' of Stravinsky's *Sacre du Printemps* in 1913, and Bob Dylan's 'electric coming out', or less famous but not insignificant, the 'Notenkrakers actie' in 1969 at the Amsterdam Concertgebouw where a younger generation of composers, musicians and new music lovers demonstrated against the conservative programming of the concert hall.[25] Breaking rules of decorum at amplified

[25] Notenkraker = Nut Cracker. On 17 November 1969 a group of young Dutch composers (Andriessen, Van Vlijmen), musicians (De Leeuw, Breuker) and intellectuals (Mulisch) disturbed a concert of the

concerts is much harder; when screaming and yelling is not frowned upon no one will be bothered by someone else trying to answer his or her phone, or changing a baby's nappies during an opera performance in the park. As suggested in the discussion of social distance a classic play at a Greek amphitheatre was a much less intimate affair than an amplified vocalist whispering in your ear, even in a football stadium. Kurzon (ibid) cites from Susan Sontag's *The Aesthetic of Silence* (1969, p. 8) :

> So far as the best art defines itself by essentially "priestly" aims, it presupposes and confirms the existence of a relatively passive, never fully initiated, voyeuristic laity that is regularly convoked to watch, listen, or hear - and then sent away.

Kurzon comments: 'this suggests a substantial distance between the performers and the performance on the one hand, and the audience on the other.' That distance is generally a condition of a performance, with the audience giving up the floor for it to take place.

From that perspective, although somewhat out-dated, again an aspect of power comes to the fore related to amplified music in the way it can support the 'priestly aims' and drown out any other sounds. When thinking of music as social action, at pop and rock concerts the 'masses' are not passive but participating and at least initiated enough to sing along, which they can because of the amplification.

In Goffman's 'theatrical' approach the dramatic frame excludes the audience from interacting with the performance or the performers, as Kurzon (ibid) explains. At a pop or rock concert interaction is key, creating the need for amplification, affording the audience the opportunity to make expression part of their musical experience. The need for louder dance bands as a consequence of the rapid growth of the dance halls in the 'jazz craze' was mentioned in chapter two. That need for loudness became even more apparent half a century later when 55,000 people could barely hear the Beatles. Not only was the outdoors venue lacking in acoustics, the much larger audience was very far from silent; fans took to making so much noise that their idols could no longer be heard. The Beatles'

Concertgebouw Orchestra under Bernard Haitink, the activists used toy frogs and rattles; they were forcefully ushered out, leaving behind an outraged audience.

concerts required a new way (or perhaps a rediscovery) of experiencing music, listening while singing along or screaming at the top of one's voice. Or as Kronenburg (2012, p. 12) describes it: 'Live performance is a physical experience that simultaneously links sensations of the ear, eye, skin and lungs …'

In contemporary theatre the rule of silence is still in place, whether amplification is used or not. This has not always been the case as Wollman (2006, p. 68) explains. In the USA the professionalisation of the vaudeville theatre in the last decades of the 19th century brought an interest in 'family friendly' entertainment. No more unfit language onstage, no more spitting and swearing by patrons, like the audiences in the concert hall reduced into silence the theatre audience was whipped into proper behaviour. Another aspect that enforced the Goffmanian framing is the advent of electric light in the late 19th early 20th century; the practice of dimming it before the start of a performance made it even more clear to an audience that attention was required.

Engel (1975, p. 168) compares the Broadway overtures to their operatic counterparts, dramatically relevant overtures such as Mozart's *Don Giovanni* or works that became symphonic repertoire in itself, eg the overtures of the Wagnerian tradition. Engel laments both the inattentiveness of the Broadway audience and the size of the musical orchestra:

> Unfortunately, however the contemporary American musical theater provides neither of those conditions: the orchestras are about one-third to one fourth the size, and audiences listen to nothing until the curtain has risen and stars have made their entrances.

Engel describes the practice that a theatrical entrance of the conductor is only anticipated on the opening night, when the lights are dimmed and a single spot on the leader is lit. During the normal 'run' the lights dim after the overture, to allow latecomers in and to find their places, but placing the overture 'out of frame':

> If, on the other hand, the auditorium lights are on when the conductor enters the pit, and the music commences without warning, audiences simply talk louder in order to be heard.

The shift in, or perhaps the disappearance of Goffman's frame, at amplified concerts is perhaps the greatest difference between a classical concert with an audience listening in silent contemplation and the lively participation at a rock or pop concert.[26]

5.4 The Rider as Text

After this discussion of the audience as stakeholder I discuss the agency of the other primary stakeholders in the process of amplifying music. In addition to the stakeholders a number of artefacts can be nominated. There is the sound system itself, but also the microphones, as discussed earlier; these artefacts have meaning potential even when they are not in use. The venue, or the room itself can be considered an artefact as well, with certain parameters, size, number of people, stage size and rigging options, but crucially for this thesis, it has a certain acoustic response that will often prove decisive for a concert's outcome. The specifications for a sound system, together with other practical considerations are collected in an artefact that remains in the background, a document called the 'rider' or 'tech rider'. This rider usually plays a formal role in how a concert comes together and how responsibilities are divided (eg whether the ensemble travels with its own crew and mixer). When, for a particular concert, a venue is decided on, the requirements for loudspeakers and microphones (and often also backline and specific instruments when performers travel from far) are formalised in the rider. It lists technical (and hospitality) requirements that are essential for the execution of a performance. Sometimes the rider is part of the contract between a promoter and performer, obliging the promoter to ensure it is followed in detail. There are great stories of surprising requests in (band) riders, but in general it is a practical document, outlining numbers of

[26] Dancing and jumping is not always key, in 2010 I attended a Jon Bon Jovi (a very popular middle aged rocker) concert at the Sydney Football Stadium. The 'field' normally filled with a standing crowd was lined with thousands of plastic chairs, reflecting the middle aged demography of the audience (who ended up standing for most of the concert nevertheless). Closer to the stage a more traditional standing area had been created, for the fans craving that experiential extra.

chairs and desks for an orchestra, dietary requirements, size and number of trucks etcetera.

One famous example of surprising rider demands is the bowls of M&M's that rock band Van Halen requested, with the brown M&M's taken out (Harrington 1981; Roth 1997, p. 97/8). Allegedly this level of detail was built in as a test to see whether the promoter had read the rider well enough. As a production manager at the Concertgebouw I misinterpreted the hospitality rider for jazz piano legend McCoy Tyner; he came by him self to perform with a local band but the rider we received was designed for when he concerts with his own band. I had simply passed the hospitality details on to those responsible for the catering and consequently his dressing room was filled with enough food and drink for a week.

When it comes to sound technology the rider lists a number of details such as the requirements for a sound system, the number of input channels on a mixing desk (or a specific mixing desk) and outboard gear (eg dynamic manipulations and effects). Very often the terms are negotiable, but with increasing 'importance' (ie more famous, more expensive performers), these terms become more vital. In some cases ensembles bring all their own equipment themselves to make sure they have everything required to the necessary specifications; an option that comes at a cost obviously. Lee's (1998, p. 47) book *Like The Night* was mentioned before, and details the entourage and the equipment Bob Dylan toured with in 1966, which was quite exceptional at that time, and possibly a first:

> The gear that Dylan's roadies were hauling around the world was state of the art American technology costing over $30,000 [a veritable King's ransom at today's prices]. It was huge. There were big black bin speakers piled on top of one another at each side of the band. There were box shaped foldback monitors positioned all over the stage, some angled directly at Dylan. […] Microphones, cables, guitar amps, organ amp, all being pumped out through the PA at 1000

> watts. The rest of the rock world didn't start using rigs this big for another two or three years.[27]

In some cases the rider may prescribe a certain brand, type and number of loudspeakers in others it may be worded more generically eg: 'an adequate three way loudspeaker system covering all the audience areas and able to produce 105 dB_{SPLA} undistorted, at the mixing desk', or a 'four way system including a subwoofer, able to cover the entire venue'. From the perspective of this thesis the rider is an important text that can be used to identify aspects of agency. The document is compiled by an ensemble's sound engineer, or by a knowledgeable person within the production in case the musicians travel without their 'own' sound engineer. The document is presented to an agent or representative who negotiates with a venue or a promoter. The first question is whether the rider is made part of the contract or not. In some areas this is much more straightforward, for instance when an orchestra is contracted to perform a certain Bruckner Symphony in a venue the composition prescribes a number of performers which then dictates a certain stage size, number of chairs and desks etcetera. A pop or rock band booked in advance may have changed their line up since, or use different instruments or play a different set of songs every night which may require some flexibility in a rider.

There is usually no reference to required acoustic conditions in riders, as that choice is usually made independently of technical requirements, in the instance of the first moment. Furthermore, most venues do not have options to adapt the existing acoustic conditions. It appears the common thought is that technology will overcome the difference between required acoustic conditions and the actual acoustics. In that light, at the Konzerthaus Wien, a classical concert hall, I experienced an interesting policy; the management sends a counter-rider when a rider for an amplified ensemble is received. The counter rider lists the available gear (loudspeakers, microphones) at the venue, but

[27] Lee mentions it being American as a consequence of a parallel he makes between technologies from that same country used for the war in Vietnam, and Dylan's hi-tech deafeningly loud (for those days) concert tour.

also explains that the particular acoustic conditions are not favourable for amplified music and as such need to be considered when preparing for a concert.[28]

In the case of a double bill, or a festival with a number of acts sharing the same stage on the same day an inventory of the riders has to be made including stage plots and infrastructure for microphone connection etcetera. Sometimes acts prefer not to share the same mixing desk with other acts, to make sure the settings arrived at in the sound check are maintained (a problem which is becoming obsolete very fast; on a digital desk this is a matter of saving and loading a different file containing all the relevant settings).[29] Before the digital era all the settings were noted down on so called 'crib sheets' that graphically depict all the buttons, dials and faders on a desk (easily thousands of them on a larger desk) organised per input channel.

