Failure and Success of Dummy Head Recording: An Innovation History of 3D Listening

1. Introduction and literature review (Theme)

Visitors of the 1973 International Radio and Television Fair (Internationale Funkausstellung) in Berlin were invited to listen to an unusual demonstration tape in the glass studio of the ARD (Arbeitsgemeinschaft der öffentlich-rechtlichen Rundfunkanstalten der Bundesrepublik Deutschland/Working Pool of the Broadcasting Corporations of the Federal Republic of Germany). The participants had to wear headphones and could then follow a mundane conversation of a father with his little son. What was so special about this recording was that listeners could locate the reproduced sound in space as if they were following the original sound event; they could trace every single movement of father and son in their (virtual) apartment. Journalists described how listeners often turned their heads during the demonstration expecting someone to be standing behind them.

The recording, that offered this astonishing sonic realism, had been made with a dummy head (Kunstkopf) developed at the Heinrich-Hertz Institute of the Berlin University of Technology. The three inventors of this technology, Ralf Kürer, Georg Plenge and Henning Wilkens, used an artificial head with two microphone inserts embedded at the eardrum locations. The dummy head emulated the sound-transmitting characteristics of a human head and allowed the recording of time and frequency differences between the two microphones. These binaural recordings (also called Kunstkopf-stereophony) contained all necessary acoustic signals to enable the listener (only when using headphones) to perceive the spatial characteristics of the original location and to trace the reproduced sound sources in three dimensions.

My research project will investigate the fascinating story of Kunstkopf-stereophony, promoted as “the next big thing” in audio technology in the mid 1970s. It will reveal the entangled history of recording technology, (professional) listening practices, recording engineers, radio makers and audiences, and try to understand why binaural recording technology did not become the new audio standard.

In 1973, the media coverage of the dummy head was extensive and enthusiastic. It further intensified with the broadcasting of the first binaural radio play that was transmitted during the radio fair. The Berlin station RIAS (Broadcasting in the American Sector) had cooperated with the dummy head inventors to produce the science-fiction play called “Demolition”, which was broadcast on September 3, 1973. The reaction of radio listeners and journalists was overwhelming. The listening experience was described as spectacular and sublime. The Kunstkopf-stereophony was considered “super-stereo” and ascribed the label of the “most natural recording technology” available. Many journalists expected that the new technology would revolutionize sound recording in the near future. Binaural recording seemed to finally fulfill the promises of the recording industry since Edison’s tone tests: absolute faithfulness of the recording to the original sound event (Schmidt Horning 2004; Thompson 1995).

The new technology seemed to be all the more promising because it fit in with the established stereo standard (developed throughout the 1950s) and with modern radio technology and its transition

to FM (stereo) broadcasting. The support from radio makers like RIAS chief-editor Ulrich Gerhardt (director of “Demolition”), who were keen to strengthen radio’s position compared with the increasing importance of television, also seemed to improve the dummy head’s prospect of success. Although the missing loudspeaker compatibility was seen as a challenging technical problem, the inventors were confident to soon overcome this problem. In the following years an impressive number of binaural radio plays, live concert recordings, and studio productions of serious and pop music were produced (not only in Germany).

However, at the end of the decade, the use of Kunstkopf-stereophony in radio and music recording and reproduction had come to an end. Despite the initial hype, dummy head recording, just like its rivalry technology of quadrophony, turned out to be a “failed innovation” (Bauer 2014). One reason which has been attributed to this failure was that the new sound technology could not gain credence in the professional community of recording engineers. In addition, the inventors blamed the hi-fi industry for boycotting dummy head recording as major manufacturers had recently invested into the competing technology of quadrophony. Furthermore, the regional broadcasting corporations of the ARD were divided into friends and enemies of the dummy head as one newspaper article in 1976 reported. Thus there were institutional, technological, communicational, and socio-cultural reasons for the failure of the dummy head.

While binaural radio and music recording failed, the development of dummy head technology did not come to an end. The Berlin inventors, together with the microphone company Neumann, and two research groups at the University Bochum and at the RWTH Aachen University continued to improve binaural recording. The latter group, situated in the Faculty of Electrical Engineering, developed (with financial support from automotive manufacturer Mercedes Benz) an alternative dummy head system. In 1986, one of the engineers, Klaus Genuit, founded a spin-off company in Aachen: HEAD acoustics. HEAD acoustics engineered the Aachen head system and specialized “in the area of head-related recording and playback systems and aurally-accurate analysis of sound events, as well as in the field of communication measurement technology” (HEAD acoustics website). Although, Genuit claimed that the Aachen dummy head could also be used for music recordings, the new field of application became industrial sound design and noise control. The successful comeback of dummy head recording in acoustical engineering came close to the original idea of the Berlin inventors, who had initially searched for a device to judge the acoustic quality of concert halls. Since the late 1980s, the Aachen dummy head system became an important measurement instrument in technical acoustics and has been effectively used in sound design and noise control, in particular in the automotive industry (Cleophas & Bijsterveld 2012).

