OVERHEARING

AN ATTUNING APPROACH TO NOISE IN DANISH HOSPITALS

A Dissertation presented to the Faculty of Arts
Aarhus University
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CHAPTER 1
INTRODUCTION

> "when I perceive, I am always perceiving from somewhere, exposed to my surroundings and in the process of doing something. Far from being simply epiphenomena, these contextual dimensions are an integral part of perceptual activity." (Thibaud, 2011, p. 205)

I was in the hospital with my two-year old son, who was going in for a minor, but urgent surgery. He had a fever and had fasted around 18 hours upon our arrival. He was bedded in a four-bed ward with three other children, recovering (and eating again) after their surgeries. He was very brave, but also very hungry and sick. It was clear to me that the both of us were acting more brave and calm than we actually were, because we shared the ward and soundscape with other families. I was very aware of not making too much noise, hushed my son and prevented him from playing too freely. The door to the hallway was open, and we could see and overhear the rhythms and routines of staffs. The open door made me feel that we were not forgotten, and at the same time the sounds from the hallway filled our ward with dynamic, lively and non-personal background sound. This background sound made sure the experienced silence between us in the ward didn't become too potent. Suddenly, I saw my son shocked, looking out of the door as a dronish-swishy-sound slowly became louder and louder. He covered his ears with his hands and searched with his eyes to understand what the sound was the sound of. I told him it was the floor-cleaning machine, but still he was very afraid until he saw the machine a few times going past the doorway. Being a mom *and* a PhD fellow doing a project about the experience of noise in Danish hospitals, I tried to calm him while reaching the phone to take a picture of the situation. Looking at the picture later on, something in his expression reminded me of the famous expressionist painting *Skrik*[1] (*The Scream*) from 1893 by the Norwegian painter Edvard Munch.

[1] With regards to annotation, I employ quotation marks when quoting directly from texts, and italics when referring to titles. Furthermore, I employ italics to emphasize salient concepts. When referring to the papers included in the second part of this dissertation, I employ a number in square brackets that designates the paper for overview purposes, e.g. [P1]. The numbers of the papers are listed in section 1.3

There was something similar not only in the gesture of covering the ears, but also in the eyes looking down. I had always learned that the painting was a self-portrait of screaming. However, in light of my experience, there was something incongruent in the combination of him covering his ears and screaming at the same time. My son was trying to be as quiet and still as possible, while covering his ears, to be able to monitor the presence of the sound he at the same time wanted to shut out; to be able to confirm when everything was ok again.

Subsequently, I tried looking into the story behind the painting by Edvard Munch, and found a passage from his diary, where Munch describes the feeling he tried to express, dated 22. January 1892:

> "One evening I was walking along a path, the city was on one side and the fjord below. I felt tired and ill. I stopped and looked out over the fjord—the sun was setting, and the clouds turning blood red. I sensed a scream passing through nature; it seemed to me that I heard the scream. I painted this picture, painted the clouds as actual blood. The color shrieked. This became *The Scream*" (Munch as cited in Bleakley, 2015, p. 226)[2]

It suddenly dawned on me that Munch in the painting is not screaming. It is the sudden presence of a frightening atmosphere that screams *at* him, leaving him frozen, gasping in horror, covering his ears to shield himself against the thick presence of horror surrounding him. It is not the loudness of surrounding sounds that makes him cover his ears, but the atmosphere that overwhelms him. It is most likely that the acoustic environment in the situation was a fairly quiet outdoor ambiance. Based on the diary note it seems to be the combination of his state of tiredness and the visual experience of the colors suddenly changing that he experience as a scream going

[2] The original German title for the painting given by Munch was *Der Schrei der Natur (The Scream of Nature).*

through nature leaving him trembling with fear. The vibrational affective atmosphere moves him almost physically, more violently than any bearable sound and leaves him frozen and unable to break out of the situation. Similarly, my son's experience of horror in the hospital emerged as a complex interaction between the atmosphere of absence, his hungry and tired state and the fear of what this hospital visit was going to bring. Furthermore, the horror was amplified by the multisensory context of the sound coming from an unseen and unknown source as well as his inability to go and explore the source, seeing as he was confined to the bed. I did not notice the urgency of his state at first, like the friends behind Munch in the painting, like they and I would have if Munch and my son were actually screaming.

At the time of this experience I was in the process of reviewing the existing research on the topic of noise in hospitals that shares the consensus that hospitals are filled with stressful noise, counteracting well-being, health and the processes of healing. This assumption underlying the field builds on research that identifies raised noise levels as the main causal explanation for ranking noise as a critical stressor for patients, relatives and staffs. Thus, this explanation establishes a direct causal link between the cause *raised noise levels* (based on quantitative methods, such as measurements of noise-levels and reverberation-times) and the effect *experiencing noise as a main stressor* (based on qualitative methods, such as questionnaires and interviews). Therefore, the most widely used strategies to tackle the problem in practice are strategies to reduce measurable and perceptual noise levels. However, research has also found that these strategies do not solve the problem and therefore the healthcare industry is still struggling to address it adequately.

Returning to my experience in the hospital I wondered if the causal link between the cause *raised noise levels* and effect *experiencing noise as a main stressor* underlying the field might wrongly take for granted that it is the same *noise* that the cause and effect refer to. My experience in the hospital questioned this assumed causality in the sense that what we might have experienced as noise was conditioned mainly be other non-acoustic factors such as the multisensory, contextual, and atmospheric conditions that the existing methods and strategies would most likely not be able to neither measure nor address adequately in practice. With my background in the interdisciplinary field *sound studies* combined with a practice-based approach through sound art and design related to the field *sonic interaction design*, my question did not emerge out of nothing. Recently, research in *sound studies* have identified and researched into the importance of considering contextual conditions in relation to listening (Thibaud, 2011), while research in *sonic interaction design* calls for an ecological and enactive approach that entails investigations of actors and their interrelations with their respective environments as attuning ecosystems (Franinović, 2012).

On this background the basic premise of the approach taken in this dissertation is, instead of trying to conceptualize the noise problem again, to turn the equation upside down and stage the sonic as a way to analyze, understand and address complex multisensory issues of the hospital environment through practice-based experiments. Due to the exploratory nature of this motivation, my research approach is emergent and has thus been developed along the way in three parallel tracks:

- Exploring the existing assumptions in the field through an interpretive framework to establish patterns or themes in the existing field as key premises that are folded into the interpretive framework.

- Developing a new transformative framework that could inform my choices of methods and theories and revisit the main hypotheses through open-ended research questions, as well as the choices of approach to which I seek insights to answer them.

- Making practice-based experiments to both inform and challenge the interpretive and transformative framework as well as developing an alternative approach to the research theme through practice.

This research approach offers other types of research validity, such as situated and ecological validity, compared to traditional types in the field such as transferability and internal validity. The term validity could therefore be replaced with identifying critical elements and writing plausible interpretations from them with the goal being *understanding* rather than *convincing* (Creswell, 2007, p. 247). This shift in terminology builds on the understanding that validation is always based on negotiations that are temporal, located and open to reinterpretation. The strength of this approach therefore lies not in seeking an objective distance from the object of study, but rather it is oppositely based on closeness and interaction with the objects of study. As such my focus has been on the transformative potential of this approach aimed to call for reflection and change in the existing field. The main contribution of the dissertation is therefore the development of what I have coined the *attuning approach* to complement the existing approaches in the field based on a cohesive and constructive non-representational framework. In particular, I explore and develop the notion of *ecological overhearing, shared rhythms* and *affective attunement* as key concepts for understanding how to unfold *attuning strategies* based on the attuning approach in practice.

The dissertation is the outcome of the doctoral project conducted at *audio design*, at the *School of Communication and Culture* at *Aarhus University.* The project is partly funded by *IT Vest*. The format of the thesis outlines the work I have done and published within the four-year duration of my studies. The included papers have all been subjected to peer review processes and discussions in different academic forums, strengthening the validity of the research throughout the project. My work is developed through interdisciplinary collaborations across design, engineering and arts disciplines. I have engaged in two main practice-based experiments through the course of my PhD project and several peripheral experiments. The reason for the overall breadth of this study is therefore due to its introductory and exploratory nature.

1.1 STRUCTURE OF THE DISSERTATION

In this section I will present the structure of the dissertation. The dissertation is composed of four parts: an overview article (Parts I-III), and a selection of peer-reviewed papers from the PhD project (Part IV) in which six papers are included.

Parts I-III: The Overview Article

The overview article serves to frame the papers in a wider context and to reflect upon their specific themes and findings in a theoretical perspective. It represents a structured reflection upon and analysis of the PhD project as a whole. Part I presents the motivational context for the overall research project (Chapters 2 and 3) and positions the themes of the dissertation within a wider discourse of listening in the hospital (Chapter 4). Part II presents and develops my research approach - *the attuning approach* (Chapters 5 to 7). Part III presents the practice-based *attuning experiments* (Chapters 8 and 9) and discusses the contributions and findings in relation to the overall research theme (Chapter 10).

Part IV: Included Papers

The papers included have been written during the course of the PhD project. The individual papers are finished works in their own right and have been evaluated as such in the journals and conferences for which they have been submitted and accepted. This implies that each paper presents and discusses experiment- and theme-specific related work, research questions and methods, lines of arguments, and contributions. In combination, however, the papers represent an unfolding inquiry into the overall theme of the dissertation. Due to the restrictions on the length of the papers, they lack a thorough unfolding of a theoretical investigation and will therefore be a part of the overview article, which explains the extent of the overview article.

The papers included in Part IV are unedited reprints, presented in chronological order by publication date. I will refer to [P1]-[P6] when referring to the individual papers throughout the overview article. The following section provides a short introduction to each of the papers:

[P1] Sofie Kinch *(lead author)* **& Marie Højlund** *(co-author)*

Kidkit Guides Children into Alarming Atmospheres: designing for embodied habituation in hospital wards [3]

In *DPPI '13: Proceeding of the 6th International Conference on Designing Pleasurable Products and Interfaces* / September 2013, pp. 01-10. © ACM press, 2013. DOI: 10.1145/2513506.2513407. Online: September 2013: http://dl.acm.org/citation.cfm?id=2513507

[3] The paper received the Reviewers' Choice Award, an honorary mention award, at the *DPPI' 13* conference in Newcastle, UK, 2013.

This paper presents the concept of *Embodied Habituation* as an architectural approach to designing contextualized technologies. It does so by identifying *Middle Ground Experiences*, acknowledging how spaces are inhabited with ambiguous qualities that affect people emotionally. The research is based on the development and evaluation of *Kidkit,* which is interactive furniture designed for young children, who are going to visit a hospitalized relative with fatal injuries for the first time. *Kidkit* empowers the child to engage and be present by shaping *Middle Ground Experiences* in the hospital ward environment that is full of intimidating medical equipment and alarms. The evaluation results indicate collective rewards gained when children succeed in *Embodied Habituation*. Finally, the paper discusses how *Middle Ground Experiences* inevitably establish grounds for how we design for spatial experiences within the interaction design community.

[P2] Marie Højlund *(lead author)* **& Sofie Kinch** *(co-author)*

Alarming Atmospheres: Embodied Sound Habituation as Design Strategy in a Neuro-Intensive Care Unit

In the *Journal Sonic Studies*, volume 6, Special Issue 01 / January 2014. © Leiden University Press, 2014.
ISSN: 22126252. Online: 15 January 2014: http://journal.sonicstudies.org/vol06/nr01/a02

Nurses working in the neuro-intensive care unit at *Aarhus University Hospital* lack the tools to prepare children for the alarming atmosphere they will enter when visiting a hospitalized relative. The complex soundscape dominated by alarms and sounds from equipment is mentioned as the main stressor. As a response to this situation, our design artifact, the interactive furniture *Kidkit*, invites children to become accustomed to the alarming sounds sampled from the ward, while they are waiting in the waiting room. Our design acknowledges how atmospheres emerge as temporal negotiations between the rhythms of the body and the environment in conjunction with our internalized perception of the habituated background. By actively controlling the sounds built into *Kidkit*, the child can habituate them through *Embodied Sound Habituation* - a process of synchronizing them with her/his own bodily rhythms. Hereby the child can establish, in advance, a familiar relationship with the alarming sounds in the ward, enabling her/him to focus more on the visit with the relative. The article discusses the proposed design strategy behind this solution and the potentiality for its use in hospital environments in general.

[P3] Marie Højlund & Morten Riis *(equal authorship)*

Wavefront Aesthetics: Attuning to a dark ecology

In the Journal *Organised Sound*, volume 20, Special Issue 02 / August 2015, pp. 249-263.
© Cambridge University Press, 2015. DOI:10.1017/S1355771815000138.
Online: 07 July 2015: http://journals.cambridge.org/abstract_S1355771815000138

In this article, we offer an *object-oriented ontological* perspective to complement the diversity of sounding ontologies, challenging the human perspective as the only valid perspective and call for the necessity of including

perspectives of objects such as a speakers, voices and light sensors. Subscribing to this view also confronts music and sound art as consistent autonomous categories and focuses on how the pieces attune to the environment, emphasizing meetings, transformations and translations through and with other objects. These meetings generate an ecological awareness of causal aesthetics where objects time and space each other. This contrasts with traditional analysis of music and sound art, which is based on the assumption that time and space are containers in which sound and music unfold. We analyze two contemporary pieces by the authors in an attempt to unfold a dark ecological approach to test the implications, limits and potentials for future use and development.

[P4] Morten Breinbjerg, Marie Højlund, Morten Riis, Jonas Fritsch & Jonas R. Kirkegaard *(Equal authorship)*
Audio Satellites: Overhearing Everyday Life

In *COOP 2016: Proceedings of the 12th International Conference on the Design of Cooperative Systems* / May 2016, pp. 297-302. © Springer International Publishing, 2016. DOI: 10.1007/978-3-319-33464-6.
Online: 08 September 2016: http://link.springer.com/chapter/10.1007/978-3-319-33464-6_18

The project *The Overheard* consists of a number of sound sculptures and mobile listening devices (*audio satellites*) from which sound is distributed in real time, from the sites of the sculptures, to a server and made available for listening and mixing through a web interface. In the web interface, the different sound streams from the individual satellites can be mixed together to form a cooperative soundscape. The project thus allows people to tune into and explore the overheard soundscape of everyday life in a collaborative and creative process of active listening.

[P5] Marie Højlund
Beyond Insulation and Isolation: Towards an attuning approach to noise in hospitals

In the Journal *SoundEffects - An Interdisciplinary Journal of Sound and Sound Experience*, volume 6, Special Issue 01 on *Sound and Listening in Healthcare and Therapy* / December 2016, pp. 121-140. © Aarhus University Press, 2016. ISSN 1904-500X. Online: 01 December 2016: http://www.soundeffects.dk/article/view/4169

Most research on the acoustic environment in the modern Western hospital identifies raised noise levels as the main causal explanation for ranking noise as a critical stressor for patients, relatives and staff. Therefore, the most widely used strategies to tackle the problem in practice are insulation and isolation strategies to reduce measurable and perceptual noise levels. However, these strategies do not actively support the need to feel like an integral part of the shared hospital environment, which is a key element in creating healing environments, according to the paradigm of Evidence-Based Design and Healing Architecture. Presenting alternative research on listening in hospitals and theories of noise and complex soundscapes from the field of sound studies, I

develop the hypothesis that *the gap in contemporary research is intimately linked to a reductionist framework underlying the field, which is incapable of accommodating the multisensory and atmospheric conditions amplifying the experience of noise.* Combining theories on acoustic atmospheres and ecology of listening with artistic- and constructive design-research methods, I outline an *attuning approach* through practice-based experiments as a complementary approach to help bridge the gap by offering active ways of attuning to the shared environment.

[P6] Marie Højlund & Morten Riis *(equal authorship)*
Inconsistent Transduction: Not-knowing Through Sounding Art in Artistic Research

In the Journal *Quadratura –writings in Danish art*, volume 4/ January 2017, pp. 01-10.
 ISSN 2246-4484. Online: 10 January 2017:
http://www.kunsthistoriker.dk/Quadratura/Quadratura_04_2016.pdf

The growing integration of sounding art as research practice in academia is part of the *practice turn* in humanities and social sciences, where artistic practices and artifacts themselves become a form of academic inquiry. As the process of creating art represents a valid research method for gaining new knowledge, sounding art pieces thus become more than mere objects for analysis: Because the research unfolds in and through the acts of creating and performing art, practice is not only a methodological vehicle but also a site of knowledge production. In this paper we argue that the implicit human-centered perspective present in these alternative understandings of knowledge production in artistic research prevents us from fully engaging with the objects in question on their own premises. Therefore, tuning into the *not-knowing* requires expanding the perspective to encompass non-human forms of knowledge incorporated through an *object-oriented ontological* line of thinking.

1.2 DEFINITIONS

Researching complex shared environments with a focus on listening raises many challenges in relation to establishing an articulated terminology and clear definitions of central terms, as it is an area of research approached by different disciplines with diverse understandings of the same terms. This section will therefore define three central terms used across disciplines: *acoustic environment, soundscape* and *noise. Noise* is a term with very different definitions, and cannot meaningfully be defined once and for all. Yet in defining the two other terms *acoustic environment* and *soundscape,* I will also sketch out the two most common meanings of *noise* in the literature. When I use *noise* with another definition than these two in the overview article, I will explicate the local understanding directly in the text.

In 2015 *International Organization for Standardization (ISO),* a worldwide federation of national standards, published the first part of the *ISO 12913-1:2014* standard on the *acoustic environment* and *soundscape* (Institution, 2014). The second part of the standard, concerning methods and measurements are not available

yet. The standard seeks to respond to the need for shared definitions of key terms in the field, due to the diversity of the field and idiosyncratic and ambiguous meanings of these in the literature. The standard thus aims to enable a new consensus on the definition of the term *soundscape,* to provide a foundation for communication across disciplines and professions, in line with the *EU COST* project *TD0804 Soundscape of European Cities and Landscapes* that introduce the *Soundscape Approach* as a new paradigm (Kang, Chourmouziadou, Sakantamis, Wang, & Hao, 2013). The standard distinguishes between the perceptual construct *soundscape* and the physical phenomenon *acoustic environment*, where *soundscape* is the *acoustic environment* translated through human perception. I adopt the following definitions from the standard and will moreover discuss them throughout the overview article:

Acoustic environment: Sound at the receiver from all sound sources as modified by the environment

Soundscape: Acoustic environment as perceived or experienced and/or understood by a person or people, in context

Noise: Literature focused on the *acoustic environment* often understands *noise* quantitatively and objectively, as something that can e.g. be measured by a decibel meter. Literature focused on *soundscape* often defines *noise* subjectively as *unwanted sound,* and is therefore today often referred to also as *sound related annoyance* (as presented in chapter 5). The subjective experience of noise is based on a complex and subjective process of interpretation from the *acoustic environment* to *soundscape* as expressed in this figure, which is adopted from the standard:

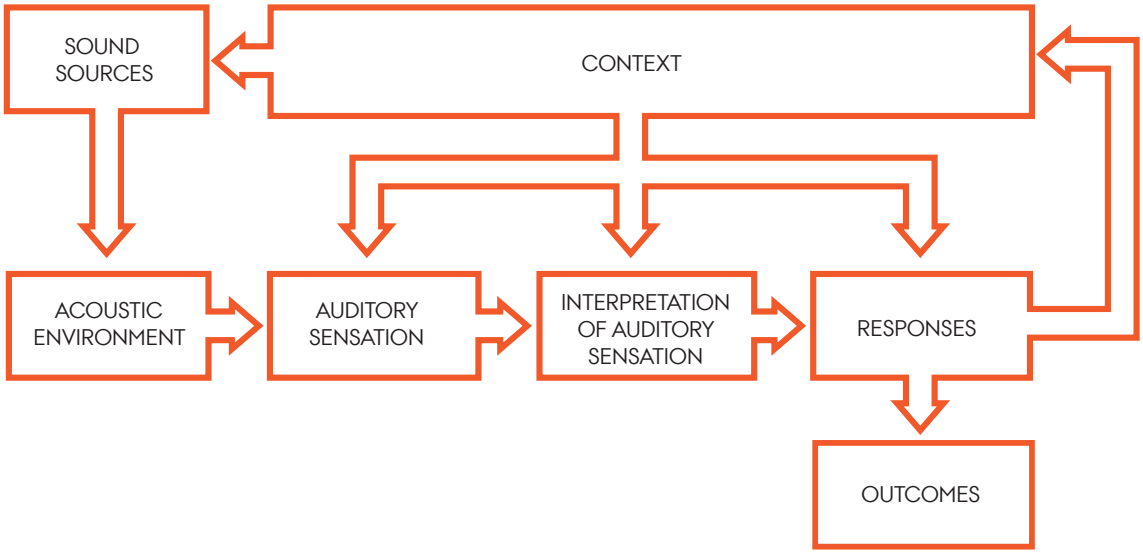

Figure 1: Elements in the perceptual construct of soundscape (Institution, 2014, p. 2)

In the figure the box *Context* refers to the interrelationships between person, activity and place in space and time and may include the attitude towards a sound source, producer of sound, experience and expectations as well as

other sensory factors. The *Context* may influence *soundscape* through all three processes of firstly the *Auditory sensation* (influenced by masking, temporal patterns etc.), secondly *Interpretation of auditory sensation* (the creating of useful information from unconscious and conscious processing) and lastly the *Responses* to the acoustic environment (the immediate reaction, emotion and behavior). *Outcome* is the overall, long-term consequences of the *soundscape* experience, including the creation of habits and behaviors related to these habits.

A foot-note in the standard to the figure states that practical applications addressing measurement, assessment or evaluation of *soundscapes,* will tend to emphasize management or change in sound sources and the *acoustic environment*, even though approaching "soundscape in accordance with the International Standard, is through human perception of the acoustic environment" (Institution, 2014, p. 1). The publication does therefore not only seek to objectively define central terms, it also seeks to position *soundscape* as a valid research approach, and highlight the consequences and challenges of taking such approach. As an example it would be necessary to consider the many complex influences of the *Context* as well as expectations and habits from earlier experiences, as presented figure above, if we are to assess the experience of noise the hospital based on the *soundscape approach* that the standard recommends.

PART I

INSULATION & ISOLATION

Part I is based on [P5] and presents the motivational context for the overall research project centered around the following research questions:

/ Present practices: what are the present methods and approaches to both the *acoustic environment* and the *soundscape* in the new Danish super hospitals?

/ Which qualities and limitations do current approaches have in relation to the subsequent call for creation of healing environments in *healing architecture* and *evidence-based design.*

Chapter 2 introduces the area of research calling into question whether a combination of the two main approaches in the field, the *noise-reduction approach* and the *human-centered approach,* will succeed in initiating the desired paradigm shift to put patients first of *healing architecture.* Expanding from [P5] this argument is unfolded in Chapter 3 through an analysis of the approaches and the practical interventions that they provide for, revealing how both the *insulation strategies* that the *noise-reduction approach* suggests, and the *isolation strategies* the *human-centered approach* suggests, imply a shared reductionist epistemological and ontological understanding of both noise and not-noise as consistent concepts that can be fixed in various representational frameworks and perception as a primarily passive and cognitive process.

In Chapter 4 recent other research has argued for the importance of addressing not only the physical and perceptual part of listening, but also the affective and thus non-representational background. This strand of research stresses the importance role of atmospheric, multisensory and embodied conditions in the organization of the subjective experiences of the hospital. Therefore they point to the need for comprehensive assessment with a view to placing noise in relation other non-acoustical aspects such as the general lack of other sensory impressions and background sound together with the lack of control and corporal confinement that all together can result in a sensitized listening state of monitory- and diagnostic listening modes. This alternative research has not yet been acknowledged in the field of *evidence- based design* and *healing architecture* and therefore the field is incapable of handling important atmospheric and multisensory parameters, and calls for a new framework capable of asking new questions, developing new methods and strategies that can be used to describe and operationalize these non-measurable parameters.

Part I concludes by deriving three working hypotheses based on the first three chapters, to pave way for the development of an alternative framework in Part II. The hypotheses stress how the experience that excessive noise in hospitals leads to stress is not only related to acoustic aspects, but also closely connected to ***1) An atmosphere of absence, 2) An alarming sonic sensibility and 3) A lack of coping skills and active coping possibilities.*** The working hypotheses will then guide both the development of my research approach in Part II and the experiments presented in Part III.

CHAPTER 2

THE ACOUSTIC ENVIRONMENT AND SOUNDSCAPE IN DANISH HOSPITALS

The focus of this chapter is to analyze and discuss existing research and strategies in relation to sound and noise within the paradigm of *evidence-based design* and *healing architecture* in the construction of new Danish super hospitals. Two main approaches dominating the field are traced and coined the *noise reduction approach* and the *human-centered approach*, respectively. *The noise reduction approach* considers noise a pollutant and provides *insulation strategies* through the use of sound-proofing material, whereas the *human-centered approach* considers noise a stressor and thus advocates for an expansion of *insulation strategies* to include the individual use of music interventions for shorter periods of time, coined *isolation strategies.*

These mappings show how a noise vs. silence dichotomy permeates both approaches and the corresponding strategies, despite adhering to a subjective definition of noise as *unwanted sound.* This results in a univalent focus on too much noise, and therefore all the strategies aim at protecting and isolating passive subjects. Moreover, both approaches focus on sound and noise detached from other senses, the body, and the surrounding environment. Therefore, the chapter concludes that there is a lack of strategies in the existing field for supporting *healing environments,* when confronted with the visions of *healing architecture* and *evidence-based design* for an updated and expanded version 2.0 – a version capable of addressing the complexity of the everyday environment of hospitals, focused on the interaction between activity, engagement, experience, the body, and the atmospheric and multisensory interplay.