A rider travels from agent to venue to local production management who may be able to fulfil the requests with in-house material and staff, or the rider can be passed on to an external party partly or in its entirety. That party can be a sound hire company, a local free lancer or a production company. The rider outlines two of the three semiotic moments, choices made regarding specific sets of resources. These choices are made after a venue has been decided on; ideally the document is optimised for a performance at a particular venue.

In the next section matters of agency in relation to the first semiotic moment, the choice of venue, are discussed.

5.5 Agency: Concert Promotion

Kronenburg (2012, p. 5) in his book *Live Architecture* refers to venues being intentional, ie dedicated to music performance, or unintentional. Buskers perform at sites that were not intended for music performance and bands can perform at local pubs or restaurants. Occasionally, more and more it seems, buskers can be seen and heard using portable battery powered amplifiers for guitars, vocals or both. They can choose their 'venue' (in some cities depending on a permit) perhaps on the grounds of potential passersby, but also choose a place that is acoustically attractive. In Sydney the (Devonshire) tunnel

[28] This was in 2000, I am not sure if that venue still does this, but it is arguably a very good policy.
[29] Which has turned this into a digital problem; if something goes wrong while saving, or when a file is accidentally overwritten, very problematic situations occur (and they do!).

under the central station is a popular spot, with many commuters passing by twice daily and its acoustics are not unfavourable. Walking through offers a nice musical journey, with the railway station's announcements offering an additional layer. In New York's subway a yearly roster of selected buskers is created on the authority of the underground transport. Potential buskers have to audition at a yearly event (see 'Buskers Audition At Grand Central' 2012). Bands operating on a local level can approach a pub, or vice versa. They can bring their own PA system (usually consisting of two loudspeakers and a mixer/amplifier to amplify vocals and keyboards, with guitars and bass relying on their own amp). When I played in a band as a teenager we used such a set up, amplifying the drums only by putting a microphone in the bass drum, to give it 'more balls' in the words of our drummer (who was coincidently also the 'agent' who got us our gigs). Larger pubs or clubs may have an actual stage, a sound system and crew, presenting themselves as a music venue. A more or less standard set of microphones, a sound system, and some floor monitors will be adequate for a large variety of rock and pop bands. The venue may contract bands through auditions or agents, or sometimes even employ someone responsible for the programming. When the hospitality business (ie selling drinks) is no longer the core objective, and organising concerts and other performances become the main intentions, a venue's role as promoter becomes more formalised.

In her PhD thesis looking at music promotion in the UK, Emma Webster (Webster 2011, p. 37) defines a promoter as: 'someone who plans an event in order to increase their economic, social and/or cultural capital in both the short- and the long-term.' The promoter risks financial and reputational loss in the process of organising concerts. Some venues can claim a mythical status as suggested by Kronenburg (ibid, p. 7) which establishes: 'both a cultural point in time (and therefore history) but also endows a continuing relevance for emerging acts who aim to play there'. The author mentions the Marquee Club in London in relation to the Rolling Stones, jazz musicians might refer to New York's Birdland.[30] For avant-garde musicians it might be the Knitting Factory in New York, an opera singer might dream of Milano's La Scala etcetera. The reputational aspect also surfaced in my Masters thesis (Mulder 2008). When jazz concerts were first organised at the Amsterdam Concertgebouw (Paul Whiteman played there in

[30] Both these clubs relocated several times, Birdland did not exist as a venue between 1965 and 1986.

1926), an icon of classical music, some negative reactions appeared both in newspapers and in letters written to the hall's management. Similar sentiments emerged when jazz concerts became a regular feature at the venue, in the 1950s. Jazz did not fit the venue's decorum at that time; but it does now, there is even a 'Jazz Orchestra of the Concertgebouw'. A letter received by the venue in 1956 talks about hysteria-music-gatherings referring to a Louis Armstrong concert. And a newspaper article from 1953 cites city council members wondering whether jazz concerts present a conflict with the cultural standing of the concert hall.[31] Interestingly concerts by legendary jazz performers (Ellington, Armstrong, Holliday, Parker, Davis and Coltrane to name a few) organised at the venue after midnight on Saturdays all through the fifties shifted jazz into the concert hall's decorum. Even though the acoustics are too reverberant for most jazz concerts and the use of amplification generally made matters worse in the 1950s, judging from newspaper reviews and letters from patrons received by the venue. The amplification technology has much improved since the 1950s and much better results are achieved, but the acoustics remain a problem for jazz.

In order to appeal to a broad group of people, venues will try to book a wide variety of acts. Some venues may have more than one room, of different sizes, offering some flexibility. The Sydney Opera House has no fewer than seven different spaces (including the forecourt which can be used as an outdoor stage) each of which can accommodate a wide variety of performance arts. Recently I visited a concert by a Danish band called 'Efterklang' who collaborated with the Sydney Symphony Orchestra as part of the yearly Vivid festival.[33] Because of the orchestra I expected the concert to take place in the massive, reverberant (classical) concert hall, but to my surprise it was at the much drier Opera Theatre (which seats roughly 1000 people less); much more appropriate for amplified music, even with an orchestra. The choice is clear: sell fewer tickets and enjoy drier acoustics or have the possibility of selling more tickets and fight the reverb of the concert hall as a consequence.

One further option for a promoter is what is known as a 'dry hire' meaning hiring a facility (eg a crane) without an operator. A concert can be organised in an empty venue,

[31]Archive nr. 2338, *Algemeen Handelsblad* 8 November 1953 and archive nr. 2832, letter by J. Geleedst, a shareholder of the Concertgebouw, dd 7 November 1952.
[33] May 2012.

essentially an empty box (for instance the Heineken Music Hall in Amsterdam that was mentioned before in §3.4). Everything has to be installed for the occasion, stage, seating, catering, light and sound etcetera, commonly also in sport stadiums. This gives promoters flexibility in organising events. For each concert a sound system can be specified to a third party (a sound hire firm for instance) to fulfil the performer's rider. Although organising concerts is not the core business of a dry hire venue, they too can act as promoter and organise concerts at their own intent. Because dry hire venues can be used for different types of events the reputational aspect of a venue, or the development of a particular decorum is less strong.

The choice of venue is a vital aspect, that is, provided there is a choice. The role of promoter, as initiator of a concert can be taken up by a venue, an ensemble or its agent, or by an organisation specialised in organising concerts commonly known as a promoter. The exact specifics of concert management are not within the scope of this study, and different wordings may be chosen, but the relations between musicians, venue and promoter can be analysed from a perspective of amplification.

5.5.1 Venues and Acoustics Revisited

> *The architecture of a venue can have a highly significant effect on the character, power and relevance of the performance, adding layers of meaning and expression for both performer and audience.* Kronenburg (ibid p. 5).

Spaces have always had an influence on the musical practices in those spaces, as argued in the first chapters; an idea supported by architects, acousticians and musicians alike. Singer David Byrne (of Talking Heads fame) elaborates on that point in a so-called 'Ted Talk': How Architecture Helped Music Evolve.[34] Byrne more or less provides the same points in relation to acoustics and music as earlier in this thesis but he offers some interesting insights from a musician's perspective, worthwhile repeating here since they concern amplified music specifically. He starts his presentation by sketching two pop and

[34] www.ted.com/talks/david_byrne_how_architecture_helped_music_evolve.html <viewed 1 August 2012>. Since writing these pages a book called *How Music Works* by Byrne has come out, documenting his anecdotes.

rock venues that he used to perform at, or more specifically, music that he wrote was performed at in the 1970s: Tootsie's Orchid Lounge in Nashville and CBGB's:[35]

> The nature of the room meant that the words could be understood. The sound system was kind of decent, and there was not a lot of reverberation in the room. So the rhythms could be pretty intact too, pretty concise. […] the volume had to be loud enough to overcome people falling down, shouting out and doing whatever else they were doing.

Byrne goes on to recall places he played at later in life which were 'much nicer' the Disney Hall (Los Angeles) and Carnegie Hall in New York, places with a different decorum. Sometimes he would notice that the music he had written, or music he was writing at the time did not sound great in some of those 'nice' halls:

> We managed, but sometimes those halls did not seem exactly suited to the music I was making or had made. So I asked myself, do I write stuff for specific rooms? Do I have a place, a venue in mind when I write? Is that a kind of model for creativity? Do we all make things with a venue, a context in mind?