My project will investigate and compare the two trajectories of the dummy head recording technology: the failed one in the field of radio and music recording, and its comeback as a measuring device in technical acoustics. This project will focus on the co-construction of the Kunstkopf-technology by its developers and professional users, paying specific attention to the parallel histories of the

Kunstkopf in the fields of broadcasting and technical accoustics. This approach asks for a multi-disciplinary and comparative research design, combining conceptual tools and methodologies from disciplines such as history of technology, sound studies and innovation studies. The geographical focus will be on Germany (as the main producers and users were located here), but earlier developments in binaural technology in the Netherlands and the United States of America (Sunier 1960) will be taken into account, too. The project's time period encompasses 1960 to 1990, however, earlier developments in binaural technology since the 1920s will also be considered. In addition, the history of dummy head recording will be embedded into the broader history of sound recording technologies since the end of the nineteenth century. For my investigation, I will combine research strands from different fields: namely media and sound studies; history of technology; and as an analytical framework, innovation studies literature on path dependencies.

So far, the development of dummy head recording has been a desideratum in media studies, sound studies, and the history of technology. There are a few popular accounts (e.g. Sunier 1960) and historical reviews of dummy head systems written by engineers and scientists who paid little attention to the complex reasons for the failure and success of the technology (Wade & Deutsch 2008; Paul 2009). I will draw from a number of excellent studies on the technical and cultural development of (music) recording technology since the invention of the phonograph in the 1870s, with a focus on the first decades up until the Second World War (e.g. Braun 2004; Katz 2004; Sterne 2003; Thompson 1995), and some interesting studies that explicitly deal with recording engineers and audiophiles (e.g. Barry 2010; Perlman 2004; Porcello 2004; Rawson 2006; Schmidt Horning 2013; Zagorski-Thomas & Frith 2012). In addition, there are many good studies on radio history and culture (e.g. Badenoch & Fickers 2010; Douglas 1999; Fickers 1998, 2012; Wagner 2005/2008), but only relatively few works on radio plays (e.g. Krug 2003; Niebur 2010; Pinto 2012; Schöning 2001), and the history of acoustical engineering (e.g. Thomson 2002). Another important strand of literature from which I will draw from, is the media and sound studies literature which deals with listening practices in different domains (for an overview see Pinch & Bijsterveld 2012). Finally, I will draw on innovation study literature on path dependencies (e.g. Duschek 2010, 2012; Schulz 2008; Sydow & Schreyögg 2010).

My own expertise, with regard to the proposed research project, lies in the field of the history and sociology of car sound design, noise measurement standards, and noise control engineering (Bijsterveld et al. 2014; Krebs 2012a). Furthermore, I have investigated listening practices of scientists, engineers and mechanics. I have shown that professional listening habits are historically and culturally situated practices; they are entangled with ways of vocational training, collective identities, the carving out and maintenance of jurisdiction, and the establishment (or contestation) of socio-technical hierarchies (Krebs 2012b, c, 2014).

2. Hypothesis and/or Research Objectives

The two distinct historical trajectories of the dummy head recording technology are interesting cases of the ruptures and discontinuities in the development of a sound technology. These ruptures reveal a multiplicity of listening practices, which would otherwise be hidden in non-discursive practices. The failed establishment of dummy head recording in radio and music recording helps to reveal the historical specificity and plurality of "listening positions" (Lacey 2000) of recording engineers, electrical engineers, radio makers, and radio listeners. Narrating the paths (or life trajectories) of the Berlin- and Aachen-dummy heads emphasizes the shifting significance and meaning of binaural technology. Conceptualizing dummy heads as "biographical objects" (Hoskins 2006) reveals how binaural listening was recontextualized through its move from radio recording to acoustical measuring.