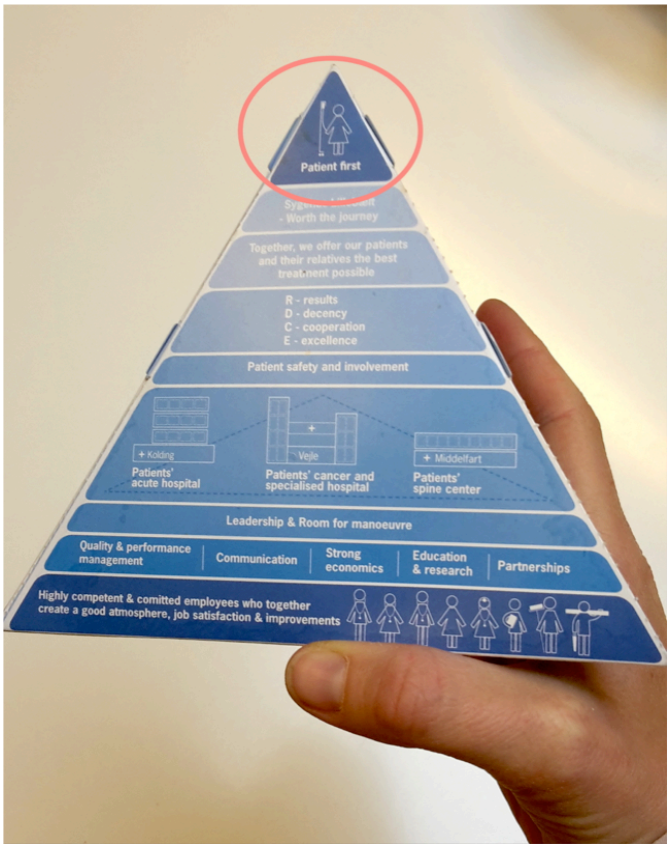

Figure 2: Vision triangle for the new Kolding hospital in Denmark[4]

2.1 PATIENTS FIRST IN THE CONSTRUCTION OF NEW DANISH HOSPITALS

Denmark is currently investing massively in the construction of new and improved hospitals. From 2010 to 2028 16 new (or upgraded) super hospitals are being built through an investment of DKK 50 billion (EURO 6.7 billion) made by the Danish government and the Danish regions. The effort is based on a vision to improve the overall quality by shifting the focus from hospitals for treatment to hospitals for healing, and by putting the patients' needs and wishes first through *patient-centered care, user-driven innovation*, and *improvement of physical surroundings.* These visions are based on the 2007 *Quality Reform* by the Danish government (Regeringen, 2007). As part of this shift there has been a growing attention to how the traditional hospital environment and its sensory impressions can have an unintended negative effect not only on patients, but also on staff and visitors (Folmer, Mullins, & Frandsen, 2012).

This discourse is part of a broader international paradigm shift in the design of the modern Western hospital from functionalism toward a growing interest in improving the environment in such a way that it supports user

[4] All photos by the author, unless stated otherwise.

needs, preferences, and sensibilities.[5] As such, the healing environment should both invite for activities and stimulation, but also make room for reflection and healing (Morgen & Innovationsrådet, 2007, p. 69). The regions are working to unfold these visions through a systematic and continuous focus on a number of key themes, including how the environment impacts on patients and staff, and how design and architecture can contribute to the healing process.[6] At the same time, there is a growing demand to base decisions concerning the creation of an improved hospital environment on scientific-based knowledge, and therefore, implementation and building processes are guided by recommendations from research done in the areas of *evidence-based design* and *healing architecture* (Frandsen et al., 2009).

2.1.1 Evidence-Based Design

Evidence-based design[7] is an attempt to base health care building design decisions on the best available evidence on how to increase safety, eliminate environmental stressors such as noise that worsen outcomes, and to design spaces ensuring the presence of positive distractions such as daylight that reduce stress and help improve outcomes. The evidence is primarily derived from large literature reviews of existing research aimed at identifying and making recommendations concerning specific environmental sources such as air quality, lighting, art, architecture, and music, thus contributing to an overall improvement of the hospital environment and best practices through, for example, introducing single-bed rooms, way-finding art, and exposure to nature. The evidence-based criteria are met by including in the review research which, for the most part, relies heavily on medical research methods and experimental results from fields such as neuroscience, evolutionary biology, immunology, and environmental psychology (Mullins, Folmer, & Fich, 2015, p. 17). As architectural research in the field is sparse, these methods dominate the field, with the *randomized controlled clinical trial* as gold standard (Becker, Bonaiuto, Bilotta, & Bonnes, 2011, p. 116; Little, 2003). *Evidence-based design* has become an international trend in human-centered health care design, as supporters believe it can assist designers in creating better hospitals, seeing as it is based on best available research. The origin of this research is the *Center for Health Design*[8] and the associated academic journal *HERD – Health Environments Research and Design Journal* published by Sage. More significantly, the introduction of the *Evidence-Based Design Accreditation and Certification (EDAC)* program by the American *Center for Health Design* allows both architects and their clients to study and gain accreditation in the field. All this suggests that *evidence-based design* is now becoming established, with the health care sector leading the way. And the publication of accessible and comprehensive books suggests that it is becoming mainstream in the Western health care system (Lawson, 2010, p. 96).

[5] The idea of a healing environment in hospital settings is not new, see e.g. Florence Nightingale's ideas from the mid-18th century about light and noise affecting the healing process (Nightingale, 1946). For an overview of the different hospital paradigms in Denmark, see (Stidsen, 2014, p. 41).
[6] See e.g. the central website for the building project: http://www.danishhospitalconstruction.com/ and the visions: http://www.godtsygehusbyggeri.dk/Maal%20og%20styring/~/media/Files/Maal%20og%20styring/Vision/Sygehusbyggeri%20med%20patienten%20i%20centrum.ashx
[7] Also referred to as *evidence-based health design* or just *health design*.
[8] See: https://www.healthdesign.org/

2.1.2 Healing Architecture

> "We must take our sensory experiences seriously" (Syddanmark, 2008, p. 3) "and let it influence the way we create better surroundings" (Dirckinck-Holmfeld & Heslet, 2007, p. 261, my translation).

In Denmark the paradigm *healing architecture* was introduced in several publications concurrently, suggesting how hospitals may accommodate more healing and pleasant environments and meet the human as a whole to maintain personal integrity (Morgen & Innovationsrådet, 2007, p. 68). In 2007 Dirckinck-Holmfeld & Heslet (2007) presented the book *Sansernes hospital* (*Hospital for the Senses*) emphasizing the importance of a holistic and stimulating approach to hospital design. The book argues for the importance of acknowledging the subjective sensory experience in hospital buildings, and was written to inspire architects and decision-makers in future work as well as offer knowledge of health care architecture and stimulating environments. In 2009 the extensive literature review publication *Healing Architecture* was published, and it has become the dominant reference for legitimizing *healing architecture* as the approach used in the construction of the new super hospitals (Folmer, Mullins, & Frandsen, 2012, p. 4; Frandsen et al., 2009). *Healing architecture* focuses on how new hospitals can be planned and built with the patient's experience of the environment in focus, but is also aimed at improving the overall experience of staff and relatives visiting. To expand this holistic and integrative vision beyond traditional architectural aspects, the use of art as a positive distraction is recommended, preferably through integrative solutions where art becomes an inseparable part of the surroundings, often serving a specific function or user group (e.g. way-finding or zoning).[9]

> "The architectural design expressed in the quality of daylight, the atmosphere of the room, colors, sounds, and the chance to be private and safe can support the physical and mental healing" (Morgen & Innovationsrådet, 2007, p. 6, my translation)

Taken together, the paradigm of *healing architecture* envisions a future hospital where the interplay between the experiences of the sensory competent human and the environment takes center attention. A healing environment should support the healing process by simultaneously *reducing stressors* and *providing positive stimulation of the senses*[10] – to meet both the need to feel protected from the environment, but also to feel like an integrated part of it. As such, both the sensory environment and the subjective experience become a domain of design and research interested in unfolding and shaping new and explicit strategies to sensibilize the new super hospitals of Denmark. In addition to the improvement of the existing physical environment, *healing architecture* also introduces a holistic perspective aimed at improving the overall atmosphere by implementing, for example, integrated art and designed light (Morgen & Innovationsrådet, 2007, p. 13). Furthermore, rethinking health care

[9] These recommendations are available in the guidelines found at the central web resource for the new hospital building: www.godtsygehusbyggeri.dk
[10] See e.g. http://www.nytouh.dk/~/media/E8530551A3E344FB83D4B58131AF38B4.ashx

based on the user's needs and wishes, patient-centered care includes a wish to empower the patient to, for example, "make choices of food, light, sound, and being social" (Morgen & Innovationsrådet, 2007, p. 15, my translation).

2.1.3 Evidence-Based Design and Healing Architecture Version 2.0

Evidence-based design serves as the primary research base for *healing architecture,* as the possibility of basing architectural and design decisions on evidence-based research has clear benefits as a way to legitimize the recommendations to other professionals in the hospital context who favor the hard empirical sciences. Furthermore, the solutions recommended in this literature can be easily operationalized and implemented without making a significant impact on the overall budget. However, the salient focus on the atmospheric, sensory, and experiential leads to a growing interest in the inclusion of non-measurable parameters to be dealt with in the research. This interest resonates with a broader trend in urban development and architecture, expanding its focus on built forms and spaces to also include awareness of the sensory environment in interplay with the body, as an explicit strategy to sensibilize inhabited space through notions like atmosphere and ambience (Böhme, 2006; Pallasmaa, 2012; Thibaud, 2014; Zumthor, 2006). This trend questions and challenges the evidence-based methods and their capability of handling such "non-handable" qualities. The key players and central publications in the Danish context are thus increasingly addressing these shortcomings and seek to lay out ideas and to point in new directions in order to keep up and accommodate the challenges. This is done as follows:

Hospital of the Senses proposes that there is a need for a different mindset to deal with "what we cannot know" (Dirckinck-Holmfeld & Heslet, p. 196, my translation) in the *evidence-based design* domain, but that matters for our existence to be able to qualify and develop *healing architecture*. For example, the existing field is not capable of addressing how atmospheric qualities impact our well-being by "striking an inner atmospheric keynote that impacts our perspective on everything" (Dirckinck-Holmfeld & Heslet, 2007, p. 256). This new mindset would also imply another language and tools for what we want to understand as it is "crucial to give the ineffable name" (Dirckinck-Holmfeld & Heslet, 2007, p. 265). Thus "Other exploration tools must be rethought and new concepts must be developed so that we at least can describe the atmosphere we want" (Dirckinck-Holmfeld & Heslet, 2007, p. 265). In this sense, *healing architecture* designates how *evidence-based design* must be expanded to include other non-measurable and qualitative approaches and methods currently absent and limited by the evidence-based criteria (Dirckinck-Holmfeld & Heslet, 2007, p. 11). Dirckinck-Holmfeld & Heslet (2007, p. 261) therefore suggest a future path that explores alternative approaches, such as phenomenological and hermeneutical methods combined with space and place theories, to gain a deeper understanding of the subjective experience in complex contexts. Likewise, Morgen & Innovationsrådet (2007, p. 11) propose user-driven innovation methods as liable ways of getting "in-depth knowledge of their (patients and relatives, red.) needs and expectations" in order to solve not only existing problems, but also to understand and explore new ones. Furthermore, the social context of the patient is emphasized through greater focus on the active involvement of other groups, including relatives (Morgen & Innovationsrådet, 2007, p. 13). It is argued that the

need for new approaches and methods stems from a lack of interdisciplinary competencies in the existing field, which can support a stronger user involvement and innovative design methods, where designers use different methods to involve user knowledge (Morgen & Innovationsrådet, 2007, p. 34).

In *Healing Architecture* the authors state that the field should be considered *research-based* rather than strictly *evidence-based* (Frandsen et al., 2009, p. 3). This shift, it is argued, is a consequence of the growing acknowledgement in the field that *evidence-based design* alone is too reductionist, primitive, and unilateral, for example, approaching one sense at a time. The reductionist focus is incapable of understanding the meaning of, for example, the sensory interplays and the overall sensory stimuli, leaving important issues "strongly underexposed" in the literature (Dirckinck-Holmfeld & Heslet, 2007, p. 196). Conversely, the missing link is the overall interaction between different aspects such as the senses, architecture, art, music, and healing. These issues are developed further in a recent publication by the researchers behind the publication *Healing Architecture* (Mullins et al., 2015), pointing out that clinical experiments test the effects of single or a few independent variables, thereby ignoring the complex everyday context. Thus, the experiments have "limitations in their external validity and generalizability" (Mullins et al., 2015, p. 17). In addition, other important single elements of the environment have never been subjected to any form of "rigorous scientific research" (Mullins et al., 2015, p. 17). According to the authors, the consequence is that it is difficult for practicing architects to draw "contextually applicable information from much of the scientifically founded documentation available" (Mullins et al., 2015, p. 17), which requires critical thinking on the part of the practitioners. Therefore, it is concluded that until correlated evidence is available "a purely scientifically based design approach to architecture is presently untenable" (Mullins et al., 2015, p. 17). Addressing these shortcomings (Mullins et al., 2015) calls for a *healing architecture version 2.0,* which could, for example, combine quantitative methods, such as systematic observation, with qualitative methods, such as interviews and photo documentation, to create better conditions for reaching valid results. It is therefore suggested that future work, aimed at understanding, for example, how we can create a space that provides an optimal framework for interaction between patients and relatives, must develop and employ methods which can address such complex problems through an investment in understanding the role of the body and physiological effects. This opening toward complexity thus pushes *evidence-based design* to engage in explanatory theories and to move beyond research that searches for purely causal connections between cause and effect (Mullins et al., 2015, p. 22).

Taken together, it is evident that as *healing architecture* and *evidence-based design* have been able to create the foundation for a new paradigm by providing evidence that the environment has an effect on the healing process, the field is now urged to take the next step in order to understand and produce these effects. This shift demands a novel focus on the interaction between the body, the atmosphere, the interplay of the senses, and the activities of the users, and on how to actively engage users in this process to address the problems adequately. In practice today the application of *evidence-based design* therefore implies incorporating the proficiency and judgment of individual architects based on their experience and ability to address these shortcomings in the field. This situation leaves a gap in areas where architects do not have sufficient knowledge and experience such as, for instance, the areas of lighting design and sound design. In the area of lightning research recent research projects

have taken up this challenge by developing ecological, cultural, and phenomenological approaches to *healing architecture* (Stidsen, 2014, Volf, 2011), focusing especially on how the overall light atmosphere in Danish hospitals can be improved. For example, Stidsen (2014) investigates how an atmospheric approach to the quality of light in the hospital ward can be applied to create a model for a pleasurable and variable indoor light atmosphere with attention to the user's socio-cultural background as well as knowledge of what homey light might mean to various users [P2].

What role does sound and noise play in the context of *healing architecture* in Denmark? The next part of the chapter sets out to investigate what roles the *acoustic environment* and *soundscape* plays in *healing architecture* in general and more specifically in the Danish context. This exploratory research draws on a number of sources, including a review of available literature on the subject in the fields of *evidence-based design* and *healing architecture*, state-of-the-art examples, and statements from semi-structured interviews with staffs at the neuro-intensive care unit at *Aarhus University Hospital*, conducted in the starting phase of the design case *KidKit* [P1]+[P2].

2.2 THE FIELD OF NOISE IN HOSPITALS

In *evidence-based design* and *healing architecture* both the *acoustic environment* and the *soundscape* have become a central concerns, as research has shown that measurable noise levels in the modern Western hospital exceed recommendations, while at the same time being consistently mentioned as a critical stressor for patients, staff, and relatives (Busch-Vishniac et al., 2005). My own research in the Danish context confirms this impression. For example, staffs at the neuro-intensive care unit at *Aarhus University Hospital* consider the *soundscape* of the unit to be both intrusive and alarming and emphasize that it represents the main stressor to patients and visitors. In the initial stages of my research one of the nurses stated that her biggest wish for the patients was for someone to design a noise deflector, which could create a private atmosphere for the patients and relatives in the shared wards [P2].

According to *healing architecture* and *evidence-based design* literature, sound in a hospital context is generally considered to be able to effect humans in two ways – either in a negative way through noise or unwanted sounds from equipment, staff, and other patients, having a stressful and sleep-disruptive effect, or in a positive way through auditive distractions with a calming and healing effect (Frandsen et al., 2009, p. 73). Reflecting this dichotomous understanding, *evidence-based design* recommendations concerning the noise problem have been dominated by two main approaches – a *noise reduction approach*[11] opting for *insulation strategies* and a *human-centered approach* opting for various *isolation strategies.*

[11] The approaches and strategies are termed by the author.

2.2.1 The Noise Reduction Approach and Insulation Strategies

Based on recommendations by the *World Health Organization* concerning environmental noise (Organization, 2011) the *noise reduction approach* argues that the increase of general noise levels in modern hospitals results in bad physiological effects, pointing to the necessity of highlighting sound and noise as central parameters when planning the design of hospitals in order to reduce noise levels (Frandsen et al., 2009, p. 73; Busch-Vishniac et al., 2005, p. 3629; Call, 2007, p. 2). This approach is based on an acoustical noise concept, where measurement of general noise levels becomes the main method for analysis and thus deals with the *acoustic environment*. The *noise reduction approach* argues that the overall sound environment in hospitals is too noisy and technological, and that new hospitals should be quieter and more natural. This basic assumption is legitimized by quantitative research mainly based on physical acoustic measuring methods of overall noise levels, identifying increasing sound pressure levels[12] and concluding that this is unhealthy for the patients' healing process, the work environment and performance due to stress and sensory overload (Okcu et al., 2011, p. 1349). As an example Busch-Vishniac et al. (2005) have detected a persistent rise in sound levels since 1968 and recorded mean sound levels ranging from L-eq 50-60 dB(A)[13] (continuous sound level) in 11-bed intensive care units across five hospital units over a 24-hour period. Noise is thus considered a dangerous pollutant to be eliminated. Therefore, it is argued that there is a need for designing a spatial sound environment that minimizes sound levels and reverberation times and promotes noise-reducing behavior. To achieve this goal the *noise reduction approach* recommends a range of *insulation strategies*, including implementing insulation material, installing sound-absorbing paneling, eliminating excess overhead paging, and culling extraneous alarms (Joseph & Ulrich, 2007; Frandsen et al., 2009, pp. 73-82; Hagerman et al 2005; Cordova et al., 2013; Grumet, 1993; Ising & Kruppa, 2004; Lim, 2014; Ryherd et al., 2008, p. 22). Taken together, the *insulation strategies* are considered to be functional and architectural interventions with no aesthetic and expressive value and can be implemented by engineers, acousticians, and architects.

2.2.2 The Human-Centered Approach and Isolation Strategies

The *noise reduction approach* has become increasingly contested as inadequate by an emerging *human-centered approach.* This approach therefore deals with dealing with the *soundscape*, and has therefore argued for a shift toward a subjective noise concept defined as *unwanted sound*, not chasing measurable silence, but facilitating perceptions of quiet and calm through stressing the importance of understanding the individual experience of annoyance (Johansson, Bergbom, & Lindahl, 2012; Topf, 2000). This shift is supported by data collected from 241 hospitals in the United States as part of the *Hospital Noise Project,* concluding that noise reduction as a cure and silence as a goal are not adequate, and "collectively, the healthcare industry is struggling to address noise or achieve any significant gains" (Wolf & Madaras, 2012).[14] The *human-centered approach* seeks to address

[12] Methods also used in *WHO* guidelines for community noise (Okcu, Ryherd, Zimring, & Samuels, 2011, p. 1349).
[13] A-weighting (dB(A)) represents a weighting function to mimic the response of the ear. It is applied to instrument-measured sound levels in an effort to account for the relative loudness perceived by the human ear, as the ear, for example, is less sensitive to low audio frequencies.
[14] A thesis by Cassandra H. Wiese from 2010 investigated patient perception of noise in the same hospital ward before, during, and after renovations, which included the installation of various noise reduction strategies. She concludes that "The

perceived noise annoyance through detailed acoustic measurements combined with qualitative studies (Okcu et al., 2011, p. 1349) based on interdisciplinary collaboration (Ryherd et al., 2008, p. 23). Noise-induced subjective stress among staff and patients has been well documented. Topf and Dillon (1988) suggest that the experience of noise is an *ambient stressor* which is likely to cause subjective or physiological stress and to increase work pressure, annoyance, fatigue, and burn-out among staff (Joseph & Ulrich, 2007; Topf & Dillon, 1988). The main strategies proposed by this approach include providing positive environmental adjustments through reduced reverberation times, isolating the patients in single bedrooms, and providing positive distractions through music intervention, earplugs, and adding continuous background sounds called masking noise (Moeller, 2005, p. 3; Dirckinck-Holmfeld & Heslet, 2007; Frandsen et al., 2009).[15] Researchers addressing human-related factors in alarm design offer an important contribution to this approach, aiming to develop new standards for alarm sounds that are patient- rather than equipment-centered (Edworthy, 2000). Building on studies that demonstrate how a typical medical environment is dominated by too many alarms that are "too loud, too insistent, and tend to disrupt thought and communication at the very time that it is vital" (Edworthy, 1995: 15), a more ergonomic way of constructing auditory warnings is proposed (Stanton, 1994; Edworthy, 1995; Edworthy & Hellier, 2005) [P2]. Other strategies address cultural and behavioral patterns through an alignment of people with an ongoing noise effort, for example through carving out blocks of daily quiet time (Wolf & Madaras, 2012). Taken together, the *isolation strategies* strive to recognize the subjective and thus divergent subjective experience of noise, and therefore aim at providing single patients with individual ways of finding islands of rest shielded from the hectic hospital environment. The dominant way of operationalizing the positive effect of auditive distraction is through music intervention, similar to the use of art as a positive distraction described earlier. Music intervention covers the use of specific types of healing music mixed with representational nature sounds or self-chosen music as positive distractions for shorter periods of time. What healing music covers is not described in detailed in the *evidence-based design* literature, which merely states that it must be appropriate for the given use and context, contain calming and positive features, and that it cannot be abstract (Ulrich, Zimring, Choudhary, Joseph, & Quan, 2004, pp. 21-23). For further research on music intervention, *evidence-based design* refers to studies done as part of the Nordic research project *Musica Humana*,[16] which focuses on music intervention through healing music or music therapy.

A white paper from 2014 summarized existing research findings on the use of music intervention, identifying great benefits of using specific music as "environmental adjustments" in hospitals. In the publication the authors argue that music intervention is thus the most widely studied and most effective intervention in a hospital settings (Gebauer & Vuust, 2014). The publication states that what makes music *music* are its internal structures, and consequently what makes music *healing* are thus related to the calming parameters of the internal musical

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renovations in this study unfortunately did not alter patients' perceptions of noise" (Wiese, 2010, p. 160), and that "Results show that current noise level guidelines were exceeded regularly; despite this the surveys showed most patients were not very annoyed with the noise" (Wiese, 2010, p. 3).

[15] More information about masking noise can be found at: http://www.hconews.com/articles/2013/08/1/creating-quiet-sound-masking-in-patient-rooms

[16] A research project (1998-2003) closely connected to *MusicCure* products http://musicure.com aimed to document the positive effect of *MusiCure* used as music intervention.

structure. Some of these parameters are said to be universally present across different cultures and traditions, for example repetition and variation, where a piece of music in order to be perceived as pleasurable must find the "perfect balance between familiarity and novelty" (Gebauer & Vuust, 2014, p. 11). Therefore, music "in itself" is found to be particularly effective in regulating low/high arousal and causing both physiological and psychological activation and emotions. Based on this view, music with a slow tempo, low pitch, and low intensity will therefore have a calming effect on the listener. Apart from the universal aspects, cultural and personal aspects are also mentioned as important in the design of effective music intervention products. Even though it is mentioned that other types of stimulation may also create some of the effects provided by music, for example masking or distraction from the existing noise in the ward, music is highlighted as a particularly effective stimulation. Furthermore, familiarity connected to the feeling of control is a key component in music intervention success, therefore advocating self-chosen music (Gebauer & Vuust, 2014, p. 31). To be legitimized as part of the *evidence-based design* literature the predominant research methods used to evaluate the effect of music intervention are quantitative methods, preferably the *randomized controlled clinical trial*, which in the medical sciences represents the ideal experiment (Nilsson, 2009a: Nilsson 2012; Nilsson, Lindell, Eriksson, & Kellerth, 2009; Warth et al., 2014) or laboratory tests (Quarto, Blasi, Pallesen, Bertolino, & Brattico, 2014; Villarreal, Brattico, Vase, Østergaard, & Vuust, 2012). Gebauer & Vuust (2014) thus pointing to the lack of proper active control groups, limited sample sizes, and differences in methodological approaches as obvious limitations for making valid conclusions and meta-analyses on the use of music intervention as a field (Gebauer & Vuust, 2014, p. 57). The role of technology, the listening context, and how the music is mediated to the listener, in what situation, and for how long are only briefly mentioned in this literature. The dominant practice is to use music intervention in passive listening situations characterized by pre-recorded musical pieces played for shorter periods of time (Gebauer & Vuust, 2014, p. 26) either through headphones (Archie, Bruera, & Cohen, 2013; Quarto et al., 2014; Villarreal et al., 2012) or various personalized speakers (e.g. music-pillows) (Nilsson, 2009b). Furthermore, the experimental condition for comparison without music intervention is not described in detail (Nilsson, 2009b; Fredriksson, Hellström, & Nilsson, 2009), or it is simply referred to as "silence" (Moorthy, Munz, Undre, & Darzi, 2004; Quarto et al., 2014, p. 4). Few studies compare outcomes when using different mediation set-ups, pointing to a problem of overhearing when using normal speakers, as they disturb the staff (Weeks & Nilsson, 2011). The effect of music interventions on a larger timescale remains to be investigated in depth (Gebauer & Vuust, 2014, p. 32).

Due to the emergence of the *human-centered approach* in the field, the noise problem is increasingly approached, internationally as well as in the Danish context, as a complicated and ongoing problem with no easy solution, highlighting the importance of not only considering negative aspects, but also including qualitative features (Mackrill, Cain, & Jennings, 2013, p. 1). This direction reflects a general paradigm shift in research on complex and public sonic environments from *no sound* or noise understood only as a pollutant to noise as a stressor and a new focus on *quality sound* – a shift that has been emerging in several disciplines. This work, termed *soundscape research* (Kang et al., 2013), has disputed the idea that sound, unless organized in accepted musical structures, is always unnecessary and undesired, highlighting that quality of life is not improved simply by removing sound, but rather by shaping its aspects, as "fighting against noise pollution may not be the same as fighting for silence"

(Thibaud & Amphoux, 2013, p. 64). In other words, the univalent focus on noise understood purely as a nuisance is problematic when addressing complex sonic environments, and therefore issues of noise must be supplanted by reflections on aural comfort through a quality of life perspective.