Music from Africa, Byrne continues, plays a big role in all our current popular music. The rhythmic nature of the music and the use of percussive instruments work really well in the great outdoors: 'There is no big room to create reverberation and confuse the rhythms, the instruments are loud enough so they can be heard without amplification etcetera.' The music works in that context; the same music in a cathedral would be a mess. This is an important point when it comes to pop and rock music, when we think of what Hope Bagenal wrote about acoustics: ranging from the outdoors, to the reverberant cave. Byrne juxtaposes the late romantic traditions in the concert halls where the attentive audience allowed a larger dynamic range and richer detail, with early jazz that was played on riverboats and in (small) dance halls with a not so silent audience. Not a lot

[35] Ceebeegeebees (Country, BlueGrass, and Blues) was a music club on Bleecker Street, New York City, which closed in 2006.

changed for rock and pop venues until in the 1970s the sport arenas became regular sites for music performance creating what Byrne calls arena-rock (aka stadium rock) as championed by bands like U2 playing arena-ballads:

> Live music ended up in what was possibly the worst sounding venues on the planet, sport stadiums, basketball arenas and hockey arenas […] They did the best they could, given what this [an arena] is what they were writing for. The tempos are medium, it sounds big, it is more a social situation than a musical situation, and in some way the music that they are writing for this place works perfectly.

No two stadiums are the same and some work well for amplified music and others not so. Even though outdoors, or rather 'open air' stadiums still have acoustic characteristics of their own. The stadiums may be designed with a number of different types of sports in mind, but acoustic requirements for amplified concerts are usually not in the design brief.

The match between a room and certain musics is not always optimal; amplification (technology) can be perceived as having to overcome the mismatch, which is not always feasible. Such matches are made by the agents involved and the 'match making' should include a discussion of the use of amplification. A repertoire of resources, types of acoustics, technology and types of music has taken shape over time, sometimes intentionally and sometimes not. Sometimes new configurations are created making a dialogue about amplification a vital aspect, rather than an afterthought. The reciprocal relation between types of venues and musical development shows a lot of variety over longer periods of time. Where live musical experiences and music making remain ephemeral, architecture is a slow art; for instance it took almost two decades of planning and building before the Sydney Opera House opened its door in 1973.[36] As described by Kronenburg, we have now entered an era in which venues are developed and built for amplified music in particular; over time we may be able to discover whether the reciprocal relation between music and buildings has continued.

[36] There are several references by romantic German authors to 'architecture as frozen music', attributed to Schelling but often also to Goethe. Khaled Saleh Pascha's (2004, p. 22) dissertation on the subject discusses its origin.

5.5.2 Agency: Loudspeaker Systems

The functionalities of the amplification system, as listed by Emmerson, together with the specifics of the venue, inform the decisions regarding the loudspeaker system. Of course in many venues for amplified music a sound system is installed, often in a standard set-up and even the suggestion of changing it can be frowned upon by the local crew. However in most cases, when it comes to rock and pop bands playing at venues catering for those musics the house system will be proficient.

For works that are more specialised or more site-specific, custom sound system designs will have to be put together. This often includes a site visit by the sound engineer, or technical team in advance, the particulars can then be formalised in a rider. In some cases a system design is specified in the score of electroacoustic composition. Stockhausen's scores are very detailed about loudspeaker layout, sometimes including diagrams detailing the settings on the mixing desk, including the 'routing', that is to say which input channels (eg microphones, tape channels) are reproduced through which loudspeakers. But such high level of detail is not always present.

In 2011 I worked for the Royal Concertgebouw Orchestra (RCO) on a program of contemporary music that contained a work by composer and conductor Bruno Maderna called *Venetian Journal* (1972) for tenor, orchestra and tape (two track).[37] Conductor Markus Stenz decided to put two relatively small loudspeakers on either side of the organ behind the stage and the orchestra, instead of using a full range loudspeaker system that would effectively cover the whole room. As a consequence the tape sounded 'dull' and 'distant' (to my ears) in the hall but matched very well with orchestra (for this work, in a small 'chamber music' setting). The tape recordings sounded rather dated, at least in a technical way; the lack of a full frequency range in the sound system did not do it a terrible injustice. We tried this system during rehearsals, which convinced the conductor this was a good solution. To get a good sense of blending, and this goes back to the discussion of mixed music in chapter two, between an ensemble and pre-recorded material is not always easy and this provided a good solution. If we had used a large full range system the blending would have to be enhanced by amplifying the entire orchestra, which is of course also a factor of additional costs.

[37] RCO AAA-series 'Illusions', 15 and 16 December 2011.

In the Holland Festival in 2011 I worked as system engineer for a performance by Jamie McDermott and his band the Irrepressibles, at the 'Muziekgebouw aan het IJ' in Amsterdam. They created a performance 'in the round' quite literally, called *Human Music Box*.[38] The musicians were playing on a large rotating platform in a large cube of trussing. Each of the four sides of the cube faced a section of the audience and therefore had loudspeakers installed. Unfortunately, it being pop music the amplification was rather loud, drowning out the sources on stage, undoing any sense of movement of rotation in the sound.

Ultimately the loudspeaker introduces and rearticulates the selected and mixed sounds into the venue, into the local acoustic and the context of the event. Loudspeaker selection is again a skill that includes technical details, insight into acoustics, the function of the amplification and budgetary requirements.

5.5.3 Agency: Microphones

Choosing microphones is generally the responsibility of the sound engineer. In some cases performers may express a preference for a certain type or bring their own, as many vocalists do. Bing Crosby to begin with had his own early RCA ribbon model, but also Frank Sinatra in his early days even brought his own sound system, according to Pleasants (1974, p. 194). Sometimes composers prescribe a particular microphone or type of microphone. For instance George Crumb for his string quartet *Black Angels* prescribes contact microphones (cf Emmerson, 2007, p. 132). In the rock and pop domain there are many variables. For some bands and engineers the microphone-list on their rider is holy and if a venue cannot comply they are required to contact the band's engineer to discuss other options. Of course some venues perhaps the ones that are not very well to do, do not always have a lot of options and visiting bands just have to use what is there; some engineers are happy to always work with whatever material at hand. Achieving quality results with available resources is an important skill. Bands that do not want to take any risks bring their own microphones (but for instance no stands and cables).

[38] An 'in the round' concert commonly takes place in an arena or stadium with the stage set up in the middle of the field. Clever setup on the flat stage allows sightlines from all directions and loudspeakers systems flown high above addressing all areas.

As mentioned before I worked on several performances of Stockhausen's *Hymnen Region III* for 4-track tape and orchestra. Sound projectionist (ie mixer) Brian Wolff and I would take Stockhausen's instructions very literally, using the same approach for loudspeaker and microphone choices as detailed in the score. We had both worked on performances of the work with the composer himself in Amsterdam in 2000; we almost literally copied and pasted the technical requirements into the riders for later performances. In the classic Stockhausen set up a large number of cardioid condenser microphones on stands would be set up, basically one per two instruments. Particularly for the string instruments, to assure the stand is not limiting the musician's range of movement (and the tip of the bow does not accidentally hit the transducer) a fair distance has to be kept. As a consequence these 'overhead' microphones not only pick up the desired sound from the two violins but also other violins and other instruments are picked up as 'bleed'. When mixing all the microphones together every single instrument is picked up by several microphones, at different levels but also at different run times, causing audible phase problems.[42] My colleague Paul Jeukendrup, performing the work with the German ensemble Musikfabik and conductor Peter Eötvös chose to use 'clip on' close microphones, miniature, omnidirectional microphones (not unlike the models taped to the foreheads of Broadway musical singers) on the violins.[43] They have the advantage of transducing much more of the violin's sound relative to the bleed of other instruments, overcoming most of the phase problems; as a consequence the sound is much cleaner but also very 'close'. This poses an interesting choice from a perspective of HIP, do what Stockhausen did, and to an extent prescribed in the score, or use up to date 'better sounding' technology? This leads to more questions: what about the loudspeakers in use, the amplifier, the mixing desk, each adding a little bit to the 'sound' of the performance, should we be using similar equipment to when the work was first performed? This is not the place for this debate but I am bringing it forward at this point to demonstrate the impact of microphone choices.

[42] Combining ('summing') two similar sounds with different runtimes (ie differing in phase) results in what is known as a comb filter, dips and peaks due to summations and cancellations in the frequency spectrum. A comb filter adds a version of a signal to itself that is slightly shifted in time. A pattern of additions and cancellations, of constructive and destructive interference, looks like a comb when represented graphically.
[43] There are specific little rubber attachments available that allow mounting the tiny microphones on the strings, behind and above the bridge to pick up a lot of the friction sound of the bow, or below to allow playing 'con sordino'.

5.5.4 Agency: the Balance

With the three fundamental semiotic moments, principal decisions about the sound systems functionality are made. Of course there are many more decisions to be made in terms of tuning and optimising the system, which include positioning and aiming the loudspeakers, time aligning (ie compensating for timing differences in relation to loudspeaker positions), levelling (the overall level of the system and separate level of individual loudspeakers) and equalisation, or 'tuning' the system to the room. That last stage is a particular skill, previously done by ear only; identifying resonant frequencies in the system (ie loudspeakers and acoustics) that can cause tonal imbalances, or even feedback when amplifying. In the past decades more and more system engineers have started to use laptops, analytical software and measuring microphones to aid in this task. Although the particular software suites are available to any one it has become a valuable and highly regarded specialisation particularly for larger systems. With or without the support of a computer ultimately fine adjustments are made to taste. Often before a sound check the mixer plays some music he or she is very familiar with, making personal adjustments to the system, aiding in creating 'the sound' for a particular concert.