As an analytical framework (which I will further develop in the methodology-section) I will use insights from innovation study literature on path dependencies. More precisely, I will look into institutional, communicational, technological, and socio-cultural path dependencies that hampered or enabled the success of dummy head recording in the two fields of application. I argue that socio-cultural path dependencies in music recording played a crucial role in the failed acceptance of the dummy head microphone in radio and music recording, as well as in the successful introduction of the dummy head as a measuring device in technical acoustics. To show this I will describe the "*aural* thinking" (Susan Schmidt Horning 2013, following Eugene Ferguson's (1992) reasoning about the mind's eye of engineers) of the different actors involved, in particular, the aural thinking of acoustical engineers, recording engineers, and radio makers. I will further argue that new ways of listening and envisioning sound evolved around the new sound technology of dummy head recording: an intriguing example of the co-construction of sound technologies and listening practices.

The research project has two main objectives: First, it will help to better understand the various conditions for technical innovation in the media industry. I argue that studying the path dependencies of a sound technology like dummy head recording will enhance our insight into innovation processes in the media industry. The project will furthermore provide insights into (professional) listening practices and thus contribute to a more general understanding of the nature and historical situatedness of *aural thinking*. The case of dummy head technology is of particular interest here as it represented a crucial episode in our general understanding of human spatial hearing (Blauert 1997 [1974], 2005; Plack 2010).

This project will be based primarily on archival sources, contemporaneous literature and oral history interviews with relevant protagonists. Different archives have already been consulted (pre-checked) and they demonstrated that the necessary resources are available. In addition, preliminary interviews with key actors have already been conducted.

3. Innovation/originality

The research project is innovative in three ways: Firstly, it will combine insights from three different research traditions: namely sound studies, innovation studies, and the history of technology. The merger

of these different approaches into a coherent methodological design is one of the key innovative aspects of this project.

The second innovative aspect is the analysis of historical audio sources. The project will treat contemporaneous binaural radio plays, features and discussion rounds as primary sources (a first set of audio files has already been retrieved from the Rundfunkarchiv Berlin). A comparison of conventional and binaural radio plays can e.g. inform us about the socio-cultural trajectories of radio makers' listening practices and directing techniques. So far, historians of sound technologies have paid little or no attention to audio sources to learn about past sounds and listening experiences.

A third innovative aspect is the use of the above mentioned audio sources for an enhanced online publication (e.g. Zeithistorische Forschungen/Studies in Contemporary History, or for more innovative ways of historical narrations Vectors) and a weblog. The enhanced publication will be used to explore new ways of historical narration for a professional audience. The weblog (as a kind of research diary) will help to disseminate the project results to a wider public. To maximize the reach of the weblog a collaboration with existing sound studies and history of technology weblogs is envisaged. In addition, the research topic will be explored and represented in a series of audio podcasts that will be produced for and published on the weblog. Although sound study scholars incorporate audio sources more often than sound historians, they seldom use these sources for the academic and non-academic dissemination of their research work.

4. Methodology

The project will draw on the concept of path dependencies as an analytical framework for the investigation of the two trajectories of dummy head recording. The concept has been developed for the analysis of large technical systems. It aims at explaining how and why decisions taken in the past have an impact on current or future developments or decisions. Path dependencies do not describe a linear, deterministic logic in the development of systems, but help to identify patterns and routines in processes of change (Pinch 2001; Duschek 2010, 2012; Sydow & Schreyögg 2010).

The concept of path dependency helps to study processes with different (technological, institutional etc.) alternatives available at the beginning of an innovation path. Specific choices during the further developmet of a technical system can have predeterministic consequences and thus limit the range of (technical, institutional etc.) options available until a closure occurs; specific choices can further trigger feedback mechanisms that reinforce the recurrence of particular patterns and routines in the future. Martin Schulz argues that "routine execution [like habitual listening practices or the regular use of recording and broadcasting equipment] tends to follow automatically the path of prior iterations of the routine" (Schulz 2008: 228). The concept of path dependency has been applied to different disciplines such as political science and economics. Although the application of the concept differs between research areas they all follow a basic model. This model, which encompasses four mechanisms that strengthen path dependency (Schulz 2008: 238), will guide my research project:

1) Investments: In a stable and consistent environment specific investments (in institutions, technology, equipment, knowledge etc.) are made by the relevant actors. These investments lose their value in the event of paths change. The longer the stability of these investments, the greater the tendency of investors to defend their investments against changes.

2) Socialization: Social learning is a two-way process. Firstly, individuals are socialized within an arrangement (institutions, technology, listening habits etc.) and thus become intimate with it. This arrangement shapes individuals in their behavior. At the same time they themselves influence the arrangements (their norms, values etc.) because they control the process of development by going back to their own beliefs.