2.2.3 Innovative Healing Architecture Projects in Denmark

This section summarizes examples of state-of-the-art projects in a Danish context, chosen for their explicit wish to integrate sound and music actively as part of a *healing architecture* approach. The projects presented share similarities with state-of-the-art projects found outside Denmark.[17] These projects also refer to current research on the benefits of introducing *Reality Orientation Programmes* to patients, who are confused or disoriented. This is done by creating environments that support a direct relation to the external world, for example through changing artificial daylight and information boards helping patients rehabilitate faster (Langhorn, Holdgaard, Worning, Sørensen, & Pedersen, 2015).

A new innovative and integrative solution for a neuro-intensive care unit for patients with severe brain trauma has been developed by several private companies, including *MedTech Innovation Center* and *Sound Focus*, in cooperation with *Aarhus University Hospital*.[18] Among other initiatives the dynamic light is regulated during the day according to the time of day outside. The new ward hosts three patients, but is divided into zones to create privacy through interior solutions, but also through the use of directional speakers placed over each bed. The speakers are controlled by the staff, who can choose to play either music intervention (*MusiCure* by Niels Eje) for a maximum of 30 minutes at a time or masking noise (pink noise) in emergency situations. The project is under evaluation and is being developed into a product that integrates sound, dynamic light, information, and surveillance.

A similar project conducted in a delivery room at Herning Hospital[19] is also under evaluation. Its focus, though, is more on creating different zones and giving the users, not the staff, control of the nature of the different atmospheres. Due to a knowledge gap when choosing music, *MusiCure* was identified as the only evidence-based choice. However, it is considered a temporary choice, as the involved stakeholders want to develop other sound atmospheres the match the visual atmosphere in the hospital.

Phillips Ambient Experience worked together with *Wavecare Technology* (a development of *MusiCure*) in Nordsjællands Hospital to develop an integrative sensory delivery room fitted with dynamic light and audiovisual stimulation[20] to improve the atmosphere and adapt to the users' changing wishes. The music is combined with natural sound (*MusiCure* by Niels Eje) to create a calm and soothing atmosphere together with

[17] See e.g. Philips Ambient Experience: http://www8.healthcare.philips.com/ae/
[18] More about the project: http://solutors.com/index.php?id=153, http://www.curavivo.com/79. More about dynamic light: http://chromaviso.com/. More about directional speakers: http://soundfocus.dk/
[19] A video of the delivery room with commentary in Danish: https://www.youtube.com/watch?v=MzIvnxX0Q1o&feature=youtu.be
[20] More about the projects: http://www.nordsjaellandshospital.dk/topmenu/Presse_Nyt/Nyheder/Arkiv2013/Sansefodestue.htm?siu=true, http://www.wavecare.com/sensory-delivery-rooms2.html

nature imagery. Furthermore, a breathing exercise is provided with imagery and the sound of waves aimed to help women in labor to maintain a constructive breathing rhythm. This rhythmic strategy is connected to the *Philips Adaptive Healing Room* concept, which uses an adaptive daily rhythm system designed by linking an artificial skylight and view with lighting and sound systems to adjust room conditions to both the time of day and the hospital agenda. The project is currently being tested and evaluated.

Figure 3: The new Sensory Delivery Room at Herning Hospital in Denmark. Photos: Modos

2.3 SUMMARY & IDENTIFICATION OF GAP

According to both *evidence-based design* and *healing architecture*, a healing environment is characterized by meeting the need to feel both protected from the hectic health care environment and like an integrated part of this environment, empowering the patient to be able to actively choose privacy or to engage in the environment at different times. These vital needs are supported by research in the field of noise in hospitals (Mackrill, 2013, p. 5; Shattell et al., 2005, p. 168). Designs aiming to achieve a healing environment must therefore simultaneously reduce stressors and positively stimulate the senses through the interplay of art and architecture. The combination of the two main approaches in the field of noise in hospitals seems to match these ideas and may therefore prove capable of adequately addressing the noise problem. However, considering the capacity of the existing strategies to shield the patient reveals that they are unsuitable in situations where *insulation* and *isolation* are not the most effective or feasible ways to meet the need to feel like an integrated part of the environment. The exploratory research into the field of noise in hospitals presented in this chapter, shows that even though there is an explicated ideological vision to unfold the *human-centered approach* through *healing architecture,* it has not yet been unfolded in the area of *acoustic environment* and *soundscape* beyond *insulation* and *isolation strategies*.

The current situation in Denmark mirrors research done in the United States, where Wolf & Madaras (2012) conclude that "there is not a consistent structure by which noise is addressed, and unlike just about every other function or factor in a hospital, the quality level of the auditory portion of the environment does not fall into anyone's formal job description." (Wolf & Madaras, 2012, p. 8) Furthermore, the wish to give patients and relatives instruments to make their own choices is also missing. Environmental and complex everyday sounds are generally approached as something negative and stressful that should be masked or avoided (Morgen & Innovationsrådet, 2007, p. 11). Few innovative project experiments explore the potential of promoting active involvement among patients and relatives to make them feel like an integrated part of the immediate environment, actively co-creating a supportive and caring environment. However, the role of sound and music in these projects is still passive, except for the interactive *Breathing Practice* program in the sensory delivery room by *Phillips Ambient Experience* and *Wavecare Technology*, which is currently being evaluated. Taken together, the noise vs. silence dichotomy permeates the existing approaches and strategies, despite the shift from noise as a pollutant to the human-centered focus on a subjective noise concept defined as *unwanted sound*, a stressor. Therefore, the strategies both aim at protecting and isolating passive subjects and focus on sound and noise as separate from the other senses, the body, and the surrounding environment.

In other words, there is nothing to suggest that the call for *evidence-based design* and a *healing architecture version 2.0* outlined in section 2.1.3 can be unfolded in relation to sound and noise now or in the near future. Therefore, the *soundscape* is consistently overlooked and under-prioritized in the planning and construction of new Danish hospitals – with the exception of basic sound-proofing intervention and an increase in the number of single bedrooms. Therefore, there is a need for new research and strategies in the field capable of addressing the complexity of the everyday environment in hospitals, focusing on the interaction between activity, engagement, experience, the body, and the atmospheric and multisensory interplay.

CHAPTER 3
REDUCTIONIST FRAMEWORK

This chapter analyzes the shared foundational framework underlying the existing approaches to fighting noise in hospitals in order to expose possible reasons for the gap identified in chapter 2. This is done in two related steps:

First, it is argued that the foundational framework is based on a dichotomous understanding of pathological and stressful noise vs. healthy quietness and a sharp division between a passive receptive subject and the object of noise. This reductionist framework builds on an understanding of the senses as divided into different channels and finds that sensory impressions such as noise bombard the passive perceiver from the outside with raw chaotic data to be interpreted cognitively into an internal model of the world. It is therefore concluded that the existing field's struggle to unfold the visions of *evidence-based design* and *healing architecture version 2.0* is connected to how this reductionist framework is unsuitable for fulfilling the need for higher ecological validity and complexity in the field.

Secondly, it is argued that the reductionist framework moreover is reluctant to include alternative research from outside the field, which aims to understand listening and the body in relation to the complex environment of the hospital, or it is reduced to simple noise reduction conclusions when translated into the existing reductionist framework. Additionally, there is no trained experts, as in the area of architecture, who can fill in the knowledge gap by combining practical experience from complex environments with the basic evidence provided in the area of noise in hospitals needed to move the field beyond a mere check list approach toward an adequate ecologically valid approach.

Therefore, the chapter ends by arguing for the advantages of adopting *reflexive epistemological diversity* in the field, which would allow the inclusion of alternative research built on different foundational frameworks. This expansion would help strengthen the explanatory validity in the field, which is necessary for meeting the wish to create engaging and healing environments in Danish hospital environments in the future.

3.1 REDUCTIONIST FRAMEWORK

The two main approaches in the field addressing noise in hospitals, presented in the last chapter – the *noise reduction approach* and the *human-centered approach* – are both based on the understanding that noise and not-noise are consistent concepts that can be fixed in various representational and dichotomous frameworks as noise vs. not-noise or unwanted vs. wanted sound. Both approaches suggest that there is something which can be separated and conceptualized in itself and thereby removed and/or described independently – the *noise reduction approach* because its quantitative premise is that noise can be objectified, measured, and thus removed, and the *human-centered approach* because its qualitative premise is that it can comprehend and deal

with noise in all its complexity by establishing a comprehensive general taxonomy to distinguish between the *unwanted* and *wanted*. The cultural theorist and musicologist Ian Biddle argues that we tend to install a "naive materialism of noise" when we detach noise from the conditions in which it is made and encountered, and thereby install a certain "politics of sonic autonomy" (Biddle, 2009, p. 3). He argues that we must question this alignment of noise to what Foucault has termed "formidable materiality", which somehow resists or exceeds the analytical trajectories through which it is constructed. The result is that noise is considered something in "itself" and, at the same time, somehow unavailable, leaving it dumbfounded. Likewise, our idea of pastoral, idealized silence as the other side of the coin is embedded in general discourse about the social good as something in itself (Biddle, 2009, p. 8).

Following the object-oriented philosophy of Graham Harman, I argue that both approaches share an underlying reductionist framework based on *undermining* and *overmining* tactics (Harman, 2013b, p. 43). Both approaches seek to handle complexity by capturing the essence of things (noise) – either through *undermining*, that is, reducing things downward to their smallest components and thus suggesting that noise is *nothing more* than its constituent elements, as when the *noise reduction approach* assumes a correspondence between observation and the real world, or through *overmining*, that is, reducing things upward into broad dichotomous concepts, as seen in the *human-centered approach,* which regards noise as nothing more than the effect on the individual subject. When both approaches are included in *evidence-based design*, the result is *duomining*, where the field not only depends on defining measurable criteria for noise, but is also commensurable with human understandings of general categories such as *noise*. In this sense, *duomining* combines the weaknesses of both *undermining* and *overmining* by reducing things through making them overly depended on what they are made of (*noise-reduction approach)* and, at the same time, too quick to assume that reality is commensurable with our human understanding of reality (*human-centered approach)* (Harman, 2013b, p. 43). According to Harman, such gestures have all sorts of practical consequences, as they justify types of conduct toward substances as degrading. For example, the *duomining* gestures in this field together ignore the fact that both the instruments for measuring and the categories for describing noise constitute the object under study by both reducing and amplifying certain aspects of it. Peter-Paul Verbeek, a central figure in postphenomenology, criticizes such traditional approaches to technology as either *instrumentalism* or *substantivism*, that wrongly considers technology something in itself, referring to Albert Borgmann (Verbeek, 2005, p. 136). *Instrumentalists* see technology as neutral tools for accomplishing tasks, and thus, technology should not be considered more than its use. *Substantivists,* on the other hand, think of technology as an independent and often negative and destructive power holding society in its grip (Verbeek, 2005, p. 174). Both views of technology can be traced in the exiting approaches – for example, the *instrumentalist* view on both the decibel meter, the technology for playing healing music, and the insulation technology as neutral means, and the *substantivist* view that technology is sterile and dangerous and something which people should be shielded against. A clear example of the *substantivist* view can be found in one of the central publications on *healing architecture* in Denmark written by Dirckinck-Holmfeld & Heslet, who state that "Frightening technology should be as invisible to the patient as possible" (Dirckinck-Holmfeld & Heslet, 2007, p. 249, my translation).

Another consequence of the reductionist *duomining* gestures is expressed in the Cartesian framework, which presupposes a dichotomous divide between the experiencing subject and the object of noise. Martin Heidegger argues in *Being and Time* (1927) that taking the subject/object dichotomy as a point of departure will lead us to fundamentally mischaracterize our prevalent engagement in the everyday world in which we are usually unreflectively immersed (Heidegger, 2002). He considered this to be the result of a prevalent modern worldview, attempting to establish mastery and control over an unruly world (Thomson, 2011). Splitting the subject from objects and other subjects makes up the foundation for what Heidegger terms *subjectivism*. From this perspective, an objective realm is separated from isolated subjects and so must be mastered by the normative and practical activities of these subjects, as reflected in the existing strategies. The attempt to skip the integral and practical entwinement of self and world will lead to *enframing* (*Gestell*), when the failed attempt to control the world turns back onto itself and the subject increasingly becomes transformed into just another object to be controlled. This tendency can be traced in the attempt of *isolation strategies* to control subject behavior through, for example, quiet time and urging individuals to seek harmony elsewhere, for instance by withdrawing into headspace through the use of healing music, which is believed to "work" as a kind of medicine controlling the patient's mind (Lind, 2007, p. 211). "Aesthetics becomes a psychology that proceeds in the manner of the natural sciences; that is, states of feeling become self-evident facts to be subjected to experiments, observation, and measurement" (Heidegger & Krell, 1991, p. 89).

As a consequence of the radical split between subject and object, the human is considered a passive receptor of raw sensory data, filling in the gaps through accumulation of knowledge in a chaotic environment, where structure is imposed on the world by building an internal model (Clarke, 2005, p. 22). This renders possible a set of epistemological orientations toward the world, which have implications for our understanding of the listening subject. For example, it facilitates fixated listening and "a way of thinking about the sonic environment as a site of contagion that must be stilled, hushed, managed, or curtailed" (Biddle as cited in (D. Clarke & Clarke, 2011, p. 73)) such that the fixated modality of listening can be installed. This view presumes a division of the senses as different channels, which can be addressed individually as discrete faculties, and thus encourages research to start with *sensory atomism* (Ihde, 2007, p. 43). This becomes evident when sound and noise and hearing are understood as passive, cut off from the other senses and their bodily interplay. In this view, the overload of sound (raw sensory data) bombarding the passive receiver makes noise an unhealthy, contaminating stressor that causes disease (Biddle, 2009). This worldview assumes that there is a quiet and balanced world somewhere, and that our job therefore is to restore the balance by removing noise through protective regulatory measures until the problem has been solved (Cox, 2009). Therefore, the noisy *acoustic environment* in hospitals likewise creates a tension amplified by the cultural understanding that quietness is the most appropriate environment for healing, as stated by Rice (Rice, 2013, p. 29). Seen through this analytical lens, the *insulation* and *isolation strategies* represent efforts to resist and prevent what Erving Goffman has identified as *contaminative exposure* (Rice, 2013, p. 44). Fear of noise urges us to mitigate the potential of contagion through bubbles of property and headphone listening (Biddle, 2009, p. 6).

3.2 HISTORICAL PRECONDITIONS

Over the last century most research on noise has focused on explaining how people become stressed and fall ill owing to noise pollution in the industrialized world, and the most common strategies thus aim at removing noise as far as possible to create a healthy and healing environment. Max Neuhaus diagnosed this tendency in 1974, stating that the "present concept of noise pollution condemns all sounds by leaving, in the public mind, the impression that sound itself is physiologically and psychologically harmful" (Neuhaus, 1974, p. 39). Concerning indoor noise pollution, Sabine von Fischer traces how various acoustical and technological developments – from the anechoic chamber after World War II through the growing sound-proofing industry to the dampened broadcasting studios etc. – together shaped a modernistic vision of the desired indoor atmosphere as controllable, quiet, and minimalistic (Fisher, 2013). On the same note, Blesser and Salter describe such technological intervention as:

> "monuments to a new acoustic era, which could be summarized as spatial design that emphasized foreground sounds in a background of silence. Soundscapes were to be stripped of living sounds and spatial acoustics, thereby weakening the aural connection of spaces to the social fabric" (Blesser & Salter, 2007, p. 108).

In other words, the growing demand for private acoustic arenas emerges with the formation of acoustic damping materials and acoustic engineering as a profession (Blesser & Salter, 2007, p. 106). Von Fisher suggests that the growing number of occurrences of indoor sound stress (in homes, offices, and hospitals) not only stems from the character of the sounds present in the environment, but even more importantly from the development of this silent, sound-proof indoor ambience, with hard surfaces that work as a silent amplifier of the sound signals present in the room. This design of silence *(Konstruktion der Stille)* (Fisher, 2013), as the desired goal, results in a state where there is no natural background sound to drown out irrelevant and annoying sounds, making them stand out even more. Karin Bijsterveld expands this understanding, arguing that the idea that echoless space represents the best acoustic indoor signature also lays the basis for social policy and the construction of sound and noise as public problems (Bijsterveld, 2008).

Following this line of thinking, common ideas of sensory atomism and the understanding of perception as passive reception are based on the premise that since the mid-nineteenth century "dominant ideas of hearing in science, technology, and medicine retreated further and further into the head, the inner ear, and the brain" (Sterne, 2015, p. 68). Modern physiology, acoustics, medicine, engineering, and psychoacoustics distinguish the hearing ear – as a pure physical capability – from the subjective experience and the meaning of what is heard. As in the field of noise in hospitals;

> "the discursive rules of psychoacoustics and psychophysics condition the kinds of questions that can be asked about human hearing, how those questions can be investigated (…) Our present psychoacoustic construct of *hearing in itself* is only accessible through sonic equipment, and through users who are comfortable working with it. Everything that is known about hearing in its natural state is a result of the interactions between ears and sound technologies" (Sterne, 2015, pp. 69-70).

In this way, the development of hearing equipment such as microphones and decibel meters shaped particular ways of hearing and institutional contexts that defined hearing as well as what was heard. Thus, the technological development allows a quantification of sound, which Emily Thompson has showed resulted in a growing perception of noise (Thompson, 2002).

Even though the *soundscape* movement and *acoustic ecology* have challenged public opinion by creating renewed interest in listening to complex sonic environments in everyday contexts, the historical premises for the reductionist framework presented above have been present in these related fields since their emergence in the 1970s. Sound artist Fransisco López shows how the value-laden aesthetic judgments of the *soundscape* movement, for example determining which environments are *hi-fi soundscapes* and which are *lo-fi soundscapes*, are closely intertwined with the role of humans as superior tuning masters of silence seeking homeostasis in the postindustrial world (López, 1998). López continues his critique by stating that this worldview results in an unfortunate mixture of health aspects merged and confounded with romantic aesthetic judgments (López, 1998). On this note other central opponents of the concept of *soundscape* have argued that it wrongly places listeners *outside* the world, distanced from it, and therefore reinforces the artificial divide commonly erected between mind and matter, subject and object (Toop, 2010, p. 37). Likewise, the repeated debate on the differences between unconscious hearing and idealized listening, as in the widespread methods of sound walking, mobilizes the same epistemic history as the one described in modern physiology, acoustics, medicine, engineering, and psychoacoustics[21] (Sterne, 2015, p. 69).

Taken together, these historical prerequisites shaped the pervasive idea that noise constitutes an unhealthy stressor by which we are passively affected. This understanding resonates with what sociologist Aaron Antonovsky found to be the most widespread understanding of diverse stressors in everyday life – they are pathogenic, causing or capable of causing disease. Antonovsky argues that the pathogenic paradigm dominating the industrialized world alone is inadequate for promoting health, because it solely seeks to explain why people get sick and therefore becomes a search for what makes us sick or how we can remove the causes of illness, thus ignoring other findings in the research. Equilibrium, order, and coherence are to be achieved by control and mastery of the world in the pathogenic discourse (Antonovsky, 1987, p. 168). Precaution measures must therefore be taken until the problem has been treated or buffered against, but also through the creation of the illusion that a balanced state of homeostasis can actually be achieved. When this attempt fails, the attempt to

[21] See e.g. Julian Treasure, TED talk, *5 ways to listen better:* https://www.ted.com/talks/julian_treasure_5_ways_to_listen_better.

control the world moves into headspace, what was termed *enframing* in section 3.1, by facilitating islands of rest in a balanced ideal world "inside" the music (as with the example of healing music). Antonovsky therefore offers an alternative salutogenic orientation to complement the pathogenic, focusing on factors that support human health and well-being rather than on factors that cause disease. On the surface the holistic health movement behind *healing architecture* and *evidence-based design* is in part founded on the salutogenic orientation of Aaron Antonovsky in his book *Health, Stress, and Coping* from 1979. However, in *Unraveling the Mystery of Health – How People Manage Stress and Stay Well* from 1987 Antonovsky explicates that the homeostatic basis of the holistic health movement is directly incompatible with the heterostatic basis of the salutogenic orientation (Antonovsky, 1987, p. 3). According to Antonovsky, the health-oriented emphasis of the holistic movement builds on a false dichotomy between health and sick people and the idea of homeostasis as a realistic goal, which one should aspire. When the perfect balance is not achievable in the interactions of the messy everyday life, it must instead be restored inside ones own head space.

3.3 CRITERIA FOR VALIDITY IN EVIDENCE-BASED DESIGN

The reductionist and pathogenic framework characterizing the existing field of noise in hospitals is consistent with the cognitive traditions and laboratory methods prevalent in *evidence-based design*, which are based on the evidence-based criteria for research validity. However, Stankos and Schwarz argue that if *evidence-based design* is to remain relevant as a paradigm for the future, it must be able to address the messy complexity in the everyday context (Stankos & Schwarz, 2007). As *evidence-based design* is increasingly presenting important implications for future health care design, it has also been met with critique concerning its status as a natural parallel to *evidence-based medicine* (Stankos & Schwarz, 2007). The critique points to both the limited size of the knowledge base which reduces the use of *evidence-based design* to a functional explanation that cannot explain actual causal relationships between design and outcomes, nor lead to meaningful predictions in health care design, and on the quality of the research, which is criticized for its narrow focus on “Does it work?”, resulting in a lack of analytical and theoretical foundation and thus a danger of *evidence-based design* being a design polemic, promoting certain ideas to justify one way of doing things, rarely derived from causal explanations (Stankos & Schwarz, 2007, p. 6). According to Annerstedt, *evidence-based design* is unsuited for dealing with complex interventions, as medical knowledge is considered neutral and objective derived from controlled and empirical research, but fails to provide solutions for complex research (Annerstedt, 2012, p. 31).

This growing critique, combined with the call for an updated version of *healing architecture*, has prompted a general shift in the research literature from *evidence-based* to *research-based* (Frandsen et al., 2009, p. 3) through the inclusion of alternative qualitative methods, as seen in the *human-centered approach.* However, the process of including such new criteria for validity poses problems for *evidence-based design*, as the increasingly diverse interdisciplinary theory and methodology put pressure on the comparability of *evidence-based design* to *evidence-based medicine*, which has been an important part of its legitimization in the health care industry. Therefore, the main consequence has been that research based on alternative methods and other foundational frameworks and criteria of validity than the ones accepted in *evidence-based design* is either not included in the

field or translated into the existing reductionist framework, supporting its presuppositions.[22] But the process of translation involves the risk of reducing and thus missing the potential of relevant research to help bridge the gap in the field. As health research often considers methods to be tools with no direct relation to the ontological and epistemological foundation, this problem is not easily spotted. In line with among others Becker et al., I thus argue that this is not a viable solution, as research should be guided by a foundational framework that reflects the complexity of the problem being approached (Becker, Bonaiuto, Bilotta, & Bonnes, 2011, p. 128). Moreover Becker et al. stresses that *evidence-based design* has a hard time rethinking baseline assumptions, as it is caught up in the evidence-based demand and thus struggles to move beyond research for either *justification* or *incremental change* incapable of rethinking and innovating (Becker et al., 2011). In the quest to legitimize itself as a valid approach, the primary goal of *research for justification* is to justify design proposals by employing evidence-based models (experimental and quasi-experimental comparative research design) focused on outcomes to convince stakeholders of the causal relationship between specific interventions and outcomes (Becker et al., 2011, p. 116). The primary goal of *research for incremental change* is to identify problems and generate data about what works and what does not work from the user's perspective, often done as one-time case studies (Becker et al., 2011, p. 119). This presents an obstacle for rethinking the *evidence-based design* paradigm, as *evidence-based design* cannot only consider research results, but also needs to rethink the frameworks used to structure the research process and the complexity of the ecological context in which the results are generated and will be applied. In situations where there is a need to rethink the foundational premises of a field it is crucial to develop and encourage *research for innovation*. This should not be understood as research aimed at coming up with novel solutions, but as research demanding a "deep understanding" and asking new questions (Becker et al., 2011, pp. 119-120). Additionally, to engage in *research for innovation* practitioners must be guided by a conceptual framework and ecological theory that reflect the complexity of the problem being approached, but also new methods that combine scientific knowledge with, for example, artistic knowledge (Lawson, 2010, p. 97).

Based on the analysis presented in this section the obvious answer would thus be that *evidence-based design* should rethink its theoretical and philosophical frameworks used to structure the research process, insofar as other methods and ecological frameworks represent relevant alternatives. However, I want to argue that instead of opting for an either/or solution, a fruitful and more constructive alternative is to think of how the field can embrace both/and, allowing more than one foundational framework to coexist within *evidence-based design*, complementing each other.

[22] An example of this is how the famous article "Pandemonium in the Modern Hospital" by Gerald W Grumet (Grumet, 1993) has been used as a simple argument for noise reduction. In a comment to the article Grumet writes that this is not his main message, as he believes that "If the problem is ever to be solved, a shift in focus from 'noise avoidance' to 'serenity creation' must occur." See: http://www.nejm.org/doi/full/10.1056/NEJM199307153290320#t=article

3.4 CALL FOR REFLEXIVE EPISTEMOLOGICAL DIVERSITY

Within the sociology of science and technology, Matthew David has proposed that the entrenchment within forms of reductionist and relativist epistemology can and should be overcome by adopting *reflexive epistemological diversity* (David, 2005, p. 22). *Reflexive epistemological diversity* recognizes the value of many forms of explanations, promoting interaction between these different explanations, at different levels of causation, and across the divide between different sciences. The prevalent view that insights from other epistemological traditions will confirm the falseness of any one tradition is to be replaced by a willingness to accept and open up to different causal explanations, as the complexity of the world is best approached in different ways and on a number of levels. However, epistemological diversity does not mean that all explanations are valid, but that causation occurs at many levels, and that specific events are caused by a complex set of factors.

Instead of aiming to find *the* evidence to solve *the* problem, *reflexive epistemological diversity* aims to gain greater explanatory validity, which recognizes that various contributions to an overall account force us to reflect upon the limitations of each individual explanatory approach, as differences encourage reflexivity if they are actively engaged with. In this way, *reflexive epistemological diversity* offers a means of balancing the need to question all taken-for-granted assumptions with the need to respect a range of explanations. This stands in contrast to non-reflexive epistemological diversity, which is often seen in interdisciplinary work, and is based on stacking up the results of insular research traditions confined within specific and self-referential disciplinary fields. Introducing *reflexive epistemological diversity* in the field of *evidence-based design* and *healing architecture* would allow alternative frameworks to fruitfully co-exist alongside the existing approaches, facilitating the inclusion of research insights that address the ineffable and thus achieve a higher explanatory validity without which the situation will remain unclear and it will be difficult to intervene in the practical field with the necessary strategies and new research in order to help bridge the gap and move toward the desired version 2.0. Both Blesser & Salter and Jean-François Augoyard have pointed out how different research approaches to noise, acoustics, and sound suffer from a *cricket effect* (Blesser & Salter, 2007, p. 298; Hellström, 2003, p. 13). This effect describes a situation where different disciplines remain fragmented in isolated islands of specialized expertise, without cooperating, due to their different criteria for research validity or different intellectual frameworks and cultural values (Blesser & Salter, 2007, pp. 276-277). I argue that the *cricket effect* also dominates the field of noise in hospitals, and the call for *reflexive epistemological diversity* is therefore applicable to both *evidence-based design* and *healing architecture* as well as to the specific field dealing with the *soundscape* in hospitals.