Before a venue opens its door to the audience a sound check takes place. This is the chance for the musicians to discuss with the mixer or mixers (a second mixer often operates the monitor's desk) matters of balance and level. During a performance this is much harder; at times musicians in bands can be seen gesturing to the left or right side of the stage where usually the monitor desk is set up. For instance pointing at the bass drum first and then up in the air, meaning: 'more bass drum in my monitor'. As discussed before it is hard and takes a lot of experience in one particular venue for a performer to judge what the audience is hearing, examples of that interaction are rare.

For instance, the balance of an amplified orchestra on an outdoor stage has to be recreated from all the different (close) microphone inputs. Theoretically the conductor should be at the mixing desk (if it was not for timekeeping and cueing duties).[44] A straightforward approach with just two microphones ('a stereo pair') that picks up the

[44] In such situations often an assistant conductor or someone from an orchestra's artistic staff joins the mixer at the desk to advise on the balance and sometimes cue solos or rehearsed adjustments from the score.

balance created on stage will simply not provide enough gain. In soft sections the microphones may pick up more wind and other environmental sounds, in the tutti sections the louder instruments can drown out the softer, without the support of the specific concert hall acoustics.[45]

One approach that offers more control to the performers in low-level amplification situations is setting up the loudspeakers behind an ensemble; the musicians can hear the amplified sound and adapt their playing dynamically, not just in interaction with an ensemble, but including the amplified sound.[46] One other much-sought approach is where the mixer is urged to not change anything after a sound check allowing the musicians to create their own dynamic balances. The problem with that strategy is that amplified dynamics change as a consequence of the microphone and loudspeaker transduction (I discussed transduction effects in chapter two); the balance in the ensemble is not transduced to the audience in a linear way. Such problems add up when more microphones are in use.

Bandoneón players can also be very particular about their microphones; they prefer a 'matching pair' on each side of the instrument at exactly the same distance amplified at precisely the same level. I worked as systems engineer and mixer on several (tango) concerts by French accordionist Richard Galliano who brought his own identical microphones to amplify his Bandoneón. During the sound check he spent some time ensuring that each microphone (one panned to the left the other to the right)[47] was amplified at the same level. During the concert he appeared unhappy with what he perceived as the balance, signalling to me to slightly change one level. A rare case of agency in terms of balance effectuated from the stage, the performer had to break through the performance frame, acknowledging the presence of technology and an operator; resulting in an awkward situation. On a recording of what is known as the 'Helsinki

[45] A sense of room acoustics is created on some occasions by surrounding the orchestra with loudspeakers that reproduce artificial reverberation; festival stages with their plastic covers offer a very different acoustic response.

[46] Loudspeaker producers Bose (L1) and Renkus Heinz (IC Live) market slim line array loudspeakers that can be positioned within an ensemble providing local amplification combined with monitoring. Smart DSP offers 'beam steering' ie control over directionality and possibly feedback elimination. Tremblay & McLaughlin (2009) discuss the Bose speakers in their 'In the Box' paper.

[47] That means that the signal of the right microphone is only sent to the right loudspeaker(s) and vice versa, the problem being that a balance between the two signals is only achieved in those seats covered by both loudspeaker systems.

Concert' of Frank Zappa and the Mothers of Invention, Zappa can be heard addressing the mixer: 'Ken, turn me up so they can hear what I'm saying'. Zappa, famous for his verbal interaction in between songs was referring to the level of his voice during announcements.[48]

Another good example of musicians playing their part as agents, was another tango ensemble playing at the Amsterdam Concertgebouw: after setting up and playing a few songs (a sort of sound check, in the unamplified practices this is referred to as an 'acoustic rehearsal') the leader of the ensemble chose to play unamplified. That is interesting (and very rare) for an ensemble that requested to be amplified, and for the occasion we had flown a sound system (the Concertgebouw has no sound amplification facilities of their own apart from a small system for speech amplification) and all the related paraphernalia. We decided to quickly remove the loudspeakers before the concert, so the audience would not think the ensemble played amplified after all.[49] As I mentioned before with regard to what their audience hears, amplified performers have generally given up control, which presupposes a relation of trust (the example of Galliano is a rare exception). This comes back to what I described earlier as the 'singers dilemma'; not being able to judge how one's sounding is perceived.

Acoustician Jaffe (2010, p. 148) provides one more agency anecdote about opera singers performing (amplified) with an orchestra in an outdoor venue with an acoustic shell. The singers kept sneaking closer to their individual microphones trying to influence the balance:

> Opera singers have tremendous vocal energy and should stand back at some distance from the microphone in performance […] No matter what we told them, as the concert progressed each one kept creeping closer and closer to the mikes.

A solution was found in placing the microphones in an elevated position in front of the stage, if they moved closer the singers would fall off.

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[48] Which addresses yet another regular problem, announcements. The whole system is set up to work well when a lead singer is singing; speaking rather than singing usually result in a drop in level (although some performers 'speak up' in front of a crowd).

[49] Juan José Mosalini and his Grand Orchestre de Tango, Concertgebouw Amsterdam 'Robeco' summer series, 27 July 2004.

5.5.5 Agency Deadlock

So whose fault is it when things get out of hand? The promoter for choosing the wrong venue? The venue for selecting the wrong band? The sound engineer for choosing the wrong gear or making the wrong balance? The musicians for accepting the concert in the first place? One example of agency in extremis, can be found in Lee (1998, p. 57) who writes that at Dylan's famous Newport concert '…Alan Lomax, Pete Seeger and others allegedly tried to cut the power cable with an axe that Seeger had been using for a demonstration of work songs'.[50] Lomax and Seeger were involved in organising the Newport Folk Festival and very unhappy about the loud amplification (for 1965) of Dylan's concert.

Things get out of hand at times; many people have experienced a concert where the sound was 'bad', unbalanced and either too loud or not loud enough. At one occasion at a particularly disastrous concert of Latin American music at the Concertgebouw a colleague of mine 'baby-sitting' as the system engineer had to protect the band's mixer from the audience who had come to complain in numbers.[51] The point I want to make in this chapter is that this is only to some extent a problem of technology and more often a problem of agency. When there is no dialogue, not even a lack of agreement, but simply no acknowledgement of the questions why and how and how loud something is amplified, none of the stakeholders is done justice. The audience has an unrewarding experience, musicians aren't heard the way they would like to be heard, the venue fears or receives complaints and the sound engineer is frustrated for not being able to deliver rewarding results.

Such dialogues start with the choice of venue, in the light of a market driven art world a very complicated issue, with more at stake than just 'good sound'. Ultimately, when amplification is used to overcome a mismatch between acoustics and music, the dialogue of the use of electronic amplification at performances of music should be a priority.

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[50] Where would rock music be without great stories? The story of the axe appears to be untrue, although it is mentioned by a few sources (cf Boyd 2006, p. 100; Shelton 1986).

[51] On that occasion the chairs had been removed from the stalls to accommodate dancing, which also made it much easier to walk up to the mixing desk and have your say.

5.6 Goffman's Participation Framework

Latour (1994) in his paper 'Technical Mediation', asks the question:

> Why is it so difficult to measure, with any precision, the mediating role of techniques? Because the action that we are trying to measure is subject to "blackboxing" a process that makes the joint production of actors and artifacts entirely opaque.

In this chapter I have tried to avoid treating amplification technology as a 'black box' by looking at individual aspects – transducers and venue choices, perhaps black boxes in themselves – and zooming in on the roles of the different stakeholders. As agents they are all, to some extend, involved in the use of technology and as such, from a perspective of social semiotics, in meaning making.

In the final section of this thesis I will provide a more abstract discussion of the practicalities reported in this chapter, first I will invoke Goffman's (1981) 'participation framework', followed by a discussion of social semiotic 'stratification', which is inspired by Goffman's work.

Goffman's (1981) 'participation framework of talk' focuses on divisions of semiotic labour in talking (ie what is meant and how is it said (cf Kress & Van Leeuwen 2001, p. 86). The strongpoints of this model emerge from the appealing clarity and simplicity of Goffman's writing, allowing an insight into the complexity of socio-technological structures. Three analytical roles can be identified in the participation framework: the 'principal', the 'author' and the 'animator'. The principal is the person (or an institution) 'whose beliefs are told'; the author is the person who 'selects the sentiments that are expressed and the words in which they are encoded', and the animator is the 'sounding box in use' (Goffman 1981, p. 144). In some cases the three roles are combined in one person, sometimes the roles are divided: Kress and Van Leeuwen (ibid) describe the example of a large media conglomerate: 'When a BBC newsreader reads the news, the BBC is 'principal' and 'author' and the newsreader 'animator'. These are what Goffman refers to as different production formats.

Directly relevant to this discussion of amplified music is what Goffman writes about the 'sounding box' and possibilities of technical distribution. Animators, as sounding boxes, 'share this physical function with a loudspeaker system or telephone'. Kress and Van Leeuwen (ibid) add to this crucial thought by pointing out that amplification can be 'a matter of pure distribution' but also has semiotic potential of its own.