3) Network effects on individuals: The greater the number of people agreeing on a set of rules, the greater the chance of individuals complying with them. Within a group of individuals, positive expectations and trust emerge, thus making members adhere to an (institutional, technical etc.) arrangement.

4) Network effects on arrangements: A second major network effect consists in the compatibility of development. Only those sociotechnical arrangements compatible with the existing institutions are incorporated into a larger arrangement.

Hence for the analysis of dummy head recording, I will differentiate between four types of path dependencies:

- *Institutional path dependencies* become noticeable in all kinds of institutional arrangements like broadcasting corporations or professional organizations.
- *Communicational path dependencies* occur in different areas of the media system, typical styles of programming or spaces of communication.
- *Technological path dependencies* affect technical equipment and large technical systems like radio broadcasting system.
- *Socio-cultural path dependencies* focus on individual actors and social groups, their listening practices and their embeddedness in cultural and societal norms and values.

The differentiation of these four types of path dependency (as well as path breaking and creation) will be applied to systematize the comparison of the two life paths of dummy head recording and thus help to reveal common patterns and differences that hampered and/or enabled the development of binaural technology. Following the two trajectories will show that each social group involved in the production and consumption of Kunstkopf-recordings had their own distinct ways of listening. Listening is then not about the individual auditory perception but the social organization of that auditory perception. Education and experience train the individual's ears, however, sensory anthropologists like Charles Goodwin assume that "perception is something that is instantiated in situated social practices, rather than in the individual brain" (Goodwin 1995: 257). Auditory perception is hence embedded in an interpretative framework, this is in particular essential for professional (listening) practices (Goodwin 1994: 621). Learning the tacit knowledge for the use of sound technology, learning how to speak

competently about sound, learning to envision sound shapes, is what Susan Schmidt Horning (2013) has termed *aural thinking*. She draws on the work of Eugene Ferguson (1992) about the visual thinking of engineers. Like engineers who can see technical drafts before their mind's eye, she claims sound engineers can hear their envisioned sound before their mind's ears. However, aural thinking is not only a mental process; it is a form of embodied knowledge. Aural thinking connects listening with the other senses, bodily interaction with the world, and draws on past (sensory) experience within the interpretative framework of a community of practice. Following the object biographies of the Berlin- and Aachen-dummy head, their shifting significance and meaning, will help to reveal the distinct aural thinking of the social groups involved. In the following, I will highlight some of the institutional, communicational, technological and socio-cultural aspects that shaped the development of dummy head recording and the *aural thinking* of recordists, radio makers and acoustical engineers.

1) **Institutional path dependencies**

a) of dummy head technology in radio and music recording

Key institutions that shaped the appropriation (or rejection) of dummy head recording were the public radio stations in Germany. Important for the development was the federal structure of the German (radio) broadcasting sector with independent regional stations (under significant political influence). Some of them embraced the idea of binaural recording and used the dummy head in different productions. Other stations objected to dummy head recording and even refused to broadcast existing binaural productions from other radio stations. Officials of the WDR for example were critical of how the overwhelming realism of binaural recordings could be exploited to indoctrinate the radio listener.

An interesting aspect of path making was stirred through the institutional competition between radio and television. Although radio broadcasting was a stable, path dependent institutional system it was open to the adoption of technological novelties in the hope that they could close the technical gap with television. The radio makers technical ambitions had already stirred and facilitated the technical shift from mono to stereo radio broadcasting in the 1960s. As Helmut Heißenbüttel, one of the protagonists of the "novel radio play" in Germany formulated in 1968, only a new „Hörsensation" ("listening sensation") would be able to lure the listener away from television. Thus it was a strategic choice of some of the main actors to look for the "next big thing" (Duschek 2010) in recording and broadcasting technology.

Other key institutions were the teaching institutions and professional organizations of recording engineers. In 1946, the music academy in Detmold introduced a unique three-and-a-half-year curriculum with the new professional degree of "master of recording" (Tonmeister). The training program encompassed technical as well as artistic training. It became a role model for the training of German recording engineers in the postwar period. The greater emphasis on the creative role of engineers forged a new professional identity and helped recordists to gain a higher status in the studio hierarchy. Did the dummy head collide with this new self-perception? The study program was accompanied by a new biannual conference series for recording engineers (Tonmeistertagung) that became an important

site for the circulation of recording knowledge. The Tonmeister-idea also spread to other European countries (Horning 2013).

b) of dummy head technology in acoustical engineering

The development of dummy head recording was further shaped through the institutional arrangements of the research institutes in Berlin and Aachen. The institutes were embedded in different research networks and industry relations. Did they also represent distinct (institutionalized) ways of aural thinking? Susan Schmidt Horning points out that engineers were, in comparison to recordists, more interested in measurements, components and theories and less in high-fidelity sound (Horning 2013). And which strategic (managerial) decisions led to the foundation of HEAD acoustics as a university spin-off?