3.5 SUMMARY

Evidence-based design and *healing architecture* recommend that a healing environment in the hospital should meet the need to feel protected from the hectic hospital environment, but also to feel like an integrated part of it. However, in relation to sound and noise the two dominant approaches *(noise reduction* and *human-centered)* share a reductionist framework that implies a radical split between subjects and objects and a passive

perception model rooted in sensory atomism. For instance, Dirckinck-Holmfeld & Heslet state that the sensory atomism in the field represents a serious limitation, as research consequently has to guess what role the multisensory and atmospheric intertwinement plays. They call for future research that is able to address these aspects, which would demand another framework for accommodating the "ineffable" (Dirckinck-Holmfeld & Heslet, 2007, p. 265, my translation). This reductionist framework is unfit to address the need to feel like an integrated part of the shared environment, as the *insulation* and *isolation strategies* show. In this sense, the wish to distinguish between the quiet and the noisy is built into the strategies by which the *acoustic environment* and *soundscape* of the hospital is managed, just as it is built into the discourses by which the existing health care literature on noise and its historical prerequisites seek to discipline and silence the social and shared space. I argue consequently that these issues will remain "ineffable", if the field continues to be based solely on a reductionist and pathological framework, which is incapable of reflecting the complexity of the problem being approached.

In this view, the gap between visions and implementation, concerning the *acoustic environment* and *soundscape* in *evidence-based design* and *healing architecture*, is not primarily a symptom of an emerging field that needs more of the same or similar research. More importantly, the inability to meet the emerging call from *healing architecture* for alternative methods and approaches is related to the limitations of building a holistic paradigm on a reductionist framework. In other words, the gap must be understood as a symptom of a deeper epistemological and philosophical problem concerning the dichotomous and demarcating understanding of the sonic in relation to the human and its surroundings, obstructing ecological coherence and validity. However, the accordance between the reductionist framework in the field and the *evidence-based design* criteria for validity presents an obstacle for the inclusion of alternative non-foundational frameworks and relevant research addressing the "ineffable" in the field. To overcome this obstacle, I have suggested that the field adopts *reflexive epistemological diversity*, which would allow the co-existence of complementary foundational frameworks, which could together help strengthen the explanatory validity of the field that is needed to create healing environments in the complex Danish hospital environments. Moreover, this would require the different approaches to describe and discuss their ontological and epistemological assumptions, counteracting the widespread *cricket effect* dominating not only the field of noise in hospitals, but also research on sound, acoustics, and noise in general.

CHAPTER 4
LISTENING IN HOSPITALS

This chapter will provide a literature review of relevant research on listening in hospitals which has not yet been included in the field, as a way to determine what an alternative foundational framework should be able to accommodate to address the "ineffable". The included research literature has its roots in the broader fields of *sound studies, acoustic ecology, soundscape research*, and *sound design* with the shared aim to understand listening in complex *soundscapes*. Furthermore, research in hospitals that focuses on listening and other subjective qualities of the hospital experience has investigated obstructive as well as encouraging factors when it comes to feeling like part of the hospital environment. These studies have been conducted using different qualitative methods, including ethnographical and phenomenological methods. Taken together, these studies stress the need to address the noise problem, focusing on how the situational multisensory, corporeal, and affective context mediates and facilitates listening as a primary sensory mode[23]. I argue that taking this relevant research into account underlines the need for a comprehensive assessment that can place noise in relation other non-acoustic factors, such as the general lack of other sensory impressions and calming background sounds as well as the lack of control and corporal confinement that all together can result in a sensitized listening state of monitory and diagnostic listening modes. Such listening modes are demanding and can therefore lead to attentional fatigue and stress, if adequate coping mechanisms are lacking. Together the research presented in this chapter shows how the patient's relationship to noise must be understood in relation to the general hospital atmosphere as a complex network of changing, fragile, and contradictory experiences.

4.1 THE UNUSUAL ATMOSPHERE OF SENSORY ABSENCES

According to anthropologist Tom Rice, who spent a year in an English hospital focusing on the patients' listening experience, the hospital environment has an "unusual atmosphere of sensory absences" (Rice, 2003, p. 5), encouraging the development of an intense sonic sensitivity. This is due to a general impoverishment of non-auditory stimuli, leading to a sense of stasis which is amplified by corporal confinement in bed, as is also suggested by others (Johansson et al., 2012, p. 113; Radley & Taylor, 2003). The stasis and sensory privation are experienced in opposition to the constant sensory flux one may face outside the hospital, as the ward comes to represent a space characterized by a peculiar sensory monotony or boredom, as described by Leroux & Bardyn (2003, p. 84), Rice (2003) and Mackrill (2013, p. 74). The experience of noise is therefore intimately connected to and cannot be demarcated from contextual conditions, jointly creating a feeling of being disconnected, isolated, exposed, and disorientated (Shattell et al., 2005, p. 168). Rather than producing affectively numbed or desensitized bodies, this atmosphere gives rise to a heightened sensibility in the auditive area by actively sensitizing listening. Rice claims that hearing in Western society is culturally

[23] In line with the *soundscape* definition of the *ISO standard* presented in section 1.2

constructed as a kind of supine passivity, but within the hospital listening and hearing appear to be an active means of orientating oneself in the world, as auditory information takes on an unusual prominence in the construction of experience. Hearing came to be privileged as a sensory mode, and the interpretation of sounds is thus understood to be vital to orientation in a social as well as a material and spatial sense. Much is heard, whereas little is seen, smelled, touched, or tasted. The complex and ambiguous relationship between the *acoustic environment* and listening takes on a central, disturbing, and reassuring role in navigating and negotiating the role of being in hospitals, both orienting and connecting, but also shielding and restoring (Johansson, Bergbom, & Lindahl, 2012, p. 112; Shattell et al., 2005, p. 161). Sounds from the outside can take on a reassuring role by making the patient feel connected to the outside world (Shattell et al., 2005, p. 168), reassuring him that there is a life outside and after the hospital (Del Barrio et al., 2004, p. 971; Radley & Taylor, 2003). The overall experience of the hospital atmosphere is also connected to memory and expectations as well as preconceived ideas about the hospital as stressful; this is often contrasted with patient's experience of the hospital as peaceful and well-organized (Del Barrio et al., 2004, p. 973).

4.2 THE SOUNDSCAPE IN HOSPITAL WARDS

The sensory absence in several sensory modalities combined with bodily and spatial confinement causes heightened awareness of the distinctive hospital *soundscape*, making hearing one of the main senses for understanding and making sense of the environment. The *soundscape* in hospital wards is distinctly different from other domestic and public spaces, as the sounds of other sick people, medical practices, and equipment define the overall hospital atmosphere as a medical space. Moreover, it is dominated by many affective, intrusive, and sudden sounds, amplified by the fact that they often cannot be confirmed and prepared for through visual or other sensory modalities or balanced with other non-medical sounds. Therefore, the *soundscape* contributes to making the patients feel that they are in the middle of something uncontrollable, and combined with illness this can lead to problems of understanding whom the sounds concern, creating unnecessary fear and anxiety.[24]

Furthermore, the many alarms that make the body acoustically present create what Rice describes as a feeling of *sonic incontinence* (Rice, 2013, p. 180), amplified by the experience of a subdued environment and lack of dynamic non-medical background sounds (Leroux & Bardyn, 2003, p. 116; Johansson et al., 2012, p. 113) forming a system of control enforced by the institution. When the ongoing annoyance and appraisal of different sounds are understood in this perspective, noise may as well consist of small, quiet, and muted sounds that reinforce the feeling of being in a system of control, but without being *in* control. Silence can also be experienced as unfamiliar and annoying (Johansson et al., 2012, p. 113). This is supported by research that describes how many patients do not focus on the noise level, even if it exceeds recommendations (Del Barrio et al., 2004, p. 974), but instead focus more on the dynamic range between the low background sounds and the unexpected sound signals on top (Wiese, 2010, p. 98), unpredictable shifts (Johansson et al., 2012, p. 113), and the source of the sounds (Park et al., 2014, p. 5).

[24] See e.g. (Rice, 2003, p. 4) as well as in our own field notes presented in [P2] where a patient, overhearing another patient's alarm monitors, misinterprets them to be a sign of her dying.

4.3 MONITORY AND DIAGNOSTIC LISTENING

According to Rice, the combination of the intense sonic sensibility and the uncontrollable *soundscape* calls for specific attentive listening modes such as *monitory listening (Is something wrong?)* and *diagnostic listening (What is wrong?)* (Rice, 2013, p. 181). He introduces the concept of *panaudicism*, referring to Foucault's *panopticon*, where the lack of visual prospect is an essential and controlling element in the architecture of institutions, where the patient is made conscious, as he is not empowered to gain perspectives on the system. In the hospital the lack of in*sight* is replaced by the prospect of in*sound* (Rice, 2013, p. 6). However, rather than undermine it, in*sound* reinforces and complements the visual mechanism of authority. Therefore, a collision of the sonic and the visual is found where sound complements the omnipresence of surveillance as a *panaudicism* – a sinister resonance of a "ghostly present absence or absent presence of authority" that establishes and reinforces the experience of being in an institution and constantly being reminded of the situation (Rice, 2013, p. 33).

The auditory system is also our most effective alarm system. When we are continually monitoring the sensory background for changes, a sudden auditory change in the environment will trigger an automatic startling reflex that is most likely to redirect unexpected stimulus to the foreground of attention, making it impossible to ignore (Horowitz 2013: 111). Following Andringa & Lanser (2013), such attentional listening modes are tuned to securing safety in unsafe environments, and as it takes much energy to distinguish between important and unimportant sounds this may lead to directed attentional fatigue and exhaustion, if the attentional listening modes are not complemented by other less demanding modes of perception (Andringa & Lanser, 2013, p. 1445). Furthermore, Barry Truax stresses how our innate ability to move sounds to the background of our awareness depends on habituation, which involves memory and associations. For our perceptual system to be able to move specific sounds to the background of awareness, they must be habituated, that is, expected and predictable in a certain context (Truax, 2001, p. 21). It is therefore not only our perception of the specific characteristics of the sound that influences whether they are moved to the background of awareness, but also the way in which they are habitually perceived (Truax, 2001, p. 22). This type of background listening demands that we are able to easily detect and separate sounds from each other, so we do not have to consciously struggle with the environment in order to make sense of it, making us feel alienated or separated from our surroundings. Less focused and vague background modes of hearing are not directed toward diagnosing specific sounds, and therefore do not make high demands on directed attention. They provide time to restore the capacity for direct attention and reduce arousal (Andringa & Lanser, 2013, p. 1445). Facilitating these modes of listening can therefore take on a key role in establishing audible safety and in enhancing a feeling of being in control of the situation.

As the hospital environment with its general lack of dynamic background sounds often does not facilitate these modes of listening, patients spend energy trying to counterbalance demanding listening modes by turning a deaf ear to first feel shielded and in so doing to restore listening attention. Rice describes a few deviant cases that actively "police and reinforce a boundary between the exterior 'pain-scape' of the ward and the resolved and positive interior space of his own mind" (Rice, 2013, p. 43), and how his ability to shut out sound has been

integral to his recovery. Rice also describes another patient who actively used "imaginative reworking of the soundscape as a coping mechanism" (Rice, 2013, p. 39). Only few patients felt capable of coping in these active ways, and so even though distractions were available (radio, TV, pillows, earplugs, etc.) and could provide some relief, patients would inevitably "have to spend time exposed to the sounds around them. They often simply had to do their best to turn a deaf ear" (Rice, 2013, p. 44). The patients' ability to successfully cope therefore depends on their ability to successfully habituate the sounds in order to overhear them, which is made difficult by their affective character and the patients' inability to control them. Therefore, many patients want an acoustic mask enabling them to choose not to overhear others and their private conversations (Johansson et al., 2012, p. 112; Wiese, 2010, p. 100). In other words, as patients are left without possibilities or skills to actively habituate and overhear sounds, the role of the *soundscape* as reassuring and restorative is obstructed and transformed into an urgent need for zones of privacy (Wiese, 2010, p. 100). In this way, the relation to the *soundscape* as a way to connect to the surroundings and orientate oneself becomes difficult (Johansson et al., 2012, p. 113).

In her PhD dissertation Mette Folmer compared patients' experience of privacy in single bedrooms and wards with multiple beds, respectively. Contrary to what she had expected, she found that patients and relatives in single bedrooms felt less private and more annoyed when overhearing others in the hallway, compared to patients in shared wards. The patients in the shared wards expressed how overhearing others created a sense of security and made them feel that they were "in the same boat" (Folmer, 2014, p. 55), whereas the people in single bedrooms expressed a feeling of isolation and false privacy.

On the same note, Bardyn and Leroux summarize what characterizes a good hospital sound environment, namely a combination of *enveloping* and a *metabolic* sonic effects[25]. The *enveloping* effect constitutes a feeling of being wrapped in sound that does not attack you, and the *metabolic* effect refers to an ambient *soundscape* where figure and ground relations between different sounds are unstable and changing (Leroux & Bardyn, 2003, p. 116). Furthermore, they highlight the need for users to be able to choose diverse *acoustic environments* themselves, and thus a need for the design of diverse atmospheres (Leroux & Bardyn, 2003, p. 155).

4.4 HABITUATION AND COPING STRATEGIES

In his PhD dissertation James Mackrill takes a communicational approach, mainly based on Truax, to the issue of noise in hospitals, concluding that perception of sound in the hospital is highly dependent on the activity and engagement of the patient when listening. He concludes that there is an urgent need for comprehensive assessment with a view to placing noise in relation other non-acoustic factors (Mackrill et al., 2013, p. 6). In this way, the appraisal of different sounds and the experience of noise are not fixed, but closely connected to the changing feeling of being and not being able to cope with a stressor and with habituation of different sounds over time, as "hospital sounds can provide a positive effect as long as they are accepted and understood within the context of the environment" (Mackrill, 2013, p. 78). He finds support both in Margaret Topf's stress model which shows how lower stress levels are found in people who feel in control of the situation, and thus the locus of

[25] The mentioned *Sonic Effects* are adopted from (Augoyard & Torgue, 2006)

control is moved from the external to the internal, stressing how negatively an inability to actively exert control over a stressor influences sound-related annoyance (Topf, 2000, p. 521). This is supported by Lawton's *environmental docility hypothesis*, which states that when the personal competence to maintain a desirable physical environment decreases, the need for outside environmental management increases. Thus, as hospital patients lack the authority, competence, and/or energy to reduce ambient stressors, external regulation of the environment may be much more necessary. This research also stresses how calm, understandable background sounds are preferred to silence, where the uncontrollable sounds come forward and draw attention to themselves, and how "The gentle hum of people doing things is good because you don't feel like you're detached. You're part of what is going on" (Mackrill, 2013, p. 81). He concludes that "the perceptual response to the soundscape will be more positive than the baseline feeling if the individual is able to accept and habituate their response" (Mackrill, 2013, p. 82). As learning and the subsequent assessment drive the emotional response toward stimuli, he finds it curious that "no research exists looking at cognitive control strategies as an intervention in soundscape perception. Perhaps as most research looks at the addition of sound rather than the modification of perception" (Mackrill, 2013, p. 91).

4.5 THE USE AND EXPERIENCE OF MUSIC INTERVENTION

A few studies have looked into music intervention from the perspective of the user's experience. Louise Bager's research shows that many patients do not hear the music intervention as music, but rather as a calm background noise, only adequate in very specific self-chosen situations. As one patient puts it: "no… it is not music … it is a quiet and calm background noise" (Bager, 2012, p. 26, my translation). That is, music intervention often serves a specific function and is not considered to be art, as listeners suspend their taste of music and base judgments on the function it has in the specific time and space and in relation to their physical state. Many patients do not think of it as genre-less music either, but as a specific *New Age* genre aimed at serving this calming function. Music intervention can in this way also be considered part of the non-controllable and stressful aspects of the *soundscape*, if patients cannot choose when and what to listen to, forcing a specific atmosphere on the patients, sometimes leading to a lack of environmental coherence. Taken together, music intervention is an ambiguous element, and its success is dependent on the time, place, and state of the individual. It is mostly experienced as good, when it becomes part of the natural background sounds, when it masks annoying sounds, or when it constitutes a room in the room that does demand attention and thus gives the patient freedom to act. It can in some situations help the patients to feel that they are part of the environment and, at the same time, that they are in a private acoustic space (Bager, 2012, p. 30). These insights on the use of music intervention are supported by ethno-musicological research of Tore Tvarnø Lind done both inside and outside the hospital context focusing on the use of healing music (*MusiCure*).[26] In his studies of how the cultural, identity, ideas of health, and the metaphysical shape the efficiency of the use of healing music, Lind writes: "for private users of *MusiCure* it is neither the music and sounds 'in themselves' nor the so-called biological effects of the music that

[26] The *MusiCure* program was created for use in two different contexts: in hospitals, as a supplement to medical treatment, and for private use, as a non-prescription 'drug' sold exclusively at pharmacies. The booklet accompanying the first *MusiCure* CD vol. 1: "The journey" introduces the program as follows: "The creation of MusiCure is based on more than four years of scientific research in the stimulating and curative effect of music on hospitalized patients. The programme is produced in close collaboration with leading doctors and nurses from the research organization Musica Humana."

cause an altered state of health and well-being, but rather the already encoded meaningfulness of visualizations, bodily feelings and ideas of 'natural music'" (Lind, 2007, p. 224). Similar to Bager's research, the use of music intervention in Lind's study often gave the users a safe and familiar foundation, making it easier for them to cope with the situation, because the sounds are familiar and meaningful to them and act as a "sound filter" subduing the basic environment of hospitals. He describes how the users are explicitly aware of how the use of healing music can reconfigure a messy everyday space into healing spaces – a timeless nowhere getaway (Lind, 2007, p. 231). Similarly, Villarreal et al. compare the analgesic effect of three types of auditive distractions, namely music, environmental sounds, and active engagement in a spoken task, concluding that the analgesic effect of music is probably not due to its musical features; instead, it is the valence, arousal, and liking that seem to drive the analgesic effect of music (Villarreal et al., 2012, p. 7). In Mackrill, Cain, & Jennings research music is also described by patients as background noise, both positively and negatively, and related to taste (Mackrill, Cain & Jennings, 2013, p. 4).

4.6 SUMMARY

Based on the research presented in this chapter it is clear that there is not *one* noise problem in hospitals that can be *solved*, but various noise problems that can be *managed* adequately, if approached differently. This research reveals how the combination of the general atmosphere of absence, confinement in bed, and lack of control creates an intense form of sonic sensibility in which the dynamic relationship between the patient and the *soundscape* plays a key role in providing or obstructing a healing environment. However, the character of the *soundscape* creates an affective state of passive vulnerability that calls for attentive listening modes dominating the organization of the experience of being a patient, while less attentive hearing modes that could potentially allow for active attuning strategies for successful coping are obstructed. Facilitating less attentive hearing modes could be a fruitful way to restore attention and cope effectively, providing both the needed indicators of security in the unsafe and demanding sonic environment and active possibilities to actively attune to the patterns and rhythms of hospital life, supporting the wish to be part of the interpersonal environment, connected to others and the outside world (Shattell et al., 2005, p. 168).

On this note, the positive experience of healing music is closely connected to the experience of listening to something familiar and controllable in an unfamiliar and uncontrollable environment – a piece of knowledge that urges future research to focus less on intra-musical aspects and more on the relation between the music and the ecological and situational aspects, such as the context, situation, and technology used. The patient's experience of the hospital environment as a whole is marked by a simultaneous wish to be helped or cared for and to become part of the surroundings in the shared social space and connected to the outside world, and not only to be distracted by, for example, music intervention. The findings are thus characterized by patients' contradictory and changing corporal relation to the sound environment and by a focus on interpersonal factors related to spatial and temporal aspects of the environment, rather than the physical environment as such (Shattell et al., 2005, p. 168). As such, time and space are experienced in relation to the patient's own body (Johansson et al., 2012, p. 108).

Taken together, this strand of research seems to argue that research in the existing field should take as its starting point the often contradictory and inconsistent situations and states – as a network of changing, fragile relationships in a complex interconnected, temporary, and shifting atmosphere. Based on these insights, emphasis should therefore be on how we can gain a higher level of environmental coherence and integration in the different and changing situations as well as acknowledge the positive orientational potential of the sounding environment (Villarreal et al., 2012, pp. 110-113). Moreover, it shows that patients often have a reflective, pragmatic, and realistic approach to the challenging situation they are in, including the complex acoustical situation. For example, Shattell, Hogan, & Thomas (2005, p. 161) describe patients' relationship to intrusive sounds as a pragmatic and reflexive way of coping, because of the widespread acknowledgment that there is a reason for being there and therefore a wish to adapt and cope with the situation (Johansson, Bergbom, & Lindahl, 2012, p. 112; Shattell et al., 2005, p. 161).

4.7 CONCLUDING REMARKS PART I / WORKING HYPOTHESES

Part I argues that there is a need for a complementary non-reductionist framework to gain a higher ecological validity in the field through focusing on the quality of the manifold, fragile, and changing relations and interactions over time. As described, Becker et al. argue that in situations, where the need is to rethink a field's baseline assumptions as well as methods and solutions, as is the case in the field of noise in hospitals related to the paradigm of *healing architecture* and *evidence-based design*, research should not primarily be aimed at coming up with novel solutions (Becker et al., 2011, pp. 119-120). Instead, there is a need to develop deep understanding and to ask new questions to address the "ineffable", which in Part I was identified as the contextual and atmospheric conditions that the current framework is incapable of accommodating.

According to Becker et al., engaging in such *research for innovation* in the area of *evidence-based design,* practitioners must develop an approach that combines a philosophical and conceptual framework based on ecological theory, reflecting the complexity of the context being approached, with practice-based methods for developing this in practice through a combination of scientific knowledge and, for example, artistic knowledge (Becker et al., 2011, p. 128; Lawson, 2010, p. 97). It is evident that addressing *in situ* situations demands for a bottom-up approach, cross-pollinating theory with practice-based work to secure a higher ecological validity to acknowledge the contextual dimensions of the noise problem in hospitals. Based on my analysis in chapter 3, this alternative framework should avoid sensory atomism, ideas of passive perception in idealized categories such as listening and hearing, *duomining* reductions into categories such as noise and silence or subject and object. Furthermore, it must challenge the *cricket effect* (see section 2.4) and rethink the role of technology as either transparent or negative. To pave way for the development of such an alternative framework developed in Part II, this part ends by deriving three working hypotheses based on this first part as follows: The experience that excessive noise in hospitals leads to stress is not only related to acoustic aspects, but also closely connected to

Hypothesis 1: **An atmosphere of absence**: The lack of sensory stimuli, such as visual and olfactory stimuli, and a general feeling that the hospital inhabits an unusual atmosphere of absence amplify sound-related annoyance.

Hypothesis 2: **An alarming sonic sensibility**: The alarming *soundscape* of the hospital and the lack of dynamic background sounds sensitize foreground and attentive listening modes, such as monitory and diagnostic listening, amplifying sound-related annoyance.

Hypothesis 3: **A lack of coping skills and active coping possibilities**: The inability to actively exert control (internally or externally) over sound-related stressors in different and changing situations and contexts enhances sound-related annoyance.

PART II

RESEARCH APPROACH

> "The challenge is to construct a flexible meshwork of qualities and capabilities, limitations and expectations, that help us to think of sound not as a thing-in-itself, flush with is-ness, confident of its quiddity, but as a dynamic substance, inescapably *and/nor,* constantly redefined by context and use." (Kim-Cohen, 2016, p. 66)

Part II aims to develop an alternative approach, to engage in *research for innovation* (see 4.6) combining theories on acoustic atmospheres and ecology of listening with artistic- and constructive design-research methods. Together they form a fruitful research approach coined the *attuning approach,* capable of bringing the contextual dimensions into the core of the inquiry. This research approach represents the overall methodology that constitutes the body of knowledge used to make judgments in the experiments presented in Part III.

Chapter 5 presents a point of departure to be developed into a coherent framework in the next two chapters. It seeks to lay the foundation for an *attuning approach* by integrating the focus of *noise design* and *aural architecture* on atmospheres with the *enactive perspective* based on an ecological framework, with a shared focus on the potentials of using technology constructively. This position implies a shift in terminology from noise to *sound related annoyance,* and from noise reduction to a *quality of life* perspective. The *attuning approach* couples the entanglements of the complex atmospheric quality of space with a model of a human being as embodied, enactive, and situated. The human and world are co-constituted through exploratory attunements based on prior experiences and resulting in *refined attunement* such as new appraisals and habits. Chapter 6 seeks to provide a philosophical and conceptual framework for the *attuning approach* combining theories on atmospheres, *ecological overhearing* and attunement based on a relational ontology. Chapter 7 presents artistic- and constructive design-research as practice-based methods fitting to challenge and unfold the *attuning approach*, and discusses their differences and what kind of knowledge they offer. Part II ends by excavating three research questions corresponding to the three hypotheses identified in Part I.