Within the participation framework, a 'production format' emerges that describes how the stakeholders in this discussion are agents. When a promoter brings together a performance space and a performance in an event, and this is a crucial point: that agent brings together context (a venue with decorum, acoustics) and music (eg genre, with perhaps a different decorum).[52] These are matters of principality and decisions of amplification are inherited from such decisions. Authorship can be found in composers or singer/songwriters, but equally in the design for an event's sound system, or formalised in a rider, or sometimes in a musical score. The role of the animator becomes shared between the musicians, the mixer(s) and when so afforded, by the audience.

5.6.1 Coparticipants

At amplified concerts musicians and audience are coparticipants in Goffman's 'participation framework', not so much in creating music but in making meaning, realising a unique production format. When a mixer envisages his or her role as imperative, the risk of a problematic production format arises, standing in the way of coparticipation. A mixer can claim principality (the only person who knows what a certain act should sound like, or how a concert should be experienced sonically) while at the same time controlling the 'sounding box', how the animator (often also the author) is heard by the audience.

In some cases there is not a clear principal. The music is not 'owned' by an organised institutional context, in the way that Beethoven's works are 'owned' by the institutions that rule how classical music is performed, or in the way that Christmas songs fit within a religious, and now also commercial context. With a song like 'Frère Jacques'

[52] This approach as such ties into discussions of 'gatekeepering' in the cultural field (Rifkin 2000). It also suggests that gatekeepers' decisions can have far fetching consequences for modes of production, in this case the use of amplification.

few, if any, people know what context it originated in, or who wrote it. It is owned by a community, rather than that it is owned by individual composers or claimed by institutions. Comparable to 'Frère Jacques' a notion of lost ownership shines through in performances that allow an audience to sing or otherwise express themselves 'along' with the musicians on stage. When music is thoroughly canonised, which equally applies to for instance Beethoven's symphonies and The Beatles' songs, a question of the relation between the audience and the principal in Goffman's framework can be raised; that is when concerts are being organised with a participating audience in mind. To an extent principality becomes a shared phenomenon; what an audience hears is not always new, very often the songs and their lyrics are known very well to all, performers and patrons alike, in some cases to the point where the need to hear becomes less important with people wearing earplugs, or the need for performers to actually play their music, miming 'live' instead. Through a coparticipatory production format, for the duration of a concert an audience can claim or express a claim to ownership of the songs performed, an affirmation of identifying with those songs, that band, or that music.

5.7 Stratification: Multimodal Discourse Analysis and Amplification

As discussed in chapter three, in the 20th century, a dramatic shift occurred: rather than performance, recorded music became the primary source for musical experience. Over a longer period of time, in the era before the introduction of recording technology, music had already seen a shift from predominantly informal entertainment to formalised social contexts with increasingly strict conventions. The early opera tradition created a frame for performance, fixing the audience's gaze, witnessing a performance as if it were a religious ritual. As a consequence of the operatic frame the musicians moved to what the ancient Greek called the orchestra, the space in front of the stage that developed into the orchestra pit. In the development from the private music rooms to the larger concert halls in the 19th century, the orchestra moved back onto the stage, establishing a tradition of musical performance in parallel to opera. To analyse the later shift in music performance that was brought about by electronic amplification, I will discuss a social semiotic approach that is known as 'stratification'.

In *Multimodal discourse: the Modes and Media of Contemporary Communication,* Kress and Van Leeuwen (2001) discuss four domains: Discourse, Design, Production and Distribution. Within a practice meaning, or meaning potential is predominantly made in these four domains or *strata*: 'The basis of stratification is the distinction between the *content* and the *expression* of communication' (ibid p. 20). Stratification as such is related to the way it is used in Hallidayan linguistics and Kress and Van Leeuwen develop it for its 'potential compatibility of description of different modes'. It was inspired by Goffman's participation framework, which deals specifically with 'talk'; the stratification model aims to establish similar roles or kinds of roles for all semiotic modes.

The configuration of these strata helps us to map different stages of expression related to a product or a 'work' in a certain practice. For example in Western art music a work is, traditionally, composed (designed), performed (production), and distributed (by means of a published score, a performance or a recording). In newer genres or newer art forms or modes of expression or communication, the strata may be fully merged, until a certain level of formalisation is reached and division of labour appears (these divisions can also be undone as are witnessing in the recording industry). For instance, with social media currently an important aspect of the media landscape, politicians or business managers may have a PR assistant to manage their twitter (or similar) accounts. Older, established configurations may be harder to sustain or disappear all together, for social, technological or economic reasons.

5.7.1 Stratification: Discourse

The social context in which a practice takes place is what is referred to as the discourse. In the words of Kress and Van Leeuwen (2010, p. 24): 'discourses are socially constructed knowledges of (some aspect of) reality.' The stratum discourse is an overarching descriptor for social significance, the many social meanings that can be expressed in a mode. In the mode music this is not limited to what is expressed musically, apart from experiencing and enjoying music by playing records or going to live performances, meaning is made in many ways. Going to see a symphony orchestra play, dressed in tradition, perhaps expresses differences in upbringing, or class (see Tagg 2013,

p. 98). Going to see a rock band, equally dressed in tradition nowadays, may still express a sense of rebelliousness, if only to demonstrate that one is mature enough to decide and live with the risk of hearing damage, on par with smoking and drinking. Besides social meanings there can be many personal musical experiences: emotional, commemorative, transcendental, meditative, empowering, energising, religious etcetera.

The stratum discourse is a repository of semiotic resources, everything that can be expressed through music, no matter what music. Cultural differences can be vast, but they appear to be disappearing rapidly. The popularity in China of euroclassical music is very impressive, and, what is known as 'world music' gives consumers in the Western countries an opportunity to express their inner anthropologist, by 'fun shopping' from other cultures.[53] Within a discourse there can be different approaches to the question of how music itself can be meaningful or expressive. I argue that music has meaning potential which can be enhanced, reduced or added to by the use of amplification. Amplification as a mode has meaning potential predominantly in relation to what is amplified. Metaphorically and possibly experientially, amplification might express hierarchy or power; relations that are apparent in speech amplification but that may resonate through musical use.

In a few ways amplification can become expressive by itself. Similar to a type font without a text, by itself it has limited meaning potential, such as found in the textural: shapes, round instead of straight, corners instead of curves etcetera. Good examples with regard to the texture of amplification are Stockhausen's *Mikrophonie I and II* or even more specific in the use of feedback in Reich's *Pendulum Music* (1968).[54] That work has two performers set off two or more microphones hanging by their cables, over loudspeakers facing up, the microphones' movement creating a feedback loop fading in and out. In these works microphones and loudspeakers become instruments – semiotic resources – explicitly, but the textures expressed seep through in other usages. Ultimately this is what makes amplification a semiotic mode.

[53] In my opinion, adding elements from different musics around the world in one eclectic work may suggest and open mind but does not necessarily embed those music's qualities, that it to say it does not automatically make great music.
[54] See also Potter (2002, p. 174).

5.7.2 Stratification: Design

The 'conceptual side of expression and the expression side of conception' (Kress and Van Leeuwen 2010, p. 5) form the stratum design. The term is often understood as pertaining to designers (of shoes, cars or sounds) while often, artistic activities such as composing or writing, are considered something different altogether. The usage here is not suggesting that artists are in fact designers, but to signify the re-configurability of artistic practices. As Kress and Van Leeuwen (ibid p. 45) argue, in the past, at least in formal art worlds:

> Music was the domain of the composer; photography was the domain of the photographer, etc. Even though a multiplicity of modes of representation were recognised, in each instance representation was treated as monomodal: discrete, bounded, autonomous, with its own practices, traditions, professions, habits.

The term design in this context is not so much about 'giving shape' but mainly the other meaning of the word: the structured and planned activities related to constructing something complex in response to a certain (set of) need(s). In the words of Kress (2010, p.6): '*Design* focuses on an individual's *realization* of their *interest* in the world… it is prospective, looking forward'; this centralises one question: 'What mode for what purpose?' In the case of a stadium concert amplification may appear to have only one purpose, distribution of sound; but with Emmerson's functions it becomes clear that amplification as a technical mode of communication can have many purposes. The purpose of using amplification follows the designer's intent, which can be outlined in scores that prescribe the use of amplification, sometimes in great detail. For performances of music that are less bound to a tradition of scores the use of the amplification resources are detailed in the rider.