What was the role of main institutional actors like the automotive industry in the second "career" of dummy head recording? Automotive manufacturers developed since the 1940s their own interest in sound design and noise and vibration control. They also founded their own acoustical research divisions in the postwar period (Mom 2014). How did the dummy head match with the R&D arrangements of the automotive industry?

2) **Communicational path dependencies**

a) of dummy head technology in radio and music recording

As mentioned earlier, the programming policy of the different radio stations played a crucial role in the decision to take side for or against dummy head recording. Did this decision correspond with the position of (avant-garde) radio plays in the stations' programming in general, and what role did programming directors and politicians play? And which audiences did the radio makers aim for, in particular the producers of avant-garde radio plays like "Demolition"? Many radiophiles that embraced binaural broadcasting did not mind the use of headphones and were also enthusiastic to explore new ways of listening. However, the average radio consumer needed to be educated how to listen to binaural broadcastings, and producers like Ulrich Gerhardt were willing to offer this listening training in his regular dummy head-program. A comparison of binaural with conventional radio plays will help to identify stable and/or shifting patterns in radio programming and perception.

Another communicational aspect is the role radio fairs played in presenting technological novelties, an important part of high-fidelity's culture of demonstration (Barry 2010). The strong impact of the sublime experience of binaural listening becomes visible in the broad press coverage of the radio fair. In this respect, the broadcasting of the first binaural radio play during the radio and television fair in 1973 was a successful media coup that could not be easily repeated during the following radio fairs. What role did the different media outlets (daily press, consumer magazines, trade journals, radio programs) play in the promotion (or rejection) of dummy head recording?

b) of dummy head technology in acoustical engineering

Did the public presentation of the Aachen head system differ from the press coverage of the Berlin head? And what aspects of dummy head recording were emphasized in the communication with

automotive engineers? How did the engineers at Bochum and Aachen University try to sell their developments as important innovations in the field of sound recording and measurement? What was their relationship with the professional associations in the field (Tonmeister)? Was their an international field of research in which these German engineers could present their work as distinct contribution to the field?

3) **Technological path dependencies**

a) of dummy head technology in radio and music recording

One important aspect of technological path dependency was already highlighted in the contemporaneous discourse: the compatibility of dummy head technology with the existing stereo standard. Radio makers could in principle use the existing stereo recording equipment as well as the new FM stereo broadcasting technology, thus the introduction of binaural technology would not have caused high switching costs. However, compatibility was at the same time limited on the side of consumer technology as binaural reproduction was not compatible with the standard stereo loudspeaker systems, and headphones were no longer standard equipment for domestic radio and music reception.

The integration of dummy head microphones with state-of-the-art recording equipment was also more difficult than the principle compatibility might suggest. Since the 1940s, magnetic tape, LP, multi mike, and multi-track recording had revolutionized the art of recording. Susan Schmidt Horning describes the 1940s to 1960s as watershed decades in the history of recording technology (2013). The studio became the center of a new recording standard: recording technologies and techniques of careful placing of multiple microphones, use of controlled reverberation, boosting of high frequencies, and the cutting and splicing of taped performances co-evolved and defined a new sound standard. And dummy head recordings were difficult to integrate into this standard, as they could not easily be mixed with “conventional” recordings.

Another aspect of technological path dependency was the financial and R&D investments that hi-fi manufacturers had placed during the 1960s into the development of quadrophony. The new technology of binaural recording threatened to render these investments into four-channel technology obsolete.

b) of dummy head technology in acoustical engineering

The “true to the original sound”-quality of dummy head recordings matched the general trend of acoustical research in the automotive industry which aimed at overcoming the subjectivity in sound design and noise control through development and use of apparently objective electro-acoustical instruments (Bijsterveld et al. 2014; Mom 2014). Did the discipline of technical acoustics follow a similar approach to objective sound measurements? And how did the dummy head technology fit into the instrumental setting of acoustical engineers. Were there comparable sound technologies that help to explain the apparently smooth integration of binaural recording technology? Furthermore, it seems reasonable, that advances in microelectronics and processor technology during the 1980s have been more important to enable path creation for the success of binaural technology in the automotive industry

in particular and technical acoustics in general. What role did computer modelling and simulation of binaural listening play for the success of dummy head technology?