CHAPTER 5
TOWARDS AN ATTUNING APPROACH

5.1 FROM NOISE REDUCTION TO SOUND-RELATED ANNOYANCE

In the last decade a shift in the discourse on complex everyday sound environments has emerged focusing on how *quality of life* is not necessarily improved by removing sound, but rather by shaping the aspects hereof (Kang et al., 2013). This shift should be seen as a response to the limitations of earlier regulative approaches, corresponding to the noise reduction approach in hospitals that have not been successful in solving general noise problems (Andringa et al., 2013). A significant example of this shift toward a *quality of life* perspective is the *EU COST* project *TD0804 Soundscape of European Cities and Landscapes*, which introduces a *soundscape approach* as a new paradigm. This change in focus connects to the growing interest in the broader field of *sound studies*, where sound design is not only considered to be a technical sound-internal skill, but also must be thought into the broader entanglements with cultural, historical, philosophical, and technological contexts. The growing focus on sound environments in research seeks to account for the increasing sound-producing products in everyday contexts, and the similar lack of education and knowledge on how sound can play a role not only as a function, as noise, or as aesthetic decoration. The *quality of life* perspective emphasizes the crucial roles that empowerment or confinement plays in forming our overall appraisal of sound environments by either enhancing or preventing us from acting upon intrusive sounds. In this way, the emerging *soundscape approach* seeks to account for the substantial part of noise annoyance explained by so-called *non-acoustic* factors. Studies have shown that an important non-acoustic factor is the feeling of being in control of (being exposed to) noise as an explanatory factor in people's coping mechanisms (Andringa et al., 2013; Bijsterveld, 2008, p. 254).[27]

To account for this new paradigm core concepts such as *noise* and the *acoustic* or *sonic environment* are rethought through the lens of the *soundscape approach*[28]. Thus, noise is replaced by *sound-related annoyance*[29] to account for the subjective, qualitative, and contextual conditions for experiencing noise. The *acoustic environment* is therefore downplayed in favor of *soundscape*, though in an updated and expanded version of the *World Soundscape Project's* definition referring broadly to the relationship between man and sonic environment (Truax, 1974). Influenced by findings from psychophysics, psychology, hearing system physiology, and auditory cognition, the concept of *soundscape* comes to refer to the relation between man and the *acoustic environment* with a focus on listening shaped by the multisensory context, expectations, knowledge, cultural meaning,

[27] The notion of control is defined as thoughts and actions to cope with a stressor (Mackrill, 2013, p. 77).
[28] The *ISO standard,* presented in section 1.2, is an important part of this paradigm shift
[29] Sound-related annoyance is a phenomenon in which exposure to some sounds, or rather noise, may have a range of detrimental effects on experienced pleasure, well-being, and health resulting in stress (WHO, 2011). Importantly, "acute noise effects do not only occur at high sound levels, but also at relatively low environmental sound levels when, more importantly, certain activities such as concentration, relaxation or sleep are disturbed" (Babisch, 2002).

motivations, shifts in attention, objectives, etc. These redefinitions have wide consequences, as addressing *noise* is e.g. essentially different from addressing *sound-related annoyance*. The paramount concern has now moved from noise reduction to providing a wide diversity of acoustic opportunities for individuals (Andringa et al., 2013, p. 17). This is to be unfolded by giving users some form of control through a participatory approach, where citizens are involved as key experts. Andringa & Lanser conclude:

> "the decision of what is wanted and unwanted sound seems to vary more with changing individual needs than with individual differences. If this conclusion is correct it suggests that a diversity of available acoustic situations (including a sufficient variety of quiet and lively ones) is preferable over a more uniform set of acoustic environments that each comply with some (legal) noise limit. This might lead to considerable monetary savings as well as to more diverse and interesting living environments." (Andringa & Lanser, 2013, p. 1457)

This strand of research offers a few general guidelines for designing what should facilitate this feeling of control in relation to *sound-related annoyance*. E.g., Andringa and Van Den Bosch recommend designing for both easiness to ignore annoying sounds and audible safety by enriching places with a variety of safety-indicating sounds (Andringa & Van Den Bosch, 2013). On a similar note, Mackrill recommends masking annoying sounds with positive sounds and providing people with information about annoying sounds, making it possible for them to become familiar with and thus habituate these sounds (Mackrill, 2013). In relation to masking sounds, as a way of making it easier to ignore annoying sounds, the key role of natural, background sounds is mentioned as a way of facilitating the experience of quietness (Andringa & Lanser, 2013) and the creation of multisensory restorative environments through e.g. green spaces as well as natural and lively people sounds (Andringa et al., 2013, p. 8). Karin Bijsterveld argues that historically unexpected, unfamiliar, and irregular sounds have often been defined as noise, whereas rhythmical, stable, and predictable sounds have signified situations in which people feel in control. She therefore argues that people should have a choice once general noise standards have been established (Bijsterveld, 2008, pp. 254-258).

However, one reason for the limited success of the *soundscape approach* in urban development so far could be the fact that it has mainly been used to identify important parameters such as control, motivation, and empowerment, and less so to recommend general ways of supporting these in practice. Therefore there is still a lack of concrete operationalization and evaluations of real-life experiments (Kang et al., 2013, p. 9). There are very few practical examples of successful *soundscape* design interventions, just as most of the existing work has been implemented in public open spaces and has focused on a single sense (Andringa et al., 2013, p. 16). Furthermore, the conditions of sonic experiences have mostly limited users to passive listening situations or discrete actions, whereas performative actions have been confined to the field of musical instrument design (Rocchesso & Serafin, 2009, p. 7). Furthermore, there is a predominance of solutions aimed at adjusting the environment, whereas, as Mackrill points out, "no research exists looking at cognitive control strategies as an intervention in soundscape perception. Perhaps as most research looks at the addition of sound rather than the modification of perception" (Mackrill, 2013, p. 91). Mackrill's research resonates with research in the broader

area of health and design conducted by Jan Golembiewski, who argues that although improving aesthetics might have a positive effect, modifying behavior by offering choices is far more important. He therefore suggests that design should offer choices embedded in the environment aimed at modifying and directing our behavior through activating self-agency (Golembiewski, 2013). Such strategies are especially necessary in situations where the overall *soundscape* cannot easily be transformed into a restorative environment and where annoying sounds cannot easily be ignored, e.g. in hospitals. In other words, both the *soundscape approach* and research in the field of *sound studies* highlight the need to create contexts that offer people choices, e.g. opportunities for action, empowerment, and coping. Yet, there is a lack of knowledge on how such ideas can be unfolded and operationalized in practice by exploring how design can facilitate behavior change and supporting an active user in control.

Another obstacle to the development of concrete experiments could be the question of which professionals are capable of unfolding them. Andringa et al. suggest that "This leads to a new role for *soundscape researchers* that they may, or may not, accept: namely to be an avant-garde of a movement that leads to the optimization of local sensescapes in terms of direct enjoyment of the living environment, facilitation of place-related activities, and conduciveness of healthy habits" (Andringa et al., 2013, p. 18). There is thus a pressing need to explore and expand the role of the *soundscape researcher,* to complement both the traditional acoustic engineer and the music composer. Even though I support this claim, I will argue that it is equally important to expand the role of the *soundscape design researcher* with knowledge from other disciplines that have experience with addressing experiential qualities in regard to the actual situation through practice-based experiments.

Furthermore, based on the analysis presented in Chapter 3, I want to propose that the lack of knowledge on how we create situations that facilitate active engagement and coping and the absence of operationalization in practice is not only related to the fact that the *soundscape approach* is in its early stages. I suggest that it is also related to a reductionist framework underlying the *soundscape approach* similar to the one described in Chapter 3 within the field addressing noise in hospitals.[30] On a similar note, Jelić et al. recently argued that the limitations of research coupling neuroscience and architecture are closely related to the way architectural spaces are interpreted as objects with quantifiable properties, and that these properties are often quantified independently of the perceiver as a bodily subject, making the perceiver a disembodied observer (Jelić et al., 2016, p. 2). In line with Jelić et al., I therefore adhere to the growing acknowledgement within the field of the relationship between space and mind/body, though I also wish to point out that future research, in order to overcome the reductionist frameworks, must include the entanglements of the complex atmospheric quality of space coupled with an ecological model of the human as an embodied, enactive, and situated agent.

[30] Based on the analysis in Chapter 3, one could argue that this situation is related to a similar reductionist framework shaping the overall conclusions of the *soundscape approach.* Within this view much *soundscape research* still falls into generalized *duomining* categories, *sensory atomism*, and an *instrumentalist* or *substantivist* view on technology. As an example of the latter Andringa et al. describe how sound artists should only use speakers once all other "natural" interventions have been tested, as "it is vital that citizens do not feel that their sensory experiences are being cynically manipulated" (Andringa et al., 2013, p. 11). The quote implies that using technology, e.g. speakers, is a way of manipulating or cheating, and therefore something people should generally be shielded against.

Based on these considerations I wish to develop an approach that can provide a coherent methodological framework capable of accommodating both the multisensory atmosphere and the active engagement of the enactive user through practice-based experiments. Furthermore, to avoid an *instrumentalist* or *substantivist* view on technology I respond to the call for "ecological modernization" by Karin Bijsterveld, and consider various audio technologies as central and constructive tools for experimenting followed by critical reflection (Bijsterveld, 2008, p. 260).

5.2 COMBINING ACOUSTIC ATMOSPHERES WITH AN ENACTIVE PERSPECTIVE

Björn Hellström describes a new and expanded role for sound design, or *noise design* as he coins it, where sound art and sound design through technology merge in an interactive approach to sound design applied in different architectural contexts. Hellström argues that as architectural discourse is redefining its boundaries toward ideas of atmosphere and fluid architecture, sound can play a new role as active material (Hellström, 2003, p. 10). In *noise design* sound art serves as a productive knowledge field, because it is rooted in technology, the interdisciplinary, and the connections between sound and space. This combination enables a new sound design field that works constructively with noise and sound beyond the "unwanted", blurring the division between musical and environmental sounds (Hellström, 2003, p. 34). This combination also highlights listening perception as a basic qualitative tool engaged in how listening awareness actively operates when acting in different environments, referring to the *sonic effect* methodology of Cresson unfolded in the book *Sonic Experience – a Guide to Everyday Sounds* (Augoyard & Torgue, 2006). Hellström's renewed focus on the architectural as an essential context for sound design resonates with Blesser and Salter, who describe how the *aural architecture* of the built environment has been neglected in *soundscape* research (Blesser & Salter, 2007). Both *noise design* and *aural architecture* focus on accommodating both the atmospheric and interactive potentials of sound design, though with a main focus on how we are affected *by* acoustical space and sounds. E.g. the *sonic effects* methodology is mostly concerned with how we are affected by sounds, whereas Blesser and Salter on a similar note describe how we "cannot escape the influence of aural architecture because we live inside it" (Blesser & Salter, 2007, p. 364). In this way, they are both only vaguely hinting at a relational and enactive take on atmospheres, like when Blesser and Salter in "Spaces Speak, Are You Listening? Experiencing Aural Architecture" describe how interactive technology can perhaps be used to create acoustic holography and thereby aural illusions of being in a larger space as a "multisensory space expander" (Blesser & Salter, 2007, p. 57). They emphasize that to make this idea work in practice it must be able to respond to our sounds in the room through the use of convolution reverb and microphones. In this way, the use of technology can empower the users turning them into virtual architects of responsive aural spaces. There is again a lack of concrete reflection on how design can facilitate active engagement, and I therefore seek to combine these with an active and embodied perspective on perception in sound design. I find this perspective in the field of *sonic interaction design*, specifically in the *enactive sound design* approach developed by Karmen Franinović (Franinović, 2012; Franinović & Salter, 2013).

The field of *sonic interaction design* is concerned with design and evaluation methods addressing the individual and social experience through interactive sounding technological artifacts and contexts providing "a fresh perspective on interactive sound as a situated and multisensory experience" (Rocchesso & Serafin, 2009, p. 12). It is a part of the broader field of *interaction design* and aims to accommodate the multisensory aspects of interactive sonic experience considering not only the auditory, but also the tactile, visual, and kinesthetic senses within real-world contexts. *Sonic interaction design* research is therefore often based on an ecological framework in its shift from reception-based auditory studies toward more active and embodied uses of sound (Rocchesso & Serafin, 2009, p. 10). In this sense, it follows the development in the broader field of *HCI* (described in Section 7.1.2) away from functionality and efficiency toward emotion and experience. "Our perceptions come into existence through our action, and not the other way round. Action and perception must be understood as one and designed as one because they are lived as one. Thus, designers have the possibility to enable a new domain of sensory and social experience to merge when interacting with technology" (Franinović & Salter, 2013, p. 50). Franinović terms her approach *enactive sound design*, exploring the untapped potential in *sonic interaction design* for empowerment through active engagement as a *doing with sound* (Franinović, 2012). She argues that with this focus *enactive sound design* has the potential of transforming habitual activities by coupling responsiveness of sound with responsibility for our actions. This ecological approach can help shift the focus away from listening as consumption of auditory material toward active engagement supporting interactivity as *enaction*. The *enactive* approach thus emphasizes how we, through movement and exploratory action, can develop our perceptual learning skills. The concept of *enactive perception* describes how the world helps guide or modulate actions that in turn continuously result in the body realigning that world through perception-action cycles (Franinović & Salter, 2013, p. 72). The *enactive approach* builds on the milestone work *The Embodied Mind*'s (Varela, Thompson, & Rosch, 1991) conception of cognition as enactive and embodied. Here the term *enaction* signifies that a living being is an autonomous agent who actively generates and maintains its own cognitive domain through continuous reciprocal interaction of the brain, the body, and the world (Varela et al., 1991).

My approach thus aims to integrate the focus of *noise design* and *aural architecture* on spatial, multisensory, and temporal atmospheres with the *enactive perspective* from *sonic interaction design.* This integration is possible, because they share an interest in exploring the potential of utilizing digital technology with sound to stimulate bodily interaction and thus expand the possibilities for sound to become an active design material in a larger process of atmospheric enrichment of our surroundings. In this way, they both focus on sound that engages sensorimotor experience, which has been neglected within existing sound design practices, and seek to describe sound and listening in a multisensory interplay. As such, they do not work *from* sound *toward* the multisensory, but the other way around, counteracting the tendency described by Jonathan Sterne's *audiovisual litany*. The *audiovisual litany* describes how sound in its search to reposition itself against ocular-centrism comes to reinsert a new aural-centrism based on ideas about sound as immersive and emotive (Sterne, 2003, p. 15). However, the combination is crucial, as it seeks to draw the *enactive perspective* toward the contextual; that is, it is not the interaction *in itself* that is in focus, but rather its potential in relation to the surrounding atmosphere. At the same

time, it draws *noise design* and *aural architecture* in the enactive direction in order to emphasize the importance of the actions of the users in conditioning and being conditioned by the atmosphere.

5.3 ATTUNEMENT

Similar to the proposed approach in the last section, Jelić et al. have developed an *enactive approach* in the field of architecture for two key reasons: First, emphasis on the situated nature of perceptual experience makes the issues of embodiment and relational embeddedness in the world vital to understanding people's engagement with environments. Secondly, the strong foothold in phenomenological thinking resonates with the experiential turn in architectural theory and qualitative design approaches, where architecture represents designed interaction between life and form (Jelić et al., 2016). Their enactive perspective is a response to the growing success of attempts to link neuroscience and architecture. They point to the limitations of this fusion when it interprets architectural spaces as objects with quantifiable properties, thus tackling only one aspect of a more complex atmospheric quality of space. Consequently, they argue that when these properties of spaces are quantified independently of the perceiver as a bodily subject, the user is problematically transformed into a disembodied observer (Jelić et al., 2016, p. 2). As a response to this critique they propose that "the enactive approach to architectural experience brings together the biological perspective on the human being through the concepts of embodiment and motivation on the one hand, and affordances as an artificially designed possibility for interaction, on the other" (Jelić et al., 2016, p. 3). In this context affordance is defined as value-rich potentials for interaction that emerge in the agent's perception, and e.g. familiarity could thus enhance the activation of action representation and motor plans. From this point of view, considering perception *embodied coping with the environment*, the co-constitution of the perceiving agent and the world can become apparent by understanding the modes of embodiment of the human being as a lived body. Based on the *sensorimotor approach* of O'Regan and Noë they develop the active and explorative understanding of perception, where our constant *perceptual attunement* to sensorimotor patterns is grounded in the organism's embodied form and structure. *Perceptual attunement* thus refers to a "particular sensitivity for the ways sensory stimuli change with movement" based on previous experiences, which do not result in representational knowledge, but in refined attunement. In this way, ruptures to habitual actions can e.g. create moments where our need to recalculate appropriate action is enough to activate the attentional switch allowing us to consciously experience both the setting and ourselves. In this way, spatial (or sounding) structures can act as *attentional cues*, which, due to interaction, can result in *refined attunemen*t, as in the example of the disrupted staircase (Figure 4) by Carlo Scarpa (Jelić et al., 2016, p. 7).

From this perspective *attunement,* based on an ecological understanding, becomes a key concept capable of accommodating the combination of the enactive and the focus on atmospheres. I therefore suggest coining my research approach an *attuning approach*[31] in order to emphasize the reciprocal dependence between the affordances in the environment and the capacities of people. In the following I wish to develop the *attuning*

[31] The verb "attune" is related to the verb "tune". Tuning is the act of modifying an instrument to the correct pitch, whereas attuning means adjusting or bringing into sympathetic or responsive relationship.

approach in relation to atmospheres and listening with a view to developing a coherent framework for the experiments presented in Part III.

Figure 4: Carlo Scarpa's stairs at the Brion Cemetery in San Vito d'Altivole, Italy. Photo: (Jelić et al., 2016, p. 8)

5.4 SUMMARY

This chapter functions as a point of departure to be developed into a coherent framework in the next two chapters. To move away from a regulative approach *soundscape research* has shifted from *noise* to *sound-related annoyance* and from a *noise reduction* to a *quality of life* perspective. This shift has enabled research that emphasizes how our appraisal of the *soundscape* is closely connected to non-acoustic factors such as bodily confinement and the feeling of being in or out of control with a focus on listening shaped by the multisensory context, expectations, knowledge, cultural meaning, motivations, shifts in attention, objectives etc. It is therefore suggested that efforts to address *soundscape* improvement should offer a diversity of available acoustic situations (including a sufficient variety of quiet and lively ones) through a participatory approach to design aimed at facilitating empowerment and control. However, there is a lack concrete practice-based experiments that address such modifications of perception through habituation and offer choices embedded in the environment to activate self-agency.

Therefore, I propose an *attuning approach* that couples the entanglements of the complex atmospheric quality of space with a model of a human being as an embodied, enactive, and situated agent through practice-based experiments. Such a framework should be based on an ecological understanding of how agent and world are co-constituted through exploratory attunement based on prior experience and resulting in refined attunement such as new appraisals and habits, and not primarily as representational knowledge. The next chapters aim to develop a coherent methodological framework combining a non-representational philosophical framework with practice-based methods through artistic and design research.

CHAPTER 6
ATMOSPHERES AND ECOLOGICAL OVERHEARING

Chapter 6 develops the *attuning approach* in relation to the overall research context presented in Part I to form a methodology capable of accommodating the objectives of the derived hypotheses. The methodology seeks to address the non-representational background of life by exploring how the affective, atmospheric, and embodied conditions shape the experience of noise and listening. Consequently, the methodology combines a philosophical and conceptual framework based on theories of atmospheres and ecological listening through the concept of *ecological overhearing* discussed in this chapter, with a practice-based methods through artistic- and constructive design research, presented in chapter 7.

6.1 NON-REPRESENTATIONAL THEORY

> "Whereas representational theories study the mind and its operations as preconditions for action, non-representational researchers examine thought exclusively in action, concentrating on unreflexive, semireflexive, unintrospective, preobjective, and habitual actions and interactions" (Vannini, 2015, p. 8).

According to Hayden Lorimer, non-representational theory is "an umbrella term for diverse work that seeks to better cope with our self-evidently more-than-human, more-than-textual, multisensual worlds" (as cited in Vannini, 2015, pp. 2-3) emerging from the post-Cartesian turn and distinct from cognition and symbolic meaning in postmodern theory. This emerging field has its roots in the field of human geography and the work of Nigel Thrift in particular, but is connected also to arts, cultural studies, the humanities, and social sciences and attempts to synthesize diverse, but interrelated theoretical perspectives such as actor-network theory, post-phenomenology, and pragmatism from multiple fields, including material culture studies, science and technology studies, contemporary continental philosophy, and anthropology of the senses. It must build on a principle of relationality, in that it seeks to give the same conceptual and empirical weight to object-human relations as human-human relations, and thus considers a concept such as "material" as wrong, as it implies that objects are consistent entities and not fragile materials entangled with other materials in use, as argued by Tim Ingold (Vannini, 2015, p. 5). Thus, non-representational research privileges the study of relations and affective resonances, as life is believed to arise from the entanglement of actors. These main concerns correspond to the contextual dimensions, which the reductionist framework in the existing field misses, hinting at how the healing power is neither to be found "in" healing architecture, healing music, or "inside" the healing human brain, but in the relations between all kinds of different actors in the changing and fragile atmospheres of the hospital. Therefore, the aim to isolate different healing parameters, such as healing music, should be complemented by research that focuses on the vital processes through which relations take place. A non-representational approach focuses not so much on "internal" states of mind, such as ideas, values, and thoughts on, for example, what

defines noise, healing music, or quiet, but on doing and attuning. It stresses the importance of relations felt in bodies, such as affects and moods, building a new ethics on craftsmanship of everyday life. It puts the unnoticed and contextual that often fall out of common awareness into center of attention as backgrounds against which particular things show up and take on significance. These backgrounds, or zones of stabilization, thus become important zones of inquiry open to intervention, manipulation, and innovation as well as colonization, domination, and control (Anderson & Ash, 2015, p. 9)[P5].

There are various directions to choose from when taking a non-representational approach, depending on the area of inquiry. Considering the content of the hypotheses I pursue a direction based on atmospheres characterized by a focus on ecological modes of listening. In this way, I attempt to redefine existing ideas about noise in hospitals in relation to atmosphere and an ecological approach to listening in order to abandon its association with illness and stress, and the association of silence with goodness and health.

6.2 ATMOSPHERES: THE VAGUE SENSE OF BEING ATTUNED

To reach an understanding of the relations between listening and general experiences of the surrounding environment the next section will develop an understanding of our general relation to the surroundings through the notion of atmospheres. It is challenging to deal with atmospheres and even more so with research atmospheres. Nevertheless, atmosphere is a growing field of research related to the broader field of non-representational research ranging from philosophies of atmospheres (Böhme, 1995; Bollnow, 1943) over analyses of urban sensory environments (Edensor, 2016; Stenslund, 2012; Thibaud, 2011) to the applied orchestrations of architectonic settings (Kinch, 2014; Stidsen, 2014; Wieczorek, 2013). The existence of atmospheres in everyday experiences is often taken for granted and remains unnoticed, as one of the central figures in the research area of atmospheres, the French sociologist Jean-Paul Thibaud, suggests; we do not perceive atmospheres as such, but instead experience *according to* or *on the basis of* atmospheres (2011) as "a sensory background that specifies the conditions under which phenomena emerge and appear" (Thibaud, 2011, p. 212) – comparable to the weather or light. As such, we grasp the atmosphere of a place "before" or "beneath" our understanding and intellectual assessment of a place (Pallasma, 2012). Atmospheres constitute our immediate all-encompassing experience of "finding oneself in environing worlds" (Böhme, 1989, p. 9), involving our entire range of senses, but often unnoticed by direct attention, although still experienced in a direct and yet complex manner. In other words, atmospheres should be understood not as abstract concepts, metaphors, or the properties of things, but as a relational "thing" or "quasi-thing" no more or less autonomous than a melody. It finds its lived quality, encountered not as a secondary quality, but as an atmospheric tonalization that colors all involved entities (Griffero & De Sanctis, 2014, p. 19). Thus, the in-betweenness does not constitute a medium, as a by-product of related substances, but appoints the relation, its relational autonomy – an idea that challenges classical ontology of substance and essence (Griffero & De Sanctis, 2014, p. 122). The fact that the perception of an atmosphere differs from person to person does not designate that it is purely subjective or private, as it is the same spatial-sentimental-atmospheric quality that we are taken by, even if we have different expectations and attitudes toward it.

The idea of investigating atmospheres is not new, but was established as a theme in the eighteenth century within the area of reception aesthetics. During the twentieth century atmospheres became part of the phenomenological school of thinking, which researches how we perceive, experience, and act in the world. Building upon Husserl and Heidegger, it was particularly the French phenomenologist Maurice Merleau-Ponty who established the theoretical grounds for discussing the intertwinement of the embodied experience and the surroundings. German philosopher Gernot Böhme is one of the founding thinkers, who have shown renewed interest in atmospheres in the realm of architecture and design over the last twenty years. In 1993 he introduced atmospheres as a fundamental concept in a new aesthetics, following the phenomenological tradition. He elaborates on the work of Herman Schmitz and argues that atmospheres are constituted by their relation to the environment, thus he distinguishes himself from earlier works, which focus on atmospheres as an internal feeling. In Böhme's understanding, atmospheres constitute the common reality of the perceiver and the perceived. His concept of atmospheres is ecological, as it focuses on the relationship between the quality of an environment and people's state-of-being inside that environment. This relationship creates what he calls the atmosphere of a place or situation – the intertwinement of world and self (Böhme, 2000). There is an expression in the German and Danish languages that contains this double in-situ relationship: in German "sich Befinden" and in Danish "at befinde sig", which both refers to being somewhere and to how one feels about being there [P2]. Moreover, Böhme elaborates on how aesthetics' close connection to art throughout the twentieth century must be opened to also include everyday experiences of atmospheres. In this sense, Böhme's entanglement of everyday aesthetics and atmospheres is in line with Dewey's pragmatics and the concept of *Somaesthetics* by Shusterman, all adhering to a pragmatic approach to everyday aesthetics (Shusterman, 2008). By insisting on a relational ontology, theories of atmospheres align with *material culture studies, actor-network theory, sensory studies*, and *affect theory* in pointing to the intermingling of objects and space. These diverse, yet related fields debate and research the differences between related concepts such as affect, emotion, ambience, atmosphere, etc. Although it is out of the scope of this overview article to develop an extensive genealogy of these differences,[32] a focus on atmosphere highlights the existential in-betweenness of subject and object as well as the temporality of atmospheric encounters. In this way, it offers a different perspective and a critical stance on erecting rigid conceptual boundaries between emotion and affect, subject and object, nature and culture (Bille et al., 2015, p. 3).

6.3 ECOLOGICAL OVERHEARING

Griffero argues that perceiving atmospheres constitutes a sixth sense; it is the "capacity to grasp complex and integrated sensory entities" (Griffero & De Sanctis, 2014, p. 132). Atmospheric perception is ecological in the sense that it integrates us in the surrounding ecological networks as a *being-with*. In this view, it makes no sense to start with passive sensory atomism; instead all the senses *take* and *make* together, though often unnoticed. A focus on listening must therefore take as its starting point the multisensory atmospheric sense, suggesting that we do not hear the sound "in itself", but units of meaning within situational backgrounds (Griffero & De Sanctis,

[32] See e.g. (Griffero & De Sanctis, 2014), (Bille, Bjerregaard, & Sørensen, 2015), and (Flatley, 2008) for extensive overviews of the related concepts and fields.