Even when the intent is 'just' making things louder, loudspeakers, loudspeaker systems and microphones can be selected and installed (ie designed) to be highly visible or the opposite, unobtrusive. German microphone brand Schoeps produces a whole series of microphones, stands and paraphernalia in a veneer that reflects very little light and is therefore harder to spot on TV or on stage. Miniature radio microphones are attached to

performers' heads, hidden in the hairline, out of sight. Others go to great lengths to ensure the artefacts can be seen: Australian rock legends AC/DC toured with an enormous loudspeaker system that according to the system designer Harry Witz was: '25% bigger than the Stones No Security Tour' (quoted in Johnson 2008).[55] American rapper Flo Rida adds to the artefactual of his microphones by dressing them in special shields, designed by popular jewellery, or 'bling', designers.[56]

5.7.3 Stratification: Production

The stratum production relates to the expression of a design and the specified parameters, which are articulated using specified (or not) materials. Bach's keyboard works can be performed on a piano, a harpsichord or other instruments.[57] Composer Louis Andriessen's composition *Workers Union* (1975) can be performed by a band, an orchestra or using empty cans of choice, as long as the sounds produced are loud. For other works the instrumentation can be much more prescriptive, for instance in works for specific tuning system (like Adrian Fokker's 31-tone organ) or Jon Rose's *Music from 4 Fences* (2009) written for the Kronos quartet to be performed on amplified sections of barbed wire fencing. Perhaps the most extreme example of specificity (but also of intentional dislocation) is Stockhausen's *Helicopter String Quartet* (1992/3): the members of a string quartet play inside a helicopter that takes off, flies around and lands.[58] The audience hears the sounds of the instruments and the helicopter that are transmitted to the concert venue, following the events on TV screens. Conceptual as such a performance may seem, the composer still had an eye for the performative aspects. The show starts with the musicians and pilots on stage, introduced by a moderator (can be the sound projectionist); they walk to the helicopters outside, followed by a camera that captures their boarding, the start of the engines and take off. After landing, the eight

[55] Rumor has it that in their earlier days AC/DC toured with a gigantic loudspeaker system, half of which were empty boxes. Unfortunately I have not been able to substantiate this gossip.
[56] The shields remind me of the standards carried around by the Roman legions, tapping into ancient notions of power.
[57] Violinist Janine Janssen, with Maxim Rysanov and Torleif Thedéen, recorded transcriptions of Bach's two and three part 'Keyboard Inventions' for violin, viola and cello (on *The Bach Album*, 2007).
[58] I was lucky enough to be on board helicopter no.4 with violinist Irvine Arditti during the 1995 world premiere in Amsterdam. The specifics are: string quartet, 4 helicopters with pilots and 4 sound technicians; 4 television transmitters, 4 x 3 sound transmitters; auditorium with 4 columns of televisions and 4 columns of loudspeakers and sound projectionist with mixing console/ moderator (ad lib.)

protagonists walk back into the room, are seated on stage and partake in a brief discussion, or debriefing, with the moderator about their experience.

5.7.4 Stratification: Distribution

The stratum distribution is closely related to production, it is not neutral to a work or a work's design. In a general sense, there are political or marketing dimensions to choices being made about how, where and when a product is sold. With a record or cd as distributing medium an overlap between the production and distribution strata can be perceived, for instance as demonstrated and discussed by Glen Gould (in *The Glenn Gould Reader,* edited by Tim Page (1984)). The contribution to a (classical) recording by a producer or recording engineer can be of vital influence, for instance in editing and take selection. In pop and rock music, recording and producing take part in the production stratum, but recordings can be mastered differently for distribution on vinyl, CD or download, designated for different distribution trajectories. Distribution of recordings can add other modes, such as the visual content on a record sleeve or CD cover in text and images. The disappearance of the actual artefacts (discs, sleeves, cassettes) as a consequence of the Internet has some interesting consequences.[59]

Closer to this thesis, at a stadium concert large-scale amplification is used to distribute what is produced on stage. The influence of that amplification is of great importance to the musical experiences of the audience (eg system design, sound mixing and amplification level but also the acoustic properties of the stadium).

5.7.5 Stratification: Configurations

When we look at amplified music from the perspective of discourse, the remaining three strata are configurable in different ways. At a rock concert the amplification is part of the way that music is produced, the strata of production and distribution overlap or fuse; at an orchestral concert that is amplified the amplification is external to the production of the music (the players and their instrument; it is only used to ensure that a large crowd can hear. That is to say the production and distribution strata are separate layers. As discussed above, the process of classical composition is more formal than for instance a rock song.

[59] For instance in relation to the visual lack that Corbett (1990) discussed.

Rock bands usually learn their songs and arrangements by heart, using many different ways or procedures to arrive at a 'new song'. For instance in the beginning of the process of creating (writing and arranging), lyrics and chords are sometimes written out (on the back of an envelope for instance); licks and riffs are played or sung to other players, taking shape through jamming and rehearsing.

When we look at the configurations of the strata of production and distribution the question 'what happens when the power fails?' provides a good insight. When the source under amplification is a group of performers playing acoustic instruments, the amplification may fail but they'll still be audible at least to people close enough. When more sources are electric or electronic not much will remain, but acoustic instruments and singing voices. The remaining instruments are not necessarily in balance: imagine a rock drummer and a singer; the latter will barely be audible. Distribution can be separate from production but they do not necessarily form an opposing pair, the two can move along a sliding scale.

When looking at amplification as a semiotic resource for performances of music the strata can be reconfigured in relation to a desired decorum but also creating or seeking new decorums. Two examples of concerts where the decorum is ambiguous in relation to the use of amplification are described. First: American singer and violinist Marques Toliver opened as support act for British dubstep singer-songwriter James Blake, at the Metro Theatre, Sydney.[60] The Metro is an old movie theatre that has successfully been developed into a pop and rock venue. The former busker sang soulful songs accompanying himself on his amplified violin, capturing the audience well enough; in between songs he performed virtuoso violin etudes, which were received rather indifferently. That annoyed the performer who responded by suggesting the crowd should listen to him play attentively, in silence. This did not happen, creating an awkward situation, making the musician clearly uncomfortable. To make matters worse, the mixer kept trying to pull up the levels, which only made the crowd noisier and the sound thinner and harsh.[61]

[60] 30 July 2011.
[61] To avoid feedback from the violin's microphone the mixer had to filter out increasing amounts of low-mid frequencies (eg from 200 to 500hz) creating a timbral imbalance and losing the 'warmness' of the violin's sound.

The second example also took place in Sydney, at a nightclub called The Standard: the reputable Australian Chamber Orchestra (ACO) who are always looking for ways of combining the old and the new, performed works by Paganini, Vivaldi, Crumb and Schnittke, but also pop songs by Radiohead and Nick Drake in a program called 'ACO Underground'.[62] All the works were amplified and the musical leader for the night, violinist Satu Vanska sang the pop songs with a breathy, reverberated, close miked voice (for which, as I maintained earlier amplification is a necessity). The audience was partly seated ('jazz club style' at round tables close to the stage), but a large number of patrons were standing. In combination with the amplification this created a 'club night' atmosphere, with one big difference, the audience was silent. Vanska is cited in a preview for the concert (Cunningham 2012): 'Amplification is one of the last taboos of classical music, but with modern technology the sound is so real that I prefer it often to a bad acoustic in a hall'. Her remarks capture many elements of this thesis, addressing matters of acoustics (that particular nightclub is indeed a very dry room, with additional hindrance of a noisy air conditioning making amplification a requirement), the 'realness' of sound and the question whether amplification is still a taboo.

5.7.6 Stratification: Reconfigurations

A number of different fusions can be observed when two different musics meet and (when successful) over time new decorums develop. Classical music played amplified on outdoor stages (eg symphony meets rock festival) was mentioned; it is now so common that for instance in the Netherlands a company has specialised in providing specific microphones in quantities and infrastructure for large numbers of input channels to accommodate the amplification of orchestras. Their services include specialised crew who often have a relevant musical background, are familiar with the repertoire and comfortable working with orchestras (that come with their own social structures, hierarchies and conventions). Another interesting specialisation can be found in orchestras that specialise in performing amplified repertoire, for instance in The Netherlands the 'Metropole' orchestra that performs with a variety of soloists, from stunt guitarist Steve Vai to trumpet player Markus Stockhausen. When an orchestra or string

[62] 1 April 2012.

quartet performs on an outdoor stage, amplification technology can be used to make it louder in order to distribute it to a larger audience. As I have argued before this is not a neutral distribution, as a consequence of the transduction effects it will sound like an amplified orchestra or an amplified string quartet. All the different microphones have a certain perspective; the loudspeakers reproduce the sound in a preferred direction rather than in all directions, different from acoustic instruments, which have very different directional patterns.

Things happen the other way around also: amplified music at classical concert halls or venues and traditional symphony orchestras working with artists from other genres. Sinatra performed with the Los Angeles Philharmonic at the Hollywood Bowl in 1943, and from 1944 Norman Granz started organising his Jazz At The Philharmonic (JATP) tours (with amplified vocals). After WWII, with a very keen audience in Europe, jazz musicians toured the concert halls of the European capitals (including JATP from 1952). In the 1970s at least in Amsterdam, The Doors, Pink Floyd, Janis Joplin, Frank Zappa and other rock and pop ensembles performed at the Concertgebouw.[63]

In 1999 rock (or rather heavy metal) band Iron Maiden performed some of their songs accompanied by the San Francisco Symphony orchestra. On the commercial DVD release *S&M* (1999) of the event members of the string section can be seen wearing earmuffs. Hearing protection has become an OH&S issue in orchestras (think of the woodwind and string players with brass players playing down their necks); performing with a rock band may have expanded those issues to new proportions. With respect to decorum, an interesting aspect can be witnessed; before the concert starts the orchestra is seated as per usual, waiting for the entrance of the conductor. Lead singer Bruce Dickinson is on stage, seated with the orchestra, instead of entering with the conductor, as a vocal soloist would in the classical tradition. That is however one of the few remnants of classical decorum, the audience is certainly not silent as they would be at a performance of a symphonic vocal work.