4) **Socio-cultural path dependencies**

a) of dummy head technology in radio and music recording

Listening habits and listening perspectives of (radio and music) consumers played an important role in the acceptance and rejection of binaural recordings. Jonathan Sterne has carved out the importance of technological mediation and the normalization processes necessary to learn listening mediated through sound technologies (and the entangled cultural and economic context) (Sterne 2003). An interesting comparison will be the normalization of listening that came with the shift from mono to stereo recording and reproduction during the 1950s. Different from the early years of radio use, consumers in the 1970s were no longer used to wearing headphones at home (and the mobile listening culture of walkman and mp3-players was still to come), thus binaural technology had high cultural switching costs for consumers. The proponents of dummy head technology further admitted that habituation was needed to spatially locate sound sources in binaural recordings (in particular sound sources that were “located” in front of the listener). Moreover, the binaural approach of exact replication of the original sound signals (as key for the perfect listening experience) clashed with some beliefs of the emerging hi-fi culture of audiophiles that electroacoustical measurements failed to describe the subjective listening experience, and that good (trained) listeners know this (Perlman 2004; Rawson 2006).

Another aspect in the failure of dummy head recording was the professional listening style of recording engineers. Thomas Porcello has shown the importance of discursive and non-discursive practices in the recording studio for the professional identity of recordists (Porcello 2004). The discourse of the Tonmeister, their emphasis on the creative aspects of recording, was incommensurable with the acoustical engineers’ discourse of the “mechanical objectivity” of binaural recordings. The same was true for the communication between acoustical engineers and radio makers. Ulrich Gerhardt for example declared that his idea of realism was different from the idea of the inventors as he (as sound artist) did not aspire “true to the source” realism but rather, as he called it, the “precision” that binaural recording offered to him.

b) of dummy head technology in acoustical engineering

Dummy head technology matched the general professional interest of acoustical engineers in objective measurements and theory building. Furthermore, binaural technology was (since the very first attempts in binaural technology in the 1880s) embedded in the scientific understanding of human spatial hearing and also helped to give new insights into psychoacoustics. Were there specific developments in acoustical engineering (during the 1980s) that facilitated the integration of dummy head recording into the research program of the academic discipline? Binaural technology also matched the instrumental culture of acoustical engineers in industrial R&D arrangements, furthermore, the promise of objective sound recordings nicely corresponded with the strive for increased control in sound design and noise

control. Thus binaural measurements corresponded with the testing culture of acoustical engineers who wanted to overcome subjective sound measurements and quality ratings.

5. Work plan

Schedule	Key activities
February 2015 - July 2015	*Research activities* Data collection: archival research, literature study, and oral history interviews *Dissemination activities* Building up of weblog (first three entries) and establishing links with existing sound studies/history of technology weblogs (e.g. Sounding Out!) *Coordination activities* Planning of workshop on history of recording technology (contact potential participants, acquire additional funding)
August 2015 – January 2016	*Research activities* Data collection: archival research, literature study, and oral history interviews Theoretical and methodological reflections *Dissemination activities* Writing of first article Publication of three weblog entries (one preferably an audio podcast) Presentation of first results at international conferences *Coordination activities* Planning of workshop (invite participants, organize venue, accommodation etc.)
February 2016 – July 2016	*Research activities* Theoretical and methodological reflections *Dissemination activities* Writing of second article together with project supervisor (Prof. Dr. Andreas Fickers) Publication of three weblog entries (one preferably an audio podcast)

	Coordination activities Workshop on history of recording technology
August 2016 – January 2017	*Research activities* Finalizing research results *Dissemination activities* Writing of "enhanced" article Publication of three weblog entries (one preferably an audio podcast) Presentation of final results at international conferences Preparation of special issue on the history of sound recording

6. Risks

The research project does not involve any particular risks. The feasibility of the research has been tested during a three months fellowship at the Deutsches Museum Munich (March-June 2013). The different archives (e.g. Rundfunkarchiv Berlin, Archiv of the Deutsches Museum Munich) have already been consulted (pre-checked) and they demonstrated that the necessary resources are available or will be made available. Contact to relevant (historical) actors in Aachen and Berlin has been established and preliminary interviews with Henning Wilkens and Klaus Genuit have already been conducted.