2014, p. 132). Following this line of thinking, the interdisciplinary *Center for Research on Sonic Space and Urban Environment* (*CRESSON*) in France extended the scope of its inquiries in the 1990s from its earlier focus on sound to take atmospheres as a starting point, applying interdisciplinary tools to develop an integrative theory of ambience[33] (Thibaud, 2011). From the perspective of atmospheres, we do not hear sounds in themselves, but what Cresson coined *sonic effects*, referring to sounds translated and distorted through various biological, perceptual, cultural, social, actions, spatial, or temporal filters (Augoyard & Torgue, 2006). The conceptual framework of *sonic effects* aims to acknowledge that what sound means to us in the contextual situation is usually more relevant than what it sounds like. Thibaud, as a central figure in *CRESSON,* argues that in relation to atmospheres *sensing* is more fitting – compared to *perceiving* – as it highlights the shared and pre-reflective dimension, one which involves a bodily and immediate sensation (Thibaud, 2014b, p. 284). Distracted listening based on peripheral attention thus has the potential to integrate us in space and its events, referring to the Finish architect Juhani Pallassma's idea of peripheral vision. Sensing requires not a specific object, but always a *sensing field* that establishes the terms of perception. Referring to Merleau-Ponty, everything is perceived on the *imperception* of a horizon or background (Thibaud, 2011, pp. 210-211). This suggests a listening mode that forms the general *attitude of listening.*

In the article *Acoustic atmospheres: a contribution to the study of ecological aesthetics* (2000) Böhme suggests a similar peripheral mode of listening, characterized by a feeling of being *Ausser-sich-sein* (beside yourself). In this mode, the listener turns away from the normal instrumental experience of listening (I hear something) to a mode through which one participates in the world breaking with the topology of inside and outside (Böhme, 2000, p. 17). In a keynote lecture at the *Tuned City: Operative Atmosphere* conference in Brussels in 2013 he expanded on this type of listening, and how it should be (re)learned, enabling us to appreciate our everyday surroundings. He argues that in our normal everyday coping we "hear away" (*weghören*), as we do not listen to sounds, but instead to signals, and in this directed attention we regard what is considered unimportant signals to be unnecessary noise (Böhme, 2013) – we overhear it, "not-listening". However, Böhme argues that we need to include the overheard to be able to appreciate the world aesthetically and atmospherically. He suggests that we can learn this through, for example, cutting the other senses off, or through sound work/installations that function as filters foregrounding and emphasizing what is normally overheard. In this gesture your ears are opened and your attention redirected to what is normally overheard. In this way, the peripheral character of normal overhearing changes, as it will not automatically categorize the overheard as noise, but function as an atmospheric sense. This character of overhearing connects to Böhme's general description of how we vaguely sense atmospheres:

[33] There has been much debate about the difference between the English concept "Atmospheres" and the French concept "Ambiance". For example see Thibaud (2014) where he discusses the differences, and afterwards sums up that "from a theoretical point of view the notion of ambiance is not fundamentally different from the notion of atmosphere (a more thorough comparison would however be worth investigating). It seems to be just a question of stressing particular aspects of subject-objet relationships: ambiance tends to emphasize more the situated, the built and the social dimensions of sensory experience while atmosphere is more affective, aerial and political oriented. Also, ambiance already has a long tradition of fieldwork, interdisciplinary tools and design activity while atmosphere is more grounded on philosophical, ontological and geographical issues." (Thibaud, 2014, p. 2).

> "In der Wahrnehmung der Atmosphäre spüre ich, in welcher Art Umgebung ich mich befinde. Diese Wahrnehmung hat also zwei Seiten: auf der einen Seite die Umgebung, die eine Stimmungsqualität *ausstrahlt*, auf der anderen Seite ich, indem ich in meiner Befindlichkeit an dieser Stimmung teilhabe und darin gewahre, dass ich jetzt hier bin. Wahrnehmung qua Befindlichkeit ist also spürbare Präsenz. Umgekehrt sind Atmosphären die Weise, in der sich Dinge und Umgebungen *präsentieren*"[34] (Böhme, 1995, p. 96).

The verb *spüren,* which I translate as *vaguely sensed*, is crucial here, insofar as it suggests how peripheral attention is given to atmospheres, and yet this is also the way we connect with and attune to our surroundings, constituting our *Befindlichkeit*, the way we *feel* in a specific place at a specific time. Hubert Tellenbach, a German psychiatrist, presents similar thoughts on how atmospheres are vaguely sensed in his phenomenological study of the oral sense, demonstrating a clear link between smell and atmosphere (Stenslund, 2015, p. 347). In his view, smell contributes to a sense of environmental characteristics containing a *more* (*ein Mehr*) that remains unspoken as a sensation (*ein Spüren*) of the uniqueness of our environment. "This more, which reaches beyond the real factual, but which we nevertheless feel in its entirety, this more we call the atmospheric" (Tellenbach translated in (Stenslund, 2015, p. 347)).

Artist, writer, and theorist Brandon Labelle similarly highlights the background as participating in overlaying ambiguity on built space, acknowledging how the senses are always navigating through a network of the present. He refers to this as "productive mishearing" (LaBelle, 2010, p. 180) and later coins it *overhearing*, constituting a generative and constructive ground on which new relations and surprising encounters can take place (LaBelle, 2015). The *overhear* introduces the shared and messy space and adds multiple perspectives, as there is always sound outside the frame of attentional listening. Echoing Michel Serres elaborations on background noise, Labelle argues that this type of listening forms an essential part of our experience of everyday environments. The *overhear* is not to be considered a neutral backdrop (as suggested in the common term background noise/noise pollution), but a necessary ground on which the signal is heard, and therefore part of the relation and a productive component in any information transmission. The *overhear* is the horizon that all sounds relate to, in open space, as there is always sound outside the frame of a specific listening situation, and therefore these multiple perspectives become part of the experience with a promise of the outside. As such, the overheard and atmospheric register and underline our spatial surroundings by explicitly connecting us more closely to it than to what we see and consciously listen to. The *overhear* expands our space or freedom to act [P4]. Labelle investigates *muzak* and other ambient background music as examples of how the *overhear* is designed and structured deliberately, but, through working with digital systems or networks sited within particular locations, he also points to the role of sound art in widening and challenging these strictly musical expressions. These projects result in a performative staging of existing ambiences, amplifying, providing feedback, and displacing

[34] English translation: "In the awareness of the atmosphere I vaguely sense what kind of environment I am in. This awareness has two sides: on the one hand the environment, that *radiates* a mood quality, on the other hand, me partaking in this atmosphere through my very situatedness and thereby becoming aware of that I am here now. Awareness qua situatedness is thus vaguely sensed presence. Conversely atmospheres are the way things and environments *present* themselves" (my translation).

experiences of the built environment "to push the listener onto another level of attention – away from *listening for something* and toward reverie, fantasy, and distraction, as a listening that remains open and prone to wandering" (LaBelle, 2011, p. 198). On a similar note the composer and acoustic ecologist David Dunn unfolds how sound is a prime integrating factor in the understanding of our place as "Sound as a vibrant plenum reminds us of the profound physical interconnectedness that is our true environment" (Dunn, 1997).

Common for these different accounts is that peripheral sonic experiences re-situate our relation to figure and ground, foreground and background by operating on the peripheries of perception, and by conditioning the atmosphere of a place, granting the design of space a dynamic affective supplement. On this view a different understanding of the overheard than that of "not-hearing" calls for attention. Instead, it suggests an ecological understanding of overhearing as our atmospheric mode of hearing through which we vaguely sense our surroundings, thus constituting a main way to feel part of the surroundings. Furthermore, both Böhme, LaBelle and Dunn emphasize that we need to re-learn this skill, as most people only focus on the signal/noise dichotomy, and through sound art, for example, we can consciously become aware of what is normally overheard and learn to overhear, in the ecological understanding. Etymologically, the word *overhear* hints at this ambiguity. *Oferhieran* from Old English, *überhæren* from Mittelhochdeutsch, or *overhøre* from Danish has two opposite meanings: namely to not hear, to disregard, disobey, but also to hear what one is not meant to hear or examine. Taking Böhme, Labelle and Dunn's understanding of overhearing into account highlights the latter understanding of overhearing, as something you by coincidence comes to hear, but without it being forced on you, in the first place. Also, they suggest that people have a choice, deciding what they want to hear and what they want to overhear. Furthermore, this understanding suggests how overhearing exceeds non-conscious background sensing, as it becomes an active or forced mode of active, yet atmospheric listening. To distinguish clearly between these two opposite understandings of overhearing I will refer to this type of overhearing as *ecological overhearing.*

Despite the suggestion to re-learn the skill of *ecological overhearing*, it is not unfolded in detail how this skill is to be acquired anew. I therefore find Eric Clarke's ecological approach to music listening fruitful. His work on listening is developed from William Gibson's ecological perceptual theory, where perception, action, and meaning are closely related, as we are engaged directly in the meaning of events in the environment – as opposed to other theories on music, where meaning is tied to expression, semiotics, social construction, etc. In contrast to pervading ideas of understanding as a reflective and passive analytical mode, Clarke argues that this is not our main way of listening, as we first grasp the wholeness or the atmosphere as non-conscious effects of great significance (D. Clarke & Clarke, 2011, p. 196). Through perceptual learning and action we learn progressive and successive differentiations, acquiring skills by learning to resonate with the already structured perceptual information: "Perception is a self-tuning process, in which the pick-up of environmental information is intrinsically reinforcing, so that the system self-adjusts so as to optimize its resonance with the environment" (D. Clarke & Clarke, 2011, p. 19). "Perception is the awareness of, and continuous adaptation to, the environment" (D. Clarke & Clarke, 2011, p. 4). However, this does not happen as a magical or preordained process, but through perceptual learning, that is, the way we shape our capacities to be in tune with the environment. In this view, ecological modes of listening are not passive modes, as the ecological approach rejects

the whole idea of stimuli. Resonance is based on a continuous perception-action cycle, as a "perceiving organism's active, exploratory engagement with its environment" (D. Clarke & Clarke, 2011, p. 19). Perceptive learning often occurs without explicit training, although it can also be directed and taught, when someone or something directs our attention to another or places us in a situation designed to elicit perceptual learning. Perception is constituted as a relationship between environmentally available information and the capacities, sensitivities, and interests of the perceiver; thus, this relationship between listener and sound environment represents an aesthetic attitude or *attunement* (Clarke, 2005, p. 91). This normal way of navigating through sounds implies that all sounds are always already in a context that also consists of other sounds and situations. These conditioning backgrounds, engaged in through *ecological overhearing*, lead to action and, action modifies perception through exploration of the source of the sound, consequently changing the way we perceive them. As different listening modes provide both distal and proximal situational awareness, the background *attuned* through *ecological overhearing* can provide a continual sense of place without requiring conscious attention and a sense of security by offering "ample opportunities for restoration" (Andringa et al., 2013, p. 15) [P5].

As presented in [P5] Ash and Gallacher propose *attunement* as a way to engage in the non-representational background, as it constitutes a basic capacity to sense, amplify and attend to difference shaped by the atmosphere, which together act as "the conditions of possibility for what and how something appears in the world, before it is organized through internal self-narration, the representational logics of language or a theoretical account of the senses as a series of discrete faculties" (Ash & Gallacher, 2015, p. 70). An *attuning approach* seeks to acknowledge how backgrounds that often fall out of common awareness and habitual dispositions both shape our capacity for action and constitute a basis on which particular things show up and take on significance, for example noise. The previously ineffable opens up as a space of possibilities for intervention and innovation as well as domination and control. An *attuning approach* to *ecological overhearing* implies that the temporal and spatial scales are defined by the *in situ* situation; hence, the point of observation and action must be closely examined (Thibaud, 2015) [P2]. Thibaud argues that we have a physical tonicity that is formed by the ambiance that increases or reduces our capacity for action by placing us in a particular physical and emotional state. "By creating a state of muscular tension in the body, the ambiance gives rhythm to our movements and modulates the manner in which we move (…) it drives action at its most elementary level, i.e. the physical gesture" (Thibaud, 2011, p. 209). *Ecological overhearing* is thus anchored in a multisensory, embodied temporal and spatial flux. Paying attention to the structured temporality may therefore help bring about a required focus on the key dimension of time in the constitution of atmospheres. As Bille et al. explain,

> "atmosphere is a phenomenon or a condition that transgresses boundaries, such as subject and object. However, by transgressing boundaries it also connects people, places and things. Accordingly, atmospheres are bound up in temporal dynamics, which again make them difficult to pin down, because they are socially and historically contingent, and bound up in the incessant metamorphosis of the sensory world, not to underestimate their inherent temporal nature" (Bille et al., 2015, p. 2).

6.4 SUMMARY

These different accounts of atmospheres, *ecological overhearing* and *attunement* share a relational ontology, in that the world is not made up of different substances with names such as noise and technology, but is constituted relationally. In this way, a relational ontology of atmospheres, based on an *ecological overhearing*, provides an alternative to the reductionist framework built on a mind-world dualism, as meaning is not placed "in" the individual alone, ruling out research of common grounds and shared experiences. Instead, an *attuning approach* insists that relations afford meaning and different atmospheres, which we can attune to or against. A relational framework implies breaking with dualistic approaches that either consider atmospheres to be internal feelings projected onto the outside or the purely externalized version proposed by Husserl, implying that a landscape "in itself" has a mood as a property (Griffero & De Sanctis, 2014, p. 105). As such, we do not perceive atmospheres; but it is intermediary elements that enable us to perceive, where space and time are not abstract concepts, but emanate from the relations between entities.

By rehabilitating *ecological overhearing* through this alternative framework I wish to approach situations, starting with their atmospheric irradiations as multisensory conditions *on the basis of which* our perception depends, consisting of a reciprocal and shifting relationship that conditions us, but is also conditioned by us. Combining overhearing with the ecological approach to action/perception cycles suggests that we need to revisit the pervading idea that hearing (as opposed to attentional listening) is a passive and unconscious process, as argued by David Toop (Toop, 2010, p. 11). In this view, the listening mode that would normally be assigned the lowest value, namely hearing, can become an active ecological listening mode and a crucial way for us to orientate ourselves and find others and ourselves in different situations and surroundings[35]. Ambient surroundings can afford *ecological overhearing* that enhances our connection to the surroundings. Ulrik Schmidt points out that ambient surroundings dissolve a clear sense of foreground and background, as they are characterized by a dynamic and ubiquitous enveloping flux – a multiple whole that demands less attention, because it is experienced as one integrated auditory stream.[36] In this way, Schmidt wants to break with the assumption that the experience of the ambient is characterized by sinking into the background, and instead suggests that it is the experience of a ubiquitous auditory envelope into which other *unwanted* sounds can be integrated (Schmidt, 2010). Based on these readings I develop Bille et al.'s definition that atmospheres are the *spatial experience of being attuned in and by a material world* (Bille et al., 2015, p. 5), to include the temporal and vaguely sensed through the concept of *ecological overhearing.*

[35] As an example *sound walking*, a key-method of *acoustic ecology* and soundscape tradition would still be a relevant method for the *attuning approach* to *ecological overhearing*. However, the goal would be very different; In *acoustic ecology* and soundscape tradition the aim of sound walking is to become aware of what we normally tend to not hear to be able to start listening *with new attention* to the sounds around us afterwards (as also indicated in the method of *ear-clearing).* Engaging in a sound walk, taking and *attuning approach* ecological, would instead aim to become attuned to the background, to enhance and refine *ecological overhearing* as a non-attentive and atmospheric mode of listening.

[36] Referring to Albert S. Bregman´s model of *auditory scene analysis (ASA),* where we group sounds together in auditory streams, as e.g. demonstrated by the "cocktail party effect": We can segregate the cacophony of voices at a cocktail party into two streams, the foreground stream that is the voice we want to listen to and a background stream that consists of all other voices. More streams demand more from our auditory attention (Bregman, 1994).

The relational framework presented here both relates to and breaks with traditional accounts of *acoustic ecology* and the *soundscape* movement. The *attuning approach* is concerned not so much with what we hear, but how relations and atmospheres are constituted via *ecological overhearing,* understood as contingent, situated, and reflexive. It shares with *acoustic ecology* and *soundscape* research an interest in sound experience in relation to the everyday ecology of life. However, as these are mainly concerned with the perception, composition, and character of *soundscape*, the framework presented in this chapter is not aimed primarily at analysis, but is instead pragmatic, in that it focuses on operative and practical issues connected to action. This operative attitude renders the concept of *soundscape,* including categories such as *keynote sounds,* unstable and reveals its fragile and dynamic character with no stable or predetermined figure and background relationship.

CHAPTER 7

ARTISTIC RESEARCH AND CONSTRUCTIVE DESIGN RESEARCH

This chapter presents practice-based methods such as artistic research and constructive design research. It is argued that the character of the key themes presented in the hypotheses and the subsequent philosophical and theoretical framework demand to be put into play, developed, and challenged through practice-based methods. In order to theorize sound as a way of knowing-in-action, the non-representational framework presented in the previous chapters calls for relational epistemology similar to *acoustemology* (conjoining acoustics and epistemology) developed by Steven Feld. From this perspective epistemology is not regarded as transcendental truths, but as relationality of knowledge production or what John Dewey has termed contextual and experiential knowledge (Feld, 2015, p. 15). As Feld argues, knowing cannot be "acquired", as one knows through an "ongoing and cumulative and interactive process of participation and reflection" (Feld, 2015, p. 13-14). From this point of view it is vital that researchers engage in critical dialogue between theoretical explorations and practice-based research *in situ* – in line with Becker's recommendation to combine an ecological framework with practice-based methods. As Bille et al. put it,

> "Focusing on atmospheres means addressing not simply 'experience', but rather the co-existence of embodied experience and the material environment. In order to get to grips with atmospheres, we have to engage more actively and analytically with architecture, colors, lighting, humidity, sound, odor, the texture of things and their mutual juxtaposition" (Bille, Bjerregaard, & Sørensen, 2015, p. 6).

However, the complexity of the subjects of inquiry and research in atmospheres' limited application in research practice and many unanswered methodological questions challenge this effort. There is not one, but many methods for unfolding a non-representational approach in practice. This situation implies that theory should always be relevant to practice. However, there is still a lack of practice-based non-representational research studies – in comparison with conceptual elaborations and theoretical interventions (Vannini, 2015, p. 12). Similarly, Thibaud (2011) points out that in order to inquire into everyday atmospheres the researcher must attune to them, and such research is thus experimental by nature in its attempt to push limits and strive for renewal in order to "rupture, unsettle, animate, and reverberate rather than report and represent" (Vannini, 2015, p. 5). Therefore, by engaging in practice-based experiments I wish to explore both how we can operationalize atmospheres and *ecological overhearing in situ*, but also how we can unsettle, shake, and challenge the research approach presented in this chapter when faced with the unruly everyday world.

The aim of this chapter is to explore the methodological challenges of my research approach in depth, and so the experiments will be unfolded in detail in the next part, which is based on the included papers. However, several of the included papers address methodological issues and are therefore referred to in this chapter. To end this part, the chapter ends by revisiting the three working hypotheses identified in Part I, and develops three corresponding research questions based on the presented *attuning approach.*

7.1 THE ROLE OF KNOWLEDGE IN PRACTICE-BASED RESEARCH

I want to position my practice-based experiments as part of both design- and artistic-research traditions, which have changed rapidly over the last fifteen years in both art schools and academia. The growing integration of these fields is part of the "practice turn" (Borgdorff, 2010, p. 51) within the humanities and social sciences, where practices and artifacts themselves become a form of academic inquiry. As the process of creating art and design now represents a valid research method for gaining new knowledge "in and through" the acts of creating and performing art and design, practice is not only a methodological vehicle, but also a site of knowledge production (Borgdorff, 2010, p. 46). As part of this integration process where art and design is not only topics for analysis, products, or solutions, tensions are constantly being negotiated in order for them to be acknowledged as "proper" research (Borgdorff, 2010; Koskinen & Krogh, 2015). Therefore, over the last two decades core concepts, including knowledge production, have been constantly negotiated and discussed in this emerging practice-based field as part of the process of being recognized as research and integrated into the "knowledge economy" of academia (Borgdorff & Schwab, 2014, p. 9; Holert, 2009, p. 1; Koskinen et al., 2011). Scholars in these strands of the literature argue that in order to manifest the conditions hidden in knowledge and the unconscious transferences that accompany the need to be "scientific," one must be critical of traditional understandings of knowledge production (Busch, 2009, p. 4)[P6].

7.1.1 Artistic Research

As presented in [P6], practice-based research through sounding art belongs to the emerging field of artistic research, which in a Danish context has only recently become a part of academia. However, over the last two decades the relation between art and research has been discussed and unfolded in the field of artistic research abroad (Borgdorff & Schwab, 2014, p. 9; Borgdorff, 2010, p. 44). Art is thus said to contribute to academic knowledge, and conversely academia offers knowledge that interferes with art practices, creating new areas of knowledge production. As stated by key figures in the field, artistic research needs to critically respond to and reflect on the existing knowledge imperative so that it does not *just* make art in order to produce knowledge or blindly apply theory as canonistic knowledge for research-driven art practice (Busch, 2009, p. 1). Therefore, it is suggested that the division of art (practice) and writing (theory) is abandoned (Borgdorff & Schwab, 2014, p. 12), if artistic research is to become more than an application of theory and theory more than mere reflections on practice (Busch, 2009, p. 1). In this understanding art and theory are "nothing more than two different forms of practice interrelated through a system of interaction and transferences" (Busch, 2009, p. 1). As such, the work

is the research, as a site of knowledge production where science and art are intertwined (Borgdorff, 2010, p. 46). Overall these positions point to the need for critical reflexivity toward knowledge production within artistic research (Busch, 2009, p. 4). "Art as research" or better the "hybridization of art and research" (Busch, 2009, p. 5) differ from *just* art, as art as research intends to carry out an original study of new things in order to enhance and contribute to what we know and understand (Borgdorff, 2010, p. 54). Thus, artistic forms of knowledge are not restricted to contributing knowledge to art practice, but rather begin to develop into hybrid formations of knowledge or intervene in and impact on theoretical discourses, contributing to theory construction (Busch, 2009, p. 5). But what are hybrid formations of knowledge, and what kind of knowledge needs to be recognized in academia (Holert, 2009, p. 1) when "thinking in, through and with art" (Borgdorff, 2010, p. 42)?

Henk Borgdorff describes how this type of knowledge differs from other types of knowledge, including "propositional knowledge" (facts) and "knowledge on skills" (how to make), as it is dealing with the articulation of the pre-reflective, non-conceptual content of art as explored in phenomenology (Borgdorff, 2010, p. 59). Therefore, it should not be considered knowledge production, but rather "not-knowing" or "not-yet-knowing", or the idea that all things could be different, thereby promoting and leading to "unfinished thinking" (Borgdorff, 2010, p. 4). Kathrin Busch coins this type of thinking "wild knowledge" (Busch, 2009, p. 6). This concept encompasses the unexpected, spontaneous, and involuntary. Artistic research is thus characterized by the fact that the actual object of research is still undetermined, and therefore "the knowledge of certain facts not being yet reduced into concepts" (Busch, 2009, p. 6). Busch quotes Michel Foucault when explaining how art is valid as a different form of knowledge not "showing the invisible, but rather showing the extent to which the invisibility of the visible is invisible" (as cited in (Busch, 2009, p. 4)). In this way, artistic research could enable us to refer to that which cannot be articulated within the respective fields of knowledge.

7.1.2 Constructive Design Research

As the scope of the field of human-computer interaction design has expanded beyond workplace studies and system development, the shift to values and experiences has occurred more generally within the field of *Human Computer Interaction* (*HCI*) with a view to addressing the need for integrating human values into critical and reflective approaches to design in the rise of ubiquitous and pervasive computing (McCarthy & Wright, 2004). These human-centered approaches move from a technology-focused design practice and an understanding of users as end users to a more radical form of design as co-creation addressing a larger context of social relations, experiences, values, and ethics. Within interaction design this development is connected to the emergence of ideas of *pervasive, calm*, and *ambient computing* based on Weise's vision of *ubiquitous computing* as technology that disappears, weaved into the fabric of everyday life (Weiser, 1999, p. 19). The aim is to keep people informed of the surrounding world, while at the same time bringing them comfort by staying in the background of their awareness, only drawing attention to itself when required. Since then the field of *HCI* has developed these ideas because of their implications for the passive role of the user toward participation and engaging the whole body and all the senses in staging sociality in space (Petersen et al., 2004). In this context design research has developed methods and practices for creating enhanced democratic conditions, e.g. through participation, in

order to renegotiate the roles and rights of users, as in the field of *participatory design* which has emerged mainly in the United States and Europe, especially in Scandinavia. *Participatory design* advocates that technology and work processes are developed to augment the skills and tools of the workers and to enable them to control their practices rather than to replace the workers (Bødker & Grønbæk, 1991; Ehn, 1988).

In 2011 Koskinen et al. suggested a revision of Frayling's methodology of *research through art and design* coined constructive design research. In the book *Design research through practice: from the lab, field, and showroom* by Koskinen et al. (2011) the authors describe constructive design research as "design research in which construction – be it product, system, space or media – takes center place and becomes a key means of constructing knowledge" (Koskinen et al., 2011, p. 5), as described in [P1]+[P2]. However, even though the construction takes center place, constructive design research focuses on the process and the context of this construction and thus on the importance of the interdisciplinary team as a way to acknowledge the limitations of the user-centered turn in the 1990s toward addressing the relational environment in which the design was meant to work (Kinch, 2014, p. 88). Taking an architectural approach to interaction design Kinch argues that designers should use the concept of atmosphere to address interactive furniture as relational objects that are always part of a whole (Kinch, 2014, p. 31). This demands that the field makes these relational features the center of attention. Atmospheres contribute to ideas of empowerment by making the sensory a showcase for different ways of lining and helping inhabitants become ordinary experts of their living spaces (Thibaud, 2014, p. 295).