The Kronos string quartet, who usually perform with their (acoustic) instruments amplified have been playing Hendrix' 'Purple Haze' as an encore to concerts since the

[63] There is a good sounding bootleg of Janis Joplin's concert at the Amsterdam Concertgebouw in 1969; the famous reverberation is audible all through the recording. It was initially made by Dutch radio broadcaster VPRO.

1980s, with the sound of their instruments distorted.[64] In 2006 Sting (of The Police fame) together with lutenist Edin Karamazov released a recording of songs by English renaissance composer John Dowland (Potter & Sorrel 2012, p, 232). Interestingly when Sting and Karamazov performed these works live they used amplification, maintaining the singer's amplified timbre and social distance, corresponding to how his voice sounds on all his famous recordings.

To summarise, from a perspective of multimodal stratification the strata production and distribution begin to overlap or even merge. This is stronger in musics where amplification is a requirement, and less so in acoustic musics that do not require amplification for the actual production of the audible music. The strata merge along a continuum from reproduction to production and as such inform the design for a concert, additionally, concerts can be designed to fit an existing decorum, or seek or create a new decorum.

5.8 To Review: Agency

This chapter described the practice of amplifying music from a perspective of agency. One important aspect I would argue is that in some aspects the musicians themselves are not powerful agents in the whole process although there are of course exceptions. Obviously they choose their own sound crew, but they have to rely on commentary from trusted sources in the audience to judge a mixer's competence and suitability.

Many problems of amplification can be overcome when the stakeholders are involved in the process; in optimal conditions the audience as stakeholder is represented by each one of the others. If the process fails, ie when the audience is not properly represented, there are currently few options for patrons to respond, recognition of the audience as stakeholder in amplification of music could provide a means of improving results.

This chapter shows the importance of the role technology plays at concerts mediating between what performers express and what audiences hear. This is so crucial to music performance that treating it as a neutral channel that does not need the involvement of any of the stakeholders but the sound engineer(s) is not beneficial to the

[64] http://www.djnoble.demon.co.uk/ints/KRONOSQ.UAR.html <viewed 1 August 2012>

results. Knowledgeable dialogues should be part of every occurrence of amplification, discussing functionality of amplification in relation to a venue's acoustics and desired amplification level.

Conclusion

Electronic amplification is a semiotic mode that offers additional means of expression to performances of music. Music is social action, live but to a lesser extent also when recorded. Music is not just what musicians do, but how it is presented and how people experience it as well. The notion of music as action is overshadowed by the primacy of recording and an emphasis on silent listening traditions in the Western music discourse.

Two important turns in music history, the evolution of formal concert practices and recording technology, are important causes of this situation. Traditionally, perhaps with some academic exceptions, music is either recorded or not, forming a binary opposite. With live music and electroacoustic technology this is not the case; there is no binary opposition of amplified versus unamplified, neither in the history of music performance, nor in current practices. Theoretically, and indeed from an historic perspective, even an acoustic performance in a dedicated performance venue is amplified by technology: not microphones, amplifiers and loudspeakers but simply the specific acoustics that were created intentionally. Electronic amplification practices take place along a continuum ranging from no amplification at all, to pop and rock concerts with sound levels possibly nearing the threshold of pain. A continuum of amplification practices and functionalities slides along with amplification level: from the reinforcement of one instrument or singer to restore or modify a balance; zooming in on timbral aspects of sound sources; to loud amplification in a sports stadium, assuring that everyone can hear while affording an audience to sing, shout, scream, jump and dance along. With increasing amplification levels sounds become more and more detached from their sources. Rather than localising them as coming from the source we identify visually, the sounds are heard as coming from the loudspeakers. In theatre and Broadway musicals, judging from the views of some critics, this appears to be a problem, much less so at rock and pop concerts. In electroacoustic composition traditions this detachment can be used as a compositional tool or parameter, such dislocation being intentional adding to a music's complexity.

The use of microphones, amplifiers and loudspeakers is not neutral with respect to the sonic parameters of a sound source under amplification. What I have termed 'transduction effects' influence timbral and dynamic parameters; directional properties of the transducers create a different relation to a venue's acoustics when compared to the directional properties of musical instruments or the human voice. The most essential transduction effect fuses the technical and the social by maintaining a particular sonic proximity, as a consequence of the chosen microphone properties and reproduction technology. This aspect, 'social distance' can equally be found in radio broadcasts, telephones and recording. Social distance is a common feature of human-to-human communication and as such our knowledge of the different grades of intimacy or lack thereof is experiential, which is an explanation for its strong meaning potential when used in music performance. It is an important feature of the popular singing voice and electronic amplification and as such becomes essential to the performance of popular music. Shifts in singing styles, in the USA in particular, were already underway at the start of the 20th century. The introduction of radio in the 1920s, enhanced by the development of electronic recording had a big impact on vocal delivery. No longer did 'big' voices drive mechanical recording, but soft voices that did not distort the sensitive early microphones. Radio shows were broadcast live usually with a studio audience; one microphone would pick up a vocalist's voice and orchestra or band to accommodate that broadcast. The microphone's signal would not be played back in the same room, ie amplified to the studio audience as both transducers connected and active in the same room would result in audible feedback loops. This problem was solved with the introduction of the directional (ribbon) microphone in the early 1930s. As a consequence, the impact of electronic amplification on the popular singing styles was limited in comparison to radio and recording. Furthermore, changes in vocal delivery in the Broadway musical and show traditions took place mainly before the introduction of amplification.

There must have been more experiments with vocal amplification before the early 1930s but there are no conclusive sources, further research is desirable. Both Rudy Vallee and Bing Crosby are candidates for being the first to regularly use electronic amplification for their singing voices. Soon after the introduction of the miraculous

directional microphones electroacoustic performances of music reached a milestone with the opening of the Radio City Music Hall in New York.

Dislocations

In the introduction I compared different technologies with respect to a number of dislocations in proximity, time, visibility and level. When compared to recorded or broadcast music, performances of music are actually very special situations: performer(s) and listener(s) are in the same venue at the same time. That does not sound out of the ordinary but when considering how relatively little music is experienced that way at the present time, while until 1877 it was the only way, this is an exceptional situation. The impact of electroacoustic technology on music is unprecedented. As several authors mentioned, before the phonograph there was no distinction between live music and recorded music, perhaps with the exception of player pianos, music boxes and carillons.

As observed, social distance is one of the crucial factors in music performance, and its relation to acoustics and acoustic technology (ie architecture but also recording and amplification) can be traced back to pre-history. A relation over the ages between acoustics and social distance emerges, in which decorum is an important factor. Dynamic range came into that mix when it became a much more important matter of musical expression with the romantic composers. The silent audience tradition allowed for an increased dynamic range, from the intimacy of a single string or woodwind player to the bombast of a brass fanfare.

Euroclassical concert traditions started in the music rooms of the well to do. Primarily as a consequence of the size of those rooms these were intimate performances, provided the attendees were actually listening, but indeed an intimate setting was created. The much larger romantic concert halls, in a very public setting, still offered or suggested intimacy through the increased dynamic range. To emphasise this once more, the specific acoustics of the successful halls aided simultaneously in the production and distribution of the music performed on stage.

From a perspective of acoustics, creating distance and dislocation to benefit (religious) rituals indoors, in caves and later in cathedrals can be contrasted with the actual distance, outdoors, at spectacles in the enormous Greek amphitheatres. Attended

by possibly over 10,000 people (presumably silent) watching an almost two-dimensional performance on the shallow stage, with regard to the distance and what is known about the declamatory styles, these were not intimate performances at all. Contemporary stadiums, some much larger than the ancient amphitheatres, offer remarkably intimate musical performances over large physical distances. This intimacy, as observed, is mainly suggested by the close-miked voice, which is experienced as such no matter the distance.

Social Semiotics

Music is meaningful on many different levels; the important focus of social semiotics is that meaning is not static. Meaning is made and remade, and as such an activity, supporting the notion of music as social action. The social semiotic approach to modality was applied to look into the specific rearticulations of electronic amplification. Different criteria with regard to modality can be observed, including authenticity. A performance can be authentic with regard to its decorum, and with regard to the technology in use, audible as well as visual. The technological criteria have a strong historical component too, suggesting that we evaluate the new from a perspective of the old. In a discussion of modality and music performance, again the primacy of recording surfaces, informing a specific modality (ie a coding orientation) that allows an enquiry into the rearticulation of Theo van Leeuwen's articulation parameters. This 'acousmatic modality' is high when a performance is more like a recording (incorporating pre-recorded material, or miming strategies) and low when a performance is acoustic. The orientation of this modality goes down from a performance aspiring to be a recording to a performance being not like a recording at all. Again this is a sliding scale similar to the level of amplification and the level of detachment, when fully detached an acousmatic condition is achieved, even though source and reproduced sound are present in the same space at (roughly) the same time.

After Erving Goffman I have used the term decorum to formalise the conventions, traditions and rules around performances of particular musics, also inclusive of the expectations that audiences may have when going to a concert. Decorum examined this way allows for an analysis of changing listening traditions and experiences, at concerts and, as a consequence of the primacy of recording also pertaining to recorded music. At

loudly amplified concerts affording an audience to participate, performers and listeners become coparticipants. Works known from recordings are remade in a new context, the audience being part of creating the musical experience that is the concert.