7. Expected Outcomes

The project output will consist of three peer-reviewed articles in international journals (preferably in different fields like history of technology, media/sound studies, innovation studies). One article will be written together with the project supervisor Prof. Dr. Andreas Fickers, a second article will be written for an "enhanced" online journal like Zeithistorische Forschungen/Studies in Contemporary History or Vectors. A very stimulating example of new digital ways of historical narration is Emily Thompson's sound history contribution "The Roaring Twenties" in Vectors. Project results will also be presented at international academic conferences in the fields of sound studies and history of technology. In addition, the weblog will be updated (on average) bimonthly and will at the end of the project time consist of a dozen entries on different aspects of the history and sociology of dummy head recording that will help to disseminate research results to a wider (non-academic) audience. Some weblog entries will consist of especially produced audio podcasts—the perfect medium to tell radio history. Finally, there will be an international expert workshop organised on the history of recording technology in Luxembourg at the end of the project, which will further help to disseminate the final research results to the academic community. The second aim of the workshop will be the organization of a special issue on the history and culture of recording technology for an international peer-reviewed journal (e.g. the forthcoming *Journal of Sound Studies*).

8. Bibliography (short)

Most relevant literature

Badenoch, A., and A. Fickers (eds.) (2010). *Europe Materializing. Transnational Infrastructures and the Project of Europe* (Basingstoke: Palgrave Macmillan).

Barry, E. (2010). High-Fidelity Sound as Spectacle and Sublime, 1950-1961. In *Sound in the Age of Mechanical Reproduction*, eds. D. Suisman and S. Strasser (Philadelphia: University of Pennsylvania Press): 115–38.

Braun, H.-J. (2004). *Music and Technology in the Twentieth Century* (Baltimore: Johns Hopkins University Press).

Bauer, R. (2014). Failed Innovations – Five Decades of Failure? *ICON* 20 (1). 33–40.

Douglas, S. (1999). *Listening In: Radio and the American Imagination* (New York: Times Books).

Duschek, S. (2010). Strategisches Pfadmanagement: “Beyond Path Dependency”. In *Organisation und Strategie*, eds. G. Schreyögg and P. Conrad (Wiesbaden: Gabler): 223–59.

Duschek, S. (2012). Regelpfade – Wirkmächte des (Miss-)Erfolgs von Organisationen. In Organisationen regeln, eds. S. Duschek et al. (Wiesbaden : springer VS) : 195–223.

Fickers, A. (1998). *Der Transistor als technisches und kulturelles Phänomen: Die Transistorisierung der Radio-und Fernsehempfänger in der deutschen Rundfunkindustrie 1955 bis 1965* (Bassum: GNT).

Fickers, A. (2012). Visibly Audible: The Radio Dial as Mediating Interface. In *The Oxford Handbook of Sound Studies*, eds. T. Pinch and K. Bijsterveld (Oxford, New York: Oxford University Press): 411–39.

Ferguson, E. (1992). *Engineering and the Mind’s Eye* (Cambridge: MIT Press).

Goodwin, C. (1994), Professional Vision. *Anthropologist* 96 (3): 606–33.

Katz, M. (2004). *Capturing Sound: How Technology has changed Music* (Berkeley, Los Angeles: University of California Press).

Niebur, L. (2010). *Special Sound: The Creation and Legacy of the BBC Radiophonic Workshop* (Oxford: Oxford University Press).

Perlman, M. (2004). Golden Ears and Meter Readers: The Contest for Epistemic Authority in Audiophilia. *Social Studies of Science* 34 (5): 783–807.

Porcello, T. (2004). Speaking of Sound: Language and the Professionalization of Sound-Recording Engineers. *Social Studies of Science* 34 (5): 733–58.

Schmidt Horning, S. (2013). *Chasing Sound: Technology, Culture, and the Art of Studio Recording from Edison to the LP* (Baltimore: Johns Hopkins University Press).

Schulz, M. (2008). Staying on track: A voyage to the internal mechanisms of routine reproduction. In *Handbook of organizational* routines, eds. M. Becker (Cheltenham: Edward Elgar): 228–55.

Sterne, J. (2003). *The Audible Past: Cultural Origins of Sound Reproduction* (Durham, London: Duke University Press).

Thompson, E. (1995). Machines, Music, and the Quest for Fidelity: Marketing the Edison Phonograph in America, 1877-1925. *The Musical Quarterly* 79 (1): 131–171.

Wagner, H.-U. (2005/2008). *Die Geschichte des Nordwestdeutschen Rundfunks,* 2 vols. (Hamburg: Hoffmann und Campe).