Markussen et al. map out three trajectories for the relationship between theory and practice in the field of interaction design research as a recent development process within design research, moving from 1) the essentialist strand that uses theory as a coherent system of concepts to be applied to design research to increase understanding over 2) the instrumentalist strand that uses theory as a toolbox full of concepts informing the design to 3) the most recent constructivist strand, where constructive design research adheres to the idea that theory and practice can work both ways; theory may apply to design research, but also to how design practice can be a vehicle for transforming theory. In this light, a practice-based approach's challenge of generalizing "local" understandings that cannot be applied uncritically to other cases becomes irrelevant, when the aim is not to generate broad generalizable solutions, but to ask questions and critically examine the potentials and limitations of alternative frameworks that can guide future practice (Markussen, Knutz, & Christensen, 2011).

> "Research through Design (RtD) is an approach to conducting scholarly research that employs the methods, practices, and processes of design practice with the intention of generating new knowledge. (…) RtD draws on design's strength as a reflective practice of continually reinterpreting and reframing a problematic situation through a process of making and critiquing artifacts that function as proposed solutions. (…) RtD asks researchers to investigate the speculative future, probing on what the world could and should be." (Zimmerman & Forlizzi, 2014, pp. 167-168)

Whereas traditional scientific research is conducted in the pursuit of new knowledge and universal truths through deductive approaches, practice-based research in design is concerned with the creation of the non-existent and non-universal (Stolterman, 2008). In other words, traditional researchers study the past and the present world as it exists and attempt to avoid influencing the objects of study, whereas design researchers try to imagine and build possible futures by intentionally affecting and changing the present world. Instead of aiming to legitimize status quo, design and artistic research envisages and anticipates the future, while helping to understand and rethink the world of today. Design research's primary goal is neither to understand the world like human sciences nor to explain and control it like natural sciences; the focus is instead on "world-making", in the words of Albert Borgmann (Koskinen & Krogh, 2015, p. 122).

By asking "what if?" design research questions the interrelation between potential changes in e.g. the technological development and social relations through a future-oriented activity (Koskinen et al., 2011, p. 42). This speculative practice opens up a space for discussing and considering alternative possibilities and options as well as for imagining and redefining our relation to the world. As such, it propels thinking, raises awareness, questions, provokes action, facilitates discussion, and can offer necessary alternatives. These are powerful aspects to rethinking assumptions and imagining possible futures. The focus is not on designing products and solving problems, but instead emphasizes that these processes concern the design of relations (Dunne & Raby, 2014) to provide alternatives to deeply ingrained habits of thought (Koskinen et al., 2011, p. 47). In this way, practicing design research helps us to articulate our needs, desires, and expectations. As in artistic research this complicates the process, as it must be open to the not yet known in order to be able to identify emergent themes. Therefore, it propels us to engage in a speculative approach through a bottom-up process that includes objects, humans, and technology in the rethinking.

Design research refers to the nature of design research problems as "wicked" (Webber, 1973). Wicked problems have no clearly defined problems to begin with, and design researchers construct a future where "Results do now come in the form of knowledge about things at hand, but in the form of suggestions for a change of a present state" (Hallnäss & Redström, 2006, p. 128). Stolterman argues that this type of knowledge requires different purposes, outcomes, and measures of success (Stolterman, 2008). Elaborating on what these purposes, outcomes, and measures of success should be within design research (Koskinen & Krogh, 2015) leads to the concept of "design accountability" aimed at helping design researchers navigate the borderline between research and practice toward a nuanced discussion of practice-based methods in design research and at assigning proper status to these methods in the design process (Koskinen & Krogh, 2015, p. 124). They reframe William Gaver's idea that design is not primarily "epistemologically accountable" as in science, but "aesthetically accountable" in the understanding that researchers who hold themselves accountable for design aim "to do research that practitioners will understand, respect, and take seriously" (Koskinen & Krogh, 2015, p. 121). As Olav W. Bertelsen puts it, practice-based research is to be used in the real world, and therefore "research in these fields tends to emphasize relevance over scientific rigour" (Bertelsen, 2000, p. 16). He suggests that the concept of "design artefacts" should also include theory as a design artifact, playing different roles in the design process

from worldviews to tools as "design-oriented epistemology should acknowledge that theories are design artifacts mediating construction, cooperation and conception" (Bertelsen, 2000, p. 16).

7.1.3 Comparing Artistic Research and Constructive Design Research

The entanglements and discussions of the roles of theory and practice are evident in both constructive design research and in artistic research, questioning traditional boundaries. When practice is a central part of the research, "new knowledge" emerges in the tension between skills, theory, and practice as a knowledge-*in-action* and *in-situ*, often in a form which from a scientific viewpoint would be categorized as "uncontrollable impurities" (Koskinen & Krogh, 2015, pp. 121-124). Koskinen et al. (2011, p. 42) argue that this is the strength of this type of research, as it deals with the uncontrollable and often unnoticed "halfway" between people and things. This halfway or atmosphere is negotiated through the senses, movement, the sense of space, etc. that we have few words to describe (i.e. the "ineffable"). The concept of "halfway" is inspired by Maurice Merleau-Ponty and describes the intertwining of the world and people as a better alternative to the concept of experience, because it highlights the sensuous and motional interactions through which we – consciously and unconsciously – negotiate our way through the world. As such, designers and artists focus on capturing structures in the ephemeral and on reframing ideas and imagination (Koskinen et al., 2011, p. 8).

Similarly, the promise of artistic research is to unravel both our intimate and distant relations to the world, proposing that the unpredictable, non-representational, sensual, and concealed can supplement traditional scientific types of propositional knowledge by "enhances our awareness of the pre-reflective nearness of things as well as our epistemological distance from them." (Borgdorff, 2010, p. 45). However, there is a key difference between artistic research and constructive design research, as design research addresses a specific situation, challenge, problem, or purpose for a specific client and user (Stolterman, 2008, p. 59), despite them being wicked problems. Artistic research, on the other hand, does not necessarily aim at a specific wicked problem or situation, in the sense that it does not start with a specific problem or question, but discovers questions or surprises during the process. This fundamental difference has great consequences for what outcome is expected and articulated through artistic and design research, respectively.

7.2 FROM METHODOLOGY TO CONCRETE EXPERIMENTS

The methods I have chosen are experimental within the field I approach, and thus other more traditional approaches require less presentation and discussion. While I argue that the practice-based methods are fruitful to the research subject, at the same time I contend that venturing into the "ineffable" requires first a thorough exploration of how the many abstractions (such as "exploring the halfway", "capturing structures in the ephemeral and reframing ideas and imagination", "unraveling both our intimate and distant relations to the world") can be comprehended and operationalized in the experiments. Second, it requires an outline of the criteria by which the methods – and the knowledge outcome – can be challenged, criticized, and evaluated. The

following will therefore reflect on the process from experiment to knowledge contribution, from artistic research to constructive design research, addressing the above-mentioned issues.

I argue that in the nascent field of artistic research the premises for outlining the criteria by which the process and its knowledge outcome can be challenged are not the same as in design research, due to its different aims. At the same time, the criteria are not clearly stated in the field of artistic research. Therefore, it was necessary for me to discuss the role of knowledge production in artistic research, which will be unfolded in length in Chapter 8 based on [P6].

To account for the need for clear criteria by which design research can be evaluated and discussed, Brandt and Binder argue that it is crucial that experimental design research is accessible to and arguable among peers. This process of making experiments accessible involves a triad of articulations consisting of a *traceable genealogy*, *intervention* in the world, and the articulation of an *argument* for others to engage with (Brandt & Binder, 2007, p. 15). These interconnected parts are all a part of an *experimental phase*, where *genealogy* refers to the history of the experiment, *intervention* refers to the transformation of a situation as a consequence of the experiment, and *argument* refers to the resulting knowledge in a form that is contestable. This triad allows for peers to make informed evaluations and critique of the contribution. Bang et al. suggest expanding this effort by adding one phase before the experimental phase, together forming three phases of a design research experiment consisting of a *motivational phase* forming the research questions, an *experimental phase* based on the triad described above, and an *evaluation phase* (Bang, Krogh, Ludvigsen, & Markussen, 2012). The three phases will be described in the following.

7.2.1 Phase 1: Motivational Phase/Entrance Level

As Bang et al. (2012) argue, the flexibility concerning theory and methodology in design research must be complemented by concrete tools for handling and bridging methodology and the concrete methods and techniques used in experiments (Bang et al., 2012). They propose bridging this gap by introducing a hierarchy, where the development of hypotheses is based on the foundation of a clear motivational context, after which the narrower research questions can be put forward and criteria for evaluation can be identified and used, together constituting the *entrance level* of concrete experiments. In this way, the *entrance level* covers the preparatory process, which ensures that the constructive design process uncovers knowledge relevant to a larger community (Bang et al., 2012, pp. 5-6). Hypothesizing and developing research questions are seen as ongoing processes framed by the overall research motivation, articulating the premises under which the experiments must be read and understood.

7.2.2 Phase 2: Experimental Phase/Program

Brandt and Binder (2007) propose that the experimental phase also relies on a *program*. The experiment denotes the inquiries developed through the creative processes. The program, however, is derived from design

praxis, as an intermediary between design question and design experiment. It is a way of framing the experiment, and as such the design researcher acknowledges how different programs potentially allow for different experimentations as they propose certain ideals and ways of doing things. The design program in design research is different from a program for commercial design, as the program for the design researcher is the suggestion that must be substantiated and discussed in the experiments (Brandt & Binder, 2007, p. 3). My overall program is the proposed *attuning approach,* though unfolded through different artifacts and materials in the specific cases. As such, this program propels our choices in the process of making. The experiments are thus suggestive in nature, showing possible outcomes of the program, and take on the form of concept development and prototyping, as the experiments were carried out using distinct methods, contexts, and users. It is important to be aware of the program throughout the process, as other participating interests and disciplines can easily sidetrack it. I have chosen to make my experiments within the field, as field deployments enable researchers to study interactions with users in situ. In this way, I seek to account for the *ecological gaps* in lab-based experiments, as field deployment explores how artifacts and technology will be adopted, used, adapted, or abandoned in real-world use and how they interact with other aspects (Konstan, Lampe, Riedl, & Terveen, 2014, p. 120).

7.2.3 Phase 3: Evaluation Phase

Acknowledging the vague, relational, and fragile status of atmospheres and *ecological overhearing* challenges the traditional evidence-based quantitative and laboratory-based methods for evaluation (see Part I). Through such evaluation methods the researcher distinguishes aspects as a way to reduce complexity in order to be able to evaluate a specific intervention. In design research, however, it is not possible to reduce the design complexity by limiting specific aspects, as the designer deals with "the whole" (Kinch, 2014, p. 100). Thus, there is no right way to evaluate atmospheres, as the complexity can be evaluated in numerous way, as described in the closing lecture by Henry Torgue at the second international congress on ambiances, *Ambiance in Action*, in Montreal in 2012. When brought into the field experiments are littered with everyday routines and contexts. This affects the roles of the user and the researcher, where the researcher does not guide the focus of the user, as opposed to in the lab setting. Moreover, traditional qualitative methods based on observation and interviews are also insufficient, as the idea that anyone can provide a complete and faithful account of their own vague and changing atmospheric experience is illusory (Clarke & Clarke, 2011), as e.g. demonstrated by Stenslund (Stenslund, 2015). Therefore collecting data in this type of experiment demands a multiple methods approach combining observation, interview, contextual inquiry, and participant observation (Konstan et al., 2014, p. 120).

7.3 SUMMARY

In this chapter I have positioned my practice-based experiments within constructive design research and artistic research and elaborated on how the knowledge contributions of these are particularly fruitful in the situation identified in Part I. Both artistic research and constructive design research are often engaged in finding ways to move away from a consumerist approach toward a focus on user choice, involvement, and empowerment. This

seems especially important in the current situation in hospitals, where the existing approaches leave the user passive, even though more and more research points toward the importance of control and activity for the appraisal and successful coping of sounds and noise. Furthermore, I find practice-based research fitting in the current situation, where the *quality of life* perspective has encouraged us to stop asking about the environment in terms of measurable parameters, e.g. decibels, and instead ask how we sense ourselves in the environment. I argue that this shift has turned the noise question into an ecological question. Sensing thus becomes the primary focus of attention, not judging what sounds are good or bad, as the primary theme of sensing is not the sound *in itself*, but the atmosphere (Böhme, 1995, p. 15). Both artistic and constructive design research deal with the felt and sensed knowledge of and in experience.

The choice of engaging with both artistic research and constructive design research has propelled an excavation of the fundamental differences between the two. Design research addresses a specific situation or problem, whereas artistic research is often discovery-led, and thus the path from experiment to knowledge contributions is fundamentally different. The knowledge from experiments is made accessible to and arguable among peers through three interconnected phases: a *motivational phase*. To establish the entrance level to the experiment there is a need for a clear motivational context, hypothesis, and research questions to ensure its relevance for the community and to guide the choice of design program. In this phase I chose artistic research due to the discovery-led character of my research approach (see Chapter 8). After the motivational phase I engaged in constructive design research (see Chapter 9) covering both the *experimental phase*, guided by the design program and consisting of a *traceable genealogy,* an *intervention* that transforms the situation, and the articulation of an *argument*, and the *evaluation phase*.

7.4 CONCLUDING REMARKS PART II / HYPOTHESES AND RESEARCH QUESTIONS

Part II describes an *attuning approach* as a productive way to address the hypotheses presented in Part II. The ecological framework is established by viewing sound and listening through the lens of atmospheres, attunement and *ecological overhearing*, highlighting the reciprocal relationship between how they organize the mood pulse by atmospherically shaping us, but also how we can attune to it in different ways through perceptual learning. The *attuning approach* thus considers the world and the human to be dynamically co-constituted through the shifting attuning relations between them. In this way, our experience of an atmosphere, including spatial and temporal scales, is dependent upon the quality of attunement between our capacities and bodily situation and the affordances and attentional cues in the environment. Attunement skills can be actively developed through perceptual learning as a way to transform habitual activities and habits. In the context of sound and listening this creates the potential of *ecological overhearing* as an atmospheric mode of listening capable of reconfiguring habitual background and foregrounding relationships.

From this perspective *ecological overhearing* becomes a generative and active way to constantly refine attunement to the environment by resituating foreground and background relations dynamically. *The attuning*

approach thus opens up a way to address the hypotheses in Part I, which focus on atmospheres of absence, sonic sensibility, lack of coping skills, and coping possibilities in the hospital, by suggesting that an *attuning approach* to noise in hospitals should provide opportunities for diverse acoustic situations and possibilities for active choice-making to meet different and shifting needs through *doing with sound* in order to enhance empowerment and *ecological overhearing*. This will provide both a continual sense of presence without demanding full attention and create ample opportunities for restoration of attention. Attuning strategies should be developed through interdisciplinary collaboration taking the multisensory atmosphere as its starting point. In conclusion three research questions are derived from Part II corresponding to the three hypotheses identified in Part I:

PART I / HYPOTHESES	**PART II / RESEARCH QUESTIONS**
The experience that excessive noise in hospitals leads to stress is closely connected to non-acoustic factors such as:	If we take an *attuning approach* through practice-based experiments, how can we:
An atmosphere of absence The lack of sensory stimuli, including visual and olfactory stimuli, and the general notion that the hospital inhabits an unusual atmosphere of absence amplify sound-related annoyance.	**Research Question 1 (RQ1)** Address sound-related annoyance in hospitals in relation to a general atmosphere of absence.
An alarming sonic sensibility The alarming *soundscape* of the hospital and the lack of dynamic background sound sensitize foreground and attentive listening modes such as monitory and diagnostic listening and thus amplify sound-related annoyance.	**Research Question 2 (RQ2)** Afford, and promote *ecological overhearing* in hospitals through *attuning strategies*.
A lack of control and active coping skills The inability to actively exert control (internally or externally) over sound-related stressors in different and changing situations and contexts enhances sound-related annoyance.	**Research Question 3 (RQ3)** Facilitate the feeling of control, safety and empowerment in hospitals through *attuning strategies.*

As this is still uncharted territory in the existing field, I have suggested artistic research and constructive design research as valuable exploration tools for exploring these research questions. I have based my choice of approach in both the specific experiments and in the overall PhD process on the discussion of the different processes and criteria for knowledge production in design and artistic research, respectively.

PART III

ATTUNING EXPERIMENTS

Part III presents the experiments that represent different explorations of how we can understand, discuss, and unfold an *attuning approach* through practice. In Chapters 8 and 9 the two main experiments are presented based on the included papers [P1]+[P2]+[P3]+[P6][37]. Part III ends with a concluding Chapter 10 that responds to the research questions by synthesizing the findings in the experiments and outlining the key findings, limitations, and conclusions of the dissertation as a whole. Lastly, pointing to future work, the ongoing experiment *The Overheard* is introduced.

In the course of my PhD I have been involved in a range of practice-based experiments in various contexts. These projects have ventured into the overall research agenda in different manners, in the sense that the questions are not posed to generate an exhaustive answer, but to guide and frame research inquiries that can result in insights and contributions on several levels. These experiments were very different in scope, spanning from entire experiments lasting up to two years to facilitating workshops. To discuss and disseminate my research I have also engaged in performances, lectures, concerts, performance lectures, and sound art installations[38]. My research has not taken place in a vacuum, and all the experiments I have been involved in have been collaborative efforts, and the perspectives and inputs of other stakeholders have influenced my work – and vice versa.

I highlight two central experiments, which are substantiated by other experiments[39] that hold peripheral positions. These peripheral experiments have been important for establishing the grounds for the central

[37] As Chapter 10 summarizes the findings from the experiments presented in chapter 8 and 9, they are not summarized individually in the chapters.
[38] For a comprehensive overview of my activities see the *List of Activities*, which also include an artistic portfolio with links to documentation videos and sound files.
[39] 1) "Pokehead" was an experiment conducted during the *Sound and Music Computing* summer school at *Aalborg University* in Copenhagen in July 2012. The theme was product sound design, innovation, and entrepreneurship, and *Pokehead* explored a novel interactive, human-computer interface and remote social communication system based on an augmented, hi-fidelity audio headphone platform. It was documented in the publication *Pokehead: An Open Source Headphone Based HCI Platform* by Stefano Trento, Visda Goudarzi, Antoine Charon, Shawn Trail, and myself. Our rapid prototype proved to be robust enough for demonstration purposes and serves as a working proof of concept. The system was built on the *DUL Radio* built into *Sennheiser PXC 250-II* headphones, together forming an embedded open-source accelerometer platform to gather three-axis position data in order to trigger real-time sonic events via specific head gestures. These gestures are mapped to sound models that convey particular messages in order to control software on the mobile device or to another simultaneous *POKEHEAD* user. The project was motivated by the desire to take advantage of the ubiquitous nature of headphone users in a social and private setting along with networked mobile devices such as smartphones and/or portable media player devices. Our goals were to design an intuitive autonomous, versatile, and practical interface context using simple, open source implementation.

experiments. The first central experiment *Lys, Landskab og Stemmer [Light, Landscape and Voices]*, which ran from 2010 to 2012 and was initiated by Kulturring Østjylland, a collaboration of municipalities in Eastern Jutland, aimed to explore the potentials of digital art outside museums and institutions. The project was conducted in collaboration with visual artist Elle-Mie Ejdrup Hansen and a range of external partners.[40] The second central experiment, *KidKit*, ran from 2011 to 2012 and was conducted in collaboration with architect Sofie Kinch; it formed part of her industrial PhD at the *Alexandra Institute, Aarhus University* and the *Aarhus School of Architecture* in collaboration with the neuro-intensive care unit at *Aarhus University Hospital*. A third experiment, *The Overheard,* initiated in 2015, is part of the concluding chapter*,* as it is still under development. It is made in collaboration with Postdoc Morten Riis from the *Center for Participatory IT* at *Aarhus University* and a range of internal and external collaborators.[41] In the figure below I have provided a sketch of my experiments, which, however, does not include performances, lectures, PhD courses, conferences, field visits to hospitals, visits to other universities, etc.

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2) I conducted a workshop during the international PhD course *Researching Atmospheres* with Jürgen Hasse, Juhani Pallasmaa, and Jean-Paul Thibaud. I also planned and managed the PhD course together with Sofie Kinch and Niels Albertsen, *Aarhus School of Architecture*. The PhD course focused on the "how" of researching atmospheres. Which methods are available, and how do they relate to specific research questions about atmosphere? In relation to this question my workshop aimed at exploring in practice whether it is possible to transport atmospheres in such ways that the atmospheric quality of the experience in situ somehow can be felt and experienced by the absent others? And how can descriptions of atmospheres themselves be atmospheric and "presenced" in such ways that absent others may feel the atmosphere? We explored these questions through two auditive gestures: a) transport of sound ambiance from one place to another through ambiance recordings, and b) transport of reverb/reflection from the same room through convolution reverb through impulse response recordings from the same spaces.

3) The site-specific *Story Bench* are placed in the municipalities surrounding Aarhus. Augmenting the function of a bench as a place for resting and mind wandering the *Story Bench* makes the local history come to life on location. When you rest your head on the headrest, a voice that only you can hear tells forgotten stories from the past of the specific surroundings, by conduction sound to the inner ear through the bones of the skull. Different from headphones, this way of listening acknowledges our ability to focus our listening attention on a single voice, overhearing the cacophony of sounds and background noises around us (known as the cocktail party effect), enabling us to remain a part of the surroundings while being able to communicate with others on the bench or focusing on the present surroundings as well as the story. The project is made in collaboration with Søren Lyngsø Knudsen, *Gustin Architects* and is commissioned by *Kulturring Østjylland* (http://kulturtarv.dk).

[40] *Kulturring Østjylland,* Søren Lyngsø Knudsen, Sune Hede, *DynAudio, Rival,* and more.

[41] *European Capital of Culture/Aarhus 2017*, *Participatory Information Technology/Aarhus University, Center for Advanced Visualization and Interaction/Aarhus University, Sonic College/UC Syd, Radar, SNYK /G((o))NG TOMORROW, Brüel & Kjær. Dansk Lyd, Silkeborg Municipality, Horsens Municipality, Aarhus Municipality, Struer Lydens By, Gimsinghoved kunst- og kulturcenter, Mønsted Kalkgruber, Lydhavnen, Kristina Green Bonne Studio*, Leo Sagastuy, and more.

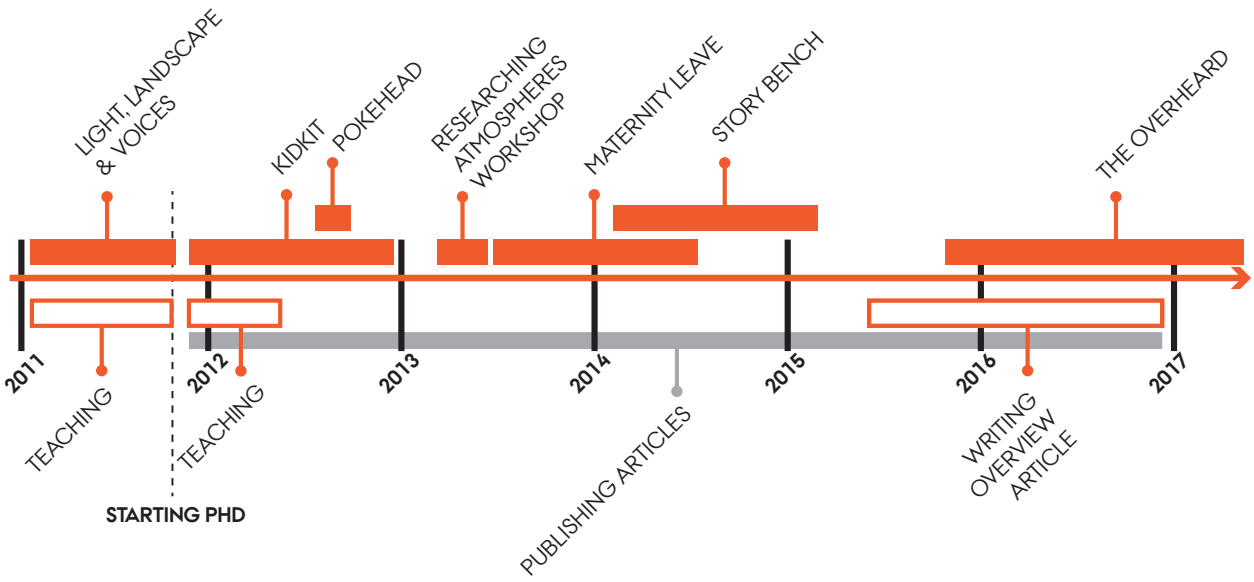

Figure 5: timeline of PhD project

The overall PhD process reflects the iterative process of experimental design research based on the three overall phases (presented in section 7.2). Parts I and I represent the motivational phase, in which the research context, hypotheses, and research questions are developed, together forming the *entrance level* of the experiments and evaluations presented in Part III. The overview article could give the impression of a chronological process from motivational context and hypotheses to experiments and evaluation. However, this process has been an ongoing reframing, questioning and challenging the different phases of the process. As such, the three phases of the experiment inform each other through out the process, and the experiment serves as the driver that facilitates exchange and challenges the hypotheses and research questions, facilitating a reframing. The experiments are happening continually as vehicles for responding to and reframing the foundation of the research. In other words, practice is considered a valid way of discussing a research problem, comparable to writing about it, and thus not as a way of unfolding theory through practice.

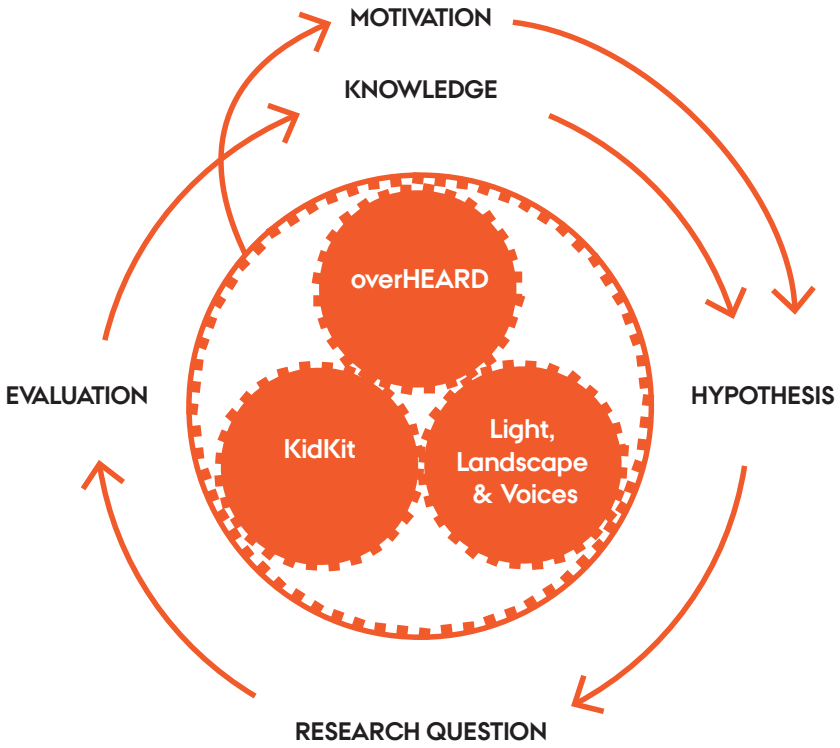

Figure 6: Research process

Concerning the criteria for grounding and reflecting upon findings from research conducted through practice, Mackay & Fayard suggest triangulation, covering the development of both theoretical, empirical, and practice-based perspectives on the same subject matter in order to get multiple perspectives and thus a more comprehensive understanding (Mackay & Fayard, 1997). I have applied this type of triangulation in my experiments, where the practice-based perspective is combined with qualitative data collection and theoretically founded discussions on the research question addressed. In addition to experiment-internal triangulation, I have also strived for triangulation on the level of the overall research project by applying the expanded three-phase structure suggested by Bang et al. to the overall research project. In this way, I have sought to expand the *entrance level* of the experiments with empirically and theoretically grounded motivational contexts presented in Parts I and II, allowing me to discuss the experiments and their knowledge contribution within the context of the overall research project. Thus, the methods and strategies chosen for the experiments in Part III are applied on the basis of informed reflection upon the overarching research aim. The value of such triangulation is not simply its ability to eliminate bias, but to openly present the research agenda and, through multiple perspectives, to offer opportunities for gaining and presenting richer understandings of the field of inquiry.

I chose to engage in artistic research at the preliminary stage of my project through the first experiment [P3]. Engaging in artistic research allowed me to explore practice-based work as a way to let the material, technology, and other objects help discuss and articulate how atmospheres and overhearing can be understood as attuning and ecological concepts. The experiment was not made in the hospital context, as the aim was not to address a

specific problematic situation, but rather to develop and discuss the *attuning approach* through practice. This process can therefore be considered part of the *motivational phase* and thus the *entrance level* of the next experiment, in the sense that it helps specify the research questions, challenging the motivational context. Furthermore, the process of working with *Light, Landscape and Voices* called for a discussion on the status of knowledge in artistic research in general as presented in [P6]. In the following stage I engage in constructive design research through *KidKit* [P1]+[P2] as a way to explore the specific hospital context, addressing a specific *wicked problem* based on an *attuning approach*. I chose to engage in constructive design research in this experiment because it allowed me to further flesh out how we can facilitate empowerment and *ecological overhearing* through approaching atmospheres as relational, temporal, and dynamic and transform it into a knowledge contribution relevant to the field I approach. As a continuation of this work I am now engaged in *The Overheard,* where experiments with the audio satellites in [P4] is a way to further explore empowerment and *ecological overhearing* through practice-based experiments.

Taken together my experiments can be characterized as *comparative*, as they explore the same subject by means of several experiments working toward a shared platform of comparison that covers different areas and subjects not yet dealt with in other experiments, and incorporating knowledge from earlier experiments. This is one of five design methodologies coined by Krogh, Markussen, and Bang labeled *accumulative, comparative, serial, expansive*, and *probing* (Krogh, Markussen, & Bang, 2015). This typology of design experiments acknowledges the role of drifting, embracing the fallibilistic quality of knowledge production in a practice-based world. The aim of the comparative experiments is to describe a novel concept, qualify phenomena, or add theoretical distinctions to known theory. A key word in this model is *acknowledging complexity*, which expresses the idea that the design experiments explore a concept by pointing to how it is embedded in a multiplicity of situations. The different methods employed in the included papers have each been subjected to peer review and discussions in academic forums such as conferences and journals. In this light, I have chosen to use the overview article to consider my research approach and the results it has yielded, instead of summing up the papers in length individually. There are many ways to approach the experience of noise in hospitals through the lens of atmospheres. My choice of artistic and constructive design research holds specific potentials, but also limitations. From the outset my working hypotheses are phrased in a certain way, which in turn affects the ways in which one can reply to them and the types of answers they can lead to. It is *wicked* in the sense that it is impossible to imagine an exhaustive answer, and it will consequently always be dependent upon the specific situation. Even though I explore distinct experiments, it is possible to identify patterns and general themes. However, there are limits to the specificity of these replies when addressing a wider range of cases. Therefore, I have refrained from establishing exhaustive models or dictums, and instead chosen to articulate considerations and sensibilities. It can thus be seen as experiments that lead to a particular type of insight valuable in understanding complex situated practices, but not applicable as general solutions or recommendations. According to Flyvbjerg, such experiments are highly valuable alternatives to predictive theories and universals, as they offer concrete context-dependent knowledge (Flyvbjerg, 2006, p. 224). He argues that it is often not desirable to summarize and generalize such experiments, as they should be read as narratives in their entirety. I support the notion that it is important to consider the case study a narrative on its own premises, and also find

great value in having a research question, expanding the frame beyond the singular experiment in order to gain richer understanding of the subject matter by comparing different experiments and methods.

I will not offer detailed descriptions of the artistic and design processes and techniques in this overview article. To the extent that they have been employed to generate research findings they have been treated in the papers in the particular context in which they have been used. Instead, the discussion of the experiments in this part of the thesis focuses on how an *attuning approach* can be discussed and unfolded through practice-based experiments in the light of my overarching research agenda. In the next chapters I will therefore show how the papers respond to the research questions and hypotheses in order to discuss and better understand the multiple and shifting relations between humans and the *soundscape* in the hospital, and to point to ways of operationalizing this knowledge in practice through attuning strategies. While some of the papers contain inquiries, analyses, and discussions framed by the key concepts of *attuning, ecological overhearing*, and *rhythms* others use alternative concepts. This is due to a combination of factors: (1) The *attuning approach* has emerged through my ongoing involvement in and reflection upon the experiments; (2) the papers are intended for varying audiences and adhere to different journal requirements and standards, and (3) some of the papers bring several strands of theory into play in order to gain a richer understanding of the subject matter.

CHAPTER 8

LIGHT, LANDSCAPE AND VOICES

As part of the *motivational phase* I engaged in artistic research through *Light, Landscape and Voices* (*LLV*) as a way to discuss and challenge the *attuning approach* through practice, focusing on the three hypotheses and research questions. *LLV* is a mixed media project engaging six municipalities around Aarhus in a large-scale cultural project over a period of two years with the aim of giving local citizens a possibility to experience and participate in innovative and interactive art outside Aarhus (as the largest city in the area). In the spring of 2011 a caravan converted into a mobile recording studio traveled the six municipalities, where local people were invited inside one by one to read parts of Inger Christensen's poem *Lys [Light]* (Christensen, 1962) aloud. The participants were informed that the recordings would be transformed into an outdoor installation for them to experience some months later at a specific location in their area. 758 voices were recorded and transformed into a site-specific piece for 24 outdoor speakers unfolded over six evenings in September 2011, starting at 6 p.m. and ending at midnight, accompanied by a green laser beam. The presentation of *LLV* consisted of six different parts, each six hours long, at each of the six sites, consisting of the voices from that specific area and chorus parts with voices from all the areas (see video documentation at www.lysogstemmer.dk).

Figure 7: Collage of photos from LLV, photos: Sune Hede and Steen Stuhr

8.1 A DEAFENING SILENCE

In the iterative prototyping phase several experiments sought to identify the appropriate framework for the recordings of the poem. The focus in a traditional recording situation is to minimize overhear as much as possible to enhance the sound quality of the recording.[42] However, this atmosphere of absence amplified the unfamiliar situation and feeling of being out of place for the test participants during the development phase, described by one of the test persons as a "deafening silence".[43] In everyday language deafening silence refers to a striking absence of noise, which takes on its own quality of absence. The perceived silence in the recording room is thus not a simple qualia related to listening, but a complex atmospheric qualia filled with motor and synesthetic suggestions (Griffero & De Sanctis, 2014, p. 16). In this sense, the powerful atmosphere of absence becomes an emotional and corporeal obstruction, which cannot be traced to discrete cause stimuli or to the merging of the five specific senses; instead it denotes the possibility of a synesthetic significance that is immediately given on the sense level. The test persons highlighted such a synesthetic feeling of not being able to act or not having the space to get into the right atmosphere for reading aloud. This created a situation where the seamless state of perception action was radically limited due to an obstruction of the perceiver's capacity to intervene in, or act upon, the immediate environment, as is often seen in the hospital (see Chapter 4).

In this sense, the lack of *ecological overhearing*, as a general atmospheric way of connecting with and orientating oneself in the environment, matters as a multisensory atmospheric absence. Anette Stenslund describes a similar experience from her fieldwork with hospital atmospheres and smells in her theoretical conceptualization of the *presence of absence*. She notes how the general "whiteout" of smell in the hospital has phenomenological significance, as it was acted and reacted upon as a sense of longing, isolation, disconnection, and cleanliness (Stenslund, 2015, p. 341). Her conclusion is thus comparable with the experience of deafening silence, in that both take on a significant atmospheric presence highlighting that "to count for nothing does not necessarily imply being of no importance" (Stenslund, 2015, p. 356). This important insight would remain a blind spot for the existing framework's focus on measurable and subjective accounts, which tended to overlook such absences. First, a decibel measurement would show such atmosphere to be quiet, which would most likely be due to our cultural understanding of quietness as healthy and associated with a good atmosphere (see Chapter 3). Secondly, there is a lack of words or language to describe such absences, as we tend to overlook them (Stenslund, 2015, p. 343). Stenslund refers to Severin Fowles' reflections on how we tend to have a bias toward presences and equate absent stuff with low value (Stenslund, 2015, p. 345). On a similar note, Flatley refers to Heidegger's concept of *Ungestimmtheit* (Heidegger, 1993, p. 134) suggesting that "precisely *those* attunements to which we pay no heed at all, the attunements we least observe, those attunements which attune us in such a way that we feel as though there is no attunement there at all, as though we were not attuned in any way at all – those attunements are the

[42] As highlighted in [P3], the pursuit of unmediated engagement with the sonic material of the voice in itself is an expression of the high fidelity paradigm of recording studio practices.
[43] Test person Lene Mailund commented during the tests: "The deafening silence in the recording situation enhanced my feeling of being in a very awkward and unfamiliar situation. I am not use to reading poems aloud. I would prefer a lighter and less serious atmosphere, where I could feel at home and secure, if I were to feel comfortable during the reading."

most powerful" (Flatley, 2008, p. 22). As such, the lack of *ecological overhearing* becomes an oppressive force that enhances the reluctance to create sound, which would mean breaking the deafening silence. I therefore searched for ways to counteract the powerful atmosphere of absence in the recording situation by facilitating an alternative atmosphere.

8.2 AFFECTIVE COUNTER-ATTUNEMENTS

To avoid being taken over by atmospheres of absences, we must, according to Heidegger, do our best to exert agency in relation to these atmospheres. As atmospheres are mostly something we are not aware of, something affective and thus prior to will and cognition, such agency must be exerted tactically in a mediated fashion. As we cannot simply decide to delete such attunements, Heidegger suggests that we must negotiate resistance through *Gegenstimmung* or *counter-attunements* (Heidegger, 2002, p. 136).[44] Resistance in this context might thus be framed as a policy of immanent *counter-attunements.* However, according to Heidegger, a *counter-attunement* can only emerge if it resonates with the existing attunement, due to its affective character. In this sense, the *counter-attunement* needs to catch the existing attunement, if the involved are to be affected by the *counter-attunement*. In this way, facilitating *counter-attunements* demands a disjunction between one "there" (existing attunement) and another (*counter-attunement*). *Counter-attunement* can thus only be achieved by creating an object of affective attachment in the existing attunement that challenges it from the "inside". Flatley suggests how such objects of affective attachment can be brought into being by drawing on Daniel Stern and his identification of *affective attunement* between parent and infant (Flatley, 2012, p. 504). In the interplay between parent and infant mirror expressions are essential building blocks in the infant's experience of intersubjective relatedness and communion with the world and other humans (Stern, 1998, p. 138). The infant's capacity to be affected and to affect the world thus depends on the parent's ability to engage in *affective attunement* in the first years of life. Characteristic of *affective attunement* is that this mirroring cannot be based on identical mimicking, but must give the impression of imitation, though translated into similar gestures in other modes or senses, e.g. from sound to movement. The cross-modal aspect is important because it shows the infant that the parent not only understands what the infant does, but also how it feels, and therefore the cross-modal attunement is focused not so much on the outside behavior of the infant, but the quality of the inside feelings. Due to its cross-modal character, *affective attunement* happens by way of *amodal*[45] *equivalences* such as intensity, shape, and time (Flatley, 2012, p. 516). According to Stern, we are rarely aware of *affective attunement*, and it creates shared experiences of being together as individuals in the same world. It is thus the existence of these abstract representations of *amodal equivalences* that permits us to experience a perceptually unified world (Stern, 1998, p. 142). Flatley suggests that objects of affective attachment can therefore be brought into being through *affective attunement* by getting close to patterns of intensities and rhythms between the involved in order to create a sense of being-together. Flatley concludes that promoting *affective attunements* through sensible exposures and rhythms can therefore facilitate *counter-attunements*. Through these exposures a *counter-*

[44] Often translated to *countermoods* (see e.g. Harman, 2013, p. 68; Flatley, 2009, p. 5). However, I chose *counter-attunement* to highlight its relation to attunements as a translation of *Stimmung*.
[45] The term *amodal* covers how certain aspects such as intensity, shape, and time are not connected to one specific modality, but are shared and can be expressed across all modalities such as hearing, seeing, and tasting (Stern, 1998, p. 152).

attunement is invoked, making new actions and behaviors attractive and compelling. However, Stern clearly states that the aim of most *affective attunements* is *not* to change the feelings of the infant, but instead to be with the infant, sharing the same feelings, as expressed in his first category of attunements termed *communing attunement.* Thus, Flatley's suggestion that *affective attunement* can set the ground for *counter-attunements* needs to be revisited. For that purpose, I propose to turn the attention to Stern and his second category of attunements termed *purposeful misattunement* or just *tuning*. When a parent engages in tuning, the aim is to be with the child through *affective attunements*, but then to change the level of activity or affect through intentionally over- or under-matching the intensities, timings, or shapes of the infant. Such tuning demands that the parent "slips inside" the infant's state of feeling "far enough to capture it," but that he or she then misexpresses it enough to alter the infant's behavior, "but not enough to break the sense of an attunement in process" (Stern, 1998, pp. 148-149). I argue that this two-way process corresponds to Heidegger's claim that to set the ground for *counter-attunements* we need to first capture the existing attunement. Second, Heidegger's idea of disjunction by offering a new object of affective attachment in the existing attunement corresponds to Stern's concept of *tuning* as a way to intentionally change the existing attunement by slightly over- or under-matching the *amodal equivalences.* I would therefore argue that to counteract atmospheres of absences, as in the case of the deafening silence in the recording situation of *LLV*, it is not enough to offer opportunities of *affective attunement* through sensible exposures to create a *counter-attunement.* Facilitating a *counter-attunement* requires a two-step process of first capturing the existing attunement by getting close to the existing intensities and then offering a process of tuning, where a *purposeful misattunement* happens by way of over- or under-matching the existing intensities. This *tuning* process would then create the needed disjunction between the existing attunement and a new *counter-attunement,* which would open up for new actions and behaviors. I therefore suggest *shared rhythm*[46] as an overarching *amodal equivalence* that can accommodate intensity, time, and shape and both steps of the two-way process of establishing *counter-attunement.* First, the process of capturing the existing attunement can be understood through the emergence of a *shared rhythm* between parent and infant based on intensity, shape, and timing. There are different internal *rhythms* "in" parent and infant, but *shared rhythm* is a relational attuning concept always involving more than one entity. The *shared rhythm* that emerges in the interplay between parent and infant is thus a necessary precondition for the subsequent *tuning* process, where the individual *rhythms* are over- or under-matched by the parent. In this way my concept of *shared rhythm* lies in direct continuation of Henri Lefebvre's term *rhythmicity*, which will be developed in the next chapter. According to Lefebvre a *rhythms* demands more than mere repetitions in a closed system, but relies on differences within repetitions. On this view there is no *rhythm* "in" a perfectly iterative repetition unresponsive to outside effects, instead *rhythms* to Lefebvre are the relational conjunctions of individual rhythms and other rhythms, similar to my concept *shared rhythm* (Lefebvre, 2004, p. 90).

Flatley and Stern primarily investigate *affective attunements* between people and social groups, while I am interested in how we can facilitate or design for *counter-attunements* in a much broader network of relations between humans, non-humans, objects, technology, spaces, etc. I therefore looked to key figures in the field of

[46] Defined broadly as regular, repeated patterns of sounds or movements.

atmospheres, searching for existing strategies to change atmospheres intentionally by way of *affective attunement.*

8.3 DESIGNING ATMOSPHERES

A few key figures in the field of atmospheres such as Thibaud and Timothy Endensor have proposed concrete operative modes of action in practice aimed at changing existing atmospheres. Thibaud suggests operative modes aimed at setting the tone of territories by installing and transforming atmospheres by "structuring time and space" (Thibaud, 2015, p. 45) or to "endow an environment with a certain character, a specific mood" (Thibaud, 2015, p. 41). Edensor suggests similar thoughts when he describes how the environment can facilitate "spatio-temporal patterns" that can help to integrate us anew and thus "reconfigure presence in a changed or unfamiliar space in order to regain ontological security" in situations where the usually unreflective sensual and rhythmic attunement to place and familiar space may be confounded (Edensor, 2016, p. 5).

However, the suggestions for concrete strategies do not point out clearly how the relational view found in the non-representational theoretical foundation where e.g. time and intensities are dependent on embodied perspectives and not something we are "in", are to be integrated into these solutions (see Chapter 6). Instead, the proposed strategies seem to indicate that our surroundings can be designed with certain inherent patterns and rhythms, somehow independent of the embodied circumstances of the involved entities. Similar to my analysis in Chapter 3, I therefore argue that the concrete strategies for unfolding an aesthetic of atmospheres in practice offered in the field remain problematic, if they are not based on *affective attunement,* but *physiognomy* as the dominant paradigm, as this will most likely reduce them to *stage-setting*[47] due to *duomining*.[48] From the perspective of *affective attunement* "installing" an atmosphere via *stage-setting* or facilitating spatio-temporal patterns "in" the environment will most likely miss these relational conditions and, therefore, potentially fail to "catch" the person involved, as it will not attune to the person's existing attunement and thus cannot set the ground for *affective attunement* leading to *counter-attunement* through shared *rhythms.*

According to Lasse S. Liebst, theories of atmospheres often operate with an implicit ontological assumption about where (not) to go searching for the atmospheric essence – either "in" the human or "in" the ecstasies of the objects, which will result in aesthetic universalism linked to an underlying phenomenology incorporated in the concept of atmospheres. From this perspective the discrepancy between the theoretical non-representational framework and the operative strategies based on *physiognomy* is linked to a failure to account for its operative ontological conditions. To account for this shortcoming, Liebst argues that there is a need to break with the implicit first-person perspective through a post-phenomenological change of perspective. As a consequence, he

[47] See e.g. Gernot Böhme's article "The art of the stage set as a paradigm for an aesthetics of atmospheres" (2013) available online at https://ambiances.revues.org/315 (accessed 11 November 2016).
[48] The paper (Højlund & Kinch, 2012), which is not one of the included papers, exemplifies such perspectives stating that: "Dalsgaard et al. (2009) suggest an expanded notion of the Böhmian atmosphere related to HCI practice, by supplementing the notion of atmospheres to encompass technological, social and temporal concerns. Concerning temporality they highlight that the atmosphere should be constructed as a processual and not static phenomenon *'implying that the dimension of time is essential to understanding atmosphere'* (ibid). The temporal aspects are not further articulated, as it is sub-ordered in more palpable concepts such as space and technology." (p. 230).

suggests, *morphology* rather than *physiognomy* is the vital condition for the emergence of atmospheres (Liebst, 2012). The decisive aspects of the space are thus the structural and morphological attunements between the objects involved, human as well as non-human, rather than its architectural physiognomic forms or the *stage-setting*. His approach still takes a phenomenological point of departure in the actual situation, but with a new emphasis on the configurations and properties forming a structural condition for the atmospheric emergence of practices and experiences. Here reality is not – as in phenomenology – dependent on the "intentionality" of consciousness of humans. Rather it is given in the affective intensities of reality through qualitative experience (Liebst, 2012, p. 7). Liebst therefore argues, referring to Gilles Deleuze, that if we are to understand or design atmospheres, we have to penetrate these conditioning intensities that give the phenomenologically given its extensive quality.

Continuing in the same vein, Ash and Gallacher argue that taking the concept of attunement seriously encourages us to concentrate on relations between body and world as a process of material exchange, translation, and differentiation between a variety of human and non-human objects, rather than a gathering and organization of forces by human perception or cognition (Ash & Gallacher, 2015). According to Ash & Gallacher, this requires a shift in our methodological imagination and the vocabularies we use to express that imaginary. If we make non-human objects – such as technology – central to our sensory experience of the world, it becomes possible to describe and analyze sensory experience in ways that do not begin and end with experiences as organized by an autonomous human subject. He argues that post-human methodology could be used to analyze how bodies engage with an environment that does not prioritize or privilege individual human senses over a vast array of non-human objects that shape and enable these faculties. From this perspective, understanding what it means to be attuned is a matter of understanding the transmission of energy between material things and how they shape the body in ways that are not reducible to the perceptions that appear through specific sensory registers (Ash & Gallacher, 2015, p. 70).

Referring to both Liebst and Ash & Gallacher, I therefore argue that a break with an anthropocentric focus is necessary if atmospheres are to become a useful theoretical and philosophical field relevant to practice. Subsequently, I suggest that to counteract atmospheres of absences we must get close to the conditioning intensities and transmissions of energy as *affective attunements* through *shared rhythms* between a vast number of human and non-human entities. This could make it possible to design for *counter-attunements* by way of the two-step process of both capturing the existing attunement and *tuning* it through *purposeful misattunements* by over- and under-matching the *rhythms* between the involved entities. Therefore, [P3] explores the consequences of breaking with the human-centered focus in order to listen to the *affective attunements* in a broader network of human and non-human entities through practice. For this purpose, [P3] subscribes to a *dark ecological approach* (connected to a speculative realist and *object-oriented ontological [OOO]* branch of philosophy).[49] *OOO* wishes to break with *correlationism*, a term used to describe how *being* exists only as a correlate between mind and world, placing humans at the center (Harman, 2010a). Therefore, based on phenomenological thinking, *OOO* breaks with its fundamental focus on human perception and suggests that "one must abandon the belief that human

[49] For a presentation of central perspectives within OOO and speculative realism see [P3] pp. 249-251.

access sits at the centre of being, organising and regulating it like an ontological watchmaker" (Bogost, 2012, p. 5). The philosophical perspectives of *OOO* can be situated within a larger frame of non-representational theory (as presented in Chapter 6). Non-representational theories build on a principle of relationality, in that they seek to give the same conceptual and empirical weight to object-human relations as to human-human relations. Thus, non-representational research privileges the study of relations and affective resonances, as life is believed to emerge from the entanglement of actors.

8.4 COUNTER-ATTUNEMENTS IN LLV

[P3] suggests the term *wavefront*[50] to strengthen the focus of *attunemen*t on how materiality behaves, interacts, develops, is manifested and translated through other objects, both human and non-human. Shifting from *attunement* to *wavefront* also demands a re-evaluation of the aesthetic dimension, as put forth by Timothy Morton. He suggests that the aesthetic dimension is not solely something that occurs in the human mind; instead it incorporates all causal events that take place in and between objects. An expanded form of causality is then integrated within a new view on aesthetics, claiming that causality is the aesthetic dimension produced by the interaction between objects (Morton, 2013b, p. 64). In the aesthetic dimension we attune to other objects, translating them into our own "language" by way of *affective attunements* shaped by our own capacities and habits. It is therefore in the aesthetic dimension that objects are affected or moved by other objects, resulting in aesthetics becoming "first philosophy" (Shaviro, 2014, p. 70). Steven Shaviro argues that we therefore cannot "know" or "exhaust" other objects epistemologically (hence, Harman's "vicarious causation"), as there is a level of being beyond the epistemological, where objects affect each other without ever becoming "known" (Shaviro, 2014, p. 106).

Morton describes how these translational processes are always inconsistent and flawed. He suggests that the inconsistency of the attuning processes between objects reveals how all entities are always fragile, as they are ontologically riven between their withdrawn essence and their appearance for other objects (Morton, 2013b, p. 56). Within the realm of sound, the *rift* can be understood as the medium or mediation between the essence of the sound and its appearance, which is meaningful in relation to how the speed of sound changes depending on the material that mediates it. This makes it impossible to grasp the essence of a sound without its mediation, suggesting that it is impossible for the sound object to be without its mediation. According to Morton, our normal experience of reality is therefore an illusion, albeit a real illusion, as the aesthetic dimension is the causal dimension, and we therefore often believe something to be an object when it is actually just its appearance, habituated to our own normalizations (Morton, 2013b, p. 143).[51] Morton therefore calls for an *ambient poetics* that can help reconfigure and break these habituated experiences by facilitating a different *here* and *now* being evoked and sustained for a while. In Morton's notion of the ambient, the environment comes forward from the

[50] As described in [P3] a wavefront is a continuous line or surface including all the points in space reached by a wave or vibration at the same time as it travels through a medium. The movements travel with a velocity that is appropriate for the medium in which the wavefront exists.
[51] Like the experience of wrongly identifying something based on a sound only and then learning that this was in fact the sound of something completely different.

background, when e.g. art explores the fragile materiality of objects (Morton, 2010, p. 107). Through *ambient effects* art can create the illusion that, for a fleeting second, there is something in between (Morton, 2007, p. 50), an understanding that challenges the concepts of ambient and atmosphere as something that just sits there ready for human perception (Morton, 2013b, p. 71). This ambient does not take place in a space and time container that has already been established; instead, it pours or radiates from the tension of the *rift* between essence and appearance, establishing the notion of *interobjectivity* (Harman, 2010b, p. 150; Morton