Amplification never happens by accident or external to the realisation of concerts of music, it is intentional and includes a number of choices with regard to available resources. Loudspeaker and microphone selection and positioning are vital sound engineering skills, once the function of the amplification has been recognised in relation to the acoustics of the venue at hand. However, I have emphasised that these are not just technological matters, the technical is interwoven with a number of contextual and social factors: a venue's specifics, including acoustics and decorum. Musicians, promoters and in some situations the audience are agents and stakeholders. In a larger domain, city councils and people affected by noise pollution become stakeholders as well. Patrons (and musicians!) choose to undergo loud sound pressure levels when going to a concert, provided they are aware of the decorum of certain concerts. That is no different than other unhealthy lifestyle choices, for instance smoking and drinking. Information is an important aspect with regard to these issues, and comparable to warnings on cigarette packaging, assuring possible consequences are known is essential. From the perspective of this thesis that implies that (prospective) patrons have to be aware they will be subjected to high sound pressure levels for a time exceeding the safe limits.

With regard to pollution, when one organises a party it is good form to inform the neighbours of possible disturbances, perhaps inviting them over for a drink. When organising a large outdoor concert similar steps of politeness can be taken. Amplification in such cases gives organisers the power to potentially disturb a whole town; the weather always has a big influence in these situations, making the area and the amount of pollution very unpredictable.

To paint the full picture it is important to look at matters of agency, whether focussing on music, on technology or both. With respect to multimodal stratification, electronic amplification becomes part of the stratum 'production', depending on functionality. Performances of traditional ensembles that are acoustically balanced can be amplified so a larger audience can be addressed with the amplification having a distributive function. At concerts of ensembles that rely on amplification to produce their

sound (eg rock bands) the strata ‘production’ and ‘distribution’ merge, again along a continuum of amplification levels. These two strata flow from decisions made by agents and scripted in a third stratum: ‘design’. Questions of agency in relation to these strata: principal agents bring together venues and music, making essential choices in relation to amplification and sound system design requirements. Sound system designs detail all amplification technology but may include choices of acoustic adaptations. Some venues can be modified using curtains or reflectors, some even allow for a change in cubic volume by lowering or raising the ceiling; others have electroacoustic systems that can increase the reverberation time. Additionally, channel separation can be increased by using acoustic barriers or scrims between instruments to avoid ‘bleed’: microphones picking up sound from other instruments than the designated source. Details for individual performances are often formalised in a document, or a script, called a technical rider; sometimes such details are prescribed in the score for a composition.

When the strata of production and distribution fully merge at concerts, performances appear to become more like recordings, raising issues of authenticity. These issues are enforced by the use of for instance pre-recorded material and miming strategies. There are many different reasons why performers may choose to use these strategies in many different situations. That is why I argued, after most notably Christopher Small and Philip Tagg, that it is an ideological pitfall to evaluate such performances with only a single decorum in mind, particularly the silent listening traditions at the concert halls of the euroclassical tradition.

Literature

One of the instigations for this research project was the suggestion that this subject is not well covered in existing literature, regardless of discipline. From that aspect this work is practice-based, ie finding out how this (my) professional practice is reviewed and treated in existing literature. Generally amplification is treated as a ‘turn-key’ technology: when something needs to be made louder microphones, loudspeakers and engineers are added and that is it. In a way I can be considered lucky to be able to ‘open up’ such a rich and relevant field of enquiry into our musical experiences.

Some authors treat electronic amplification as a mass medium, which, I argued, is inadequate. That approach brings older paradigms (not to say dogmas) of social critiquing on board that are not helpful in a broader analysis of the use of this particular technology. Commercial concerts play their role in the global economy of a commodified music market, and are as events part of mass culture, regardless of genre. The day after a stadium concert the same crew may be rigging some of the same loudspeakers in an abandoned factory to amplify a string quartet or an avant-garde work of novel instrumentation. The context is defining, not theoretical or critical ideas about the impact or even the essence of technology.

Only a few authors, notably, Simon Emmerson, Denis Smalley and Theo van Leeuwen, take a systematic, analytical approach, with the latter providing a critical and analytical framework, and the former two a functional systemic approach. A few specialised sound engineering books are available, focussing on the technical and physical aspects, with very little attention to its application and social implications. I argue that a thorough analysis of this technology needs a multidisciplinary focus that includes the physical, the technological, the musicological and the social.

Electronic amplification is a special acousmatic situation that is philosophically challenging because of the co-presence of the sources. Rather than seeing that as a problem or a necessary evil, I argue that this situation is an opportunity, adding meaning potential, and creating room for play in music and theatre. I have added to the usage of the much-used term acousmatic to underline the fundamental similarities in the use of transducers, whether for recording, live electronic treatment or amplification. To abuse the term even more I have involved Scruton's acousmatic experience to emphasise that, philosophical problems or not, I think that music can be abstracted away from its mode of production; it is just not telling the full story.

I reflect on my profession as intermediary; this requires, apart from technical knowledge, skills and experience, an understanding of the physicality and perception of sound, musicality, but foremost great communication skills, underlining the importance of the social aspects. The intermediary is responsible for what an audience hears (which includes a risk of crossing safe sound level boundaries) and equally responsible for what a performance sounds like to an audience. Complications in the relation between the

stakeholders are not always acknowledged, missing out on the opportunities of dialogue in an alignment of shared goals, predominantly why and how and how loud electronic amplification is used. Mono-disciplinary approaches based purely on technological, acoustical, musical or social assumptions, miss valuable aspects of how this technology gives shape to what we do, an observation that can possibly be extended to other technologies that are strongly interwoven socially. Multimodality, as used in this thesis, opens up possibilities to deal with the complexity that multidisciplinary analysis brings, to which I hope I have added with the work presented in this thesis.

Recommendations

The main recommendation than can be distilled from this thesis is actively pursuing dialogue between the stakeholders. For that to happen those stakeholders have to identify themselves as such. That does not mean that all involved have to become technologists but a realisation that the goals that are presumed are generally shared and better obtained when expectations are aligned. In addition to that a stronger realisation of the audience as stakeholder is needed, possibly sustained by formalised ways of obtaining their feedback. The technologists in this profession are multi skilled as I hope has become apparent from this thesis, however their communication skills are essentially what has the biggest impact on the quality of the amplified musical experience. Quality is hard to express but can be identified in the number of stakeholders that see their interests looked after and their goals fulfilled.

Local governing bodies are long-term stakeholders when it comes to the development of new venues. Building new venues modelled on traditional decorum is great for sustaining classical music practices, but becomes questionable if the majority of concerts will be of amplified genres. Electroacoustic technology can help in creating compromises that reflect current musical practices; the multimodal approaches proposed in this thesis can aid in such debates.

Research agenda

The importance of context, as a consequence of the ephemeral outcomes of the processes involved, makes empirical data gathering very problematic. ‘Just notable differences’,

common in psychoacoustic experimentation, are not very likely to be measured in a venue with thousands of singing and dancing people. However the aspect of dislocation that was discussed in the third chapter has important perceptive and cognitive implications that can inform research about musical performance while engaging with research done into auditory and visual fusion. A suite of experiments can be designed in which performative contexts are replicated (venue, stage, lighting) while subjects change simple amplification parameters (ie level and dynamic routing or 'panning'); such changes, a subject's actions, are quantifiable while contextual parameters eg different musics, microphone and loudspeaker choices but also lighting and background noise, are changed.[66]

As several authors, most notably Simon Emmerson, have mentioned, the history of music amplification is under-researched. While some of the key players from the 1960s are still alive some urgency should be recognised in harbouring the oral knowledge, before it is no more.[67] Documenting this history is valuable from musical and musicological perspectives, but also for cultural and media studies. The importance of the relation between recording technology and music is attracting more and more scholarly attention as can be seen in a growing amount of publications and conferences around the 'Art of Record Production' theme.[68] Ultimately it may provide solid ground to this profession that is decentralised in many ways, but although often operating locally, supports a global music industry.

Power Failures

The initial title of this research project was 'The influence of electronic amplification of music', a very complex question that does not allow for many general conclusions. One important aspect that might provide some enlightenment is the 'power failure' question: what happens when the electricity drops out? I will end this thesis with a reference to the use of feedback in Steve Reich's *Pendulum Music* (1968) which was

[66] Reliable acoustic sources with little deviation can be realised by using, for instance, digital player pianos (cf Goebl & Bresin 2003).
[67] The AES has a historical committee (AESHC) that has an oral history project. They have created a DVD with interviews, amongst others with the legendary Bill Hanley. http://www.aes.org/aeshc/
[68] A new book around that theme has just come out, edited by Simon Frith and Simon Zagorski-Thomas called *The Art of Record Production: An Introductory Reader for a New Academic Field*, Ashgate 2012.

mentioned a number of times. In this work amplification is not a means but a goal, it has become the essence and the texture of a performance. The work has two performers set off two or more microphones hanging by their cables, over loudspeakers facing upwards. The microphones' movement creates a feedback loop fading in and out (Reich & Hillier 2002, p. 31). The performers who launched the microphones:

> Sit down to watch and listen to the process along with the audience. The piece is ended sometime after all mikes have come to rest and are feeding back a continuous tone by performers pulling out the power cords of the amplifiers.

Ultimately pulling the plug that feeds the electronic systems can become part of a performance, an everyday act becoming a meaningful gesture.

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