Zagorski-Thomas, S., and S. Frith (eds.) (2012). *The Art of Record Production* (Farnham: Ashgate).

Further reading

Bijsterveld, K., E. Cleophas, S. Krebs, and G. Mom (2014). *Sound and Safe: A History of Listening Behind the Wheel* (Oxford, New York: Oxford University Press).

Blauert, J. (1997 [1974]). *Räumliches Hören* (Stuttgart: Hirzel).

Blauert, J. (eds.) (2005). *Communication Acoustics* (Heidelberg, New York: Springer).

Cleophas, E. and K. Bijsterveld (2012). Selling Sound: Testing, Designing, and Marketing Sound in the European Car Industry. In *The Oxford Handbook of Sound Studies*, eds. T. Pinch and K. Bijsterveld (Oxford, New York: Oxford University Press): 102–24.

Hoskins, J. (2006). Agency, Biography and Objects. In *Handbook of Material Culture*, eds. C. Tilley et al. (London: Routledge): 74–84.

Krebs, S. (2012a). Standardizing Car Sound – Integrating Europe? International Traffic Noise Abatement and the Emergence of a European Car Identity, 1950–1975. *History and Technology* 28 (1): 25–47.

Krebs, S. (2012b). "Sobbing, Whining, Rumbling" – Listening to Automobiles as Social Practice. In *The Oxford Handbook of Sound Studies*, eds. T. Pinch and K. Bijsterveld (Oxford, New York: Oxford University Press): 79–101.

Krebs, S. (2012c). Automobilgeräusche als Information: Über das geschulte Ohr des Kfz-Mechanikers. In *Das geschulte Ohr: Eine Kulturgeschichte der Sonifikation*, eds. Andi Schoon and Axel Volmar (Bielefeld: Transcript): 95–110.

Krebs, S. (2014). "Dial Gauge versus Senses 1 - 0": German Car Mechanics and the Introduction of New Diagnostic Equipment, 1950–1980. *Technology and Culture* 55 (2): 354–389.

Krug, H.-J. (2003). *Kleine Geschichte des Hörspiels* (Konstanz: UVK).

Lacey, K. (2000). Towards a Periodization of Listening: Radio and Modern Life. *International Journal of Cultural Studies* 3 (2): 279–88.

Mom, G. (2014). Orchestrating Automobile Technology: Comfort, Mobility Culture, and the Construction of the "Family Touring Car," 1917–1940. *Technology and Culture* 55 (2): 299–325.

Paul, S. (2009). Binaural Recording Technology: a Historical Review and Possible Future Developments. *Acta Acustica* 95: 767–88.

Pinch, T. (2001). Why You Go to a Piano Store to Buy a Synthesizer: Path Dependence and the Social Construction of Technology. In *Path Dependence and Creation*, eds. R. Garud and P. Karnoe (New Jersey: Lawrence Erlbaum): 381–400.

Pinch, T., and K. Bijsterveld (2012). New Keys to the World of Sound. In *The Oxford Handbook of Sound Studies*, eds. T. Pinch and K. Bijsterveld (Oxford, New York: Oxford University Press): 3–35.

Pinto, V. (2012). *Stimmen auf der Spur. Zur technischen Realisierung der Stimme im Theater, Hörspiel und Film* (Bielefeld: transcript).

Plack, C. (2010). *Oxford Handbook of Auditory Science: Hearing* (Oxford: Oxford University Press).

Schöning, K. (2001). Ars Acoustica. Ein Prospekt. In *Radio-Kultur und Hör-Kunst. Zwischen Avantgarde und Popularkultur 1923-2001*, ed. A. Stuhlmann (Würzburg: Königshausen & Neuman), pp. 246–259.

Sydow, J., and G. Schreyögg (eds.) (2010). *The Hidden Dynamics of Path Dependence: Institutions and Organizations* (Basingstoke: Palgrave Macmillan).

Sunier, J. (1960). *The Story of Stereo: 1881-* (New York: Gernsback Libr.).

Rawson, E. (2006). Perfect Listening: Audiophilia, ambiguity, and the Reduction of the Arbitrary. *The Journal of American Culture* 29 (2): 202–12.

Thompson, E. (2002). *The soundscape of modernity: architectural acoustics and the culture of listening in America, 1900-1933* (Cambridge, London: MIT press).

Wade, N. and D. Deutsch (2008). Binaural Hearing – Before and After the Stethophone. *Acoustics Today* 4 (3): 16–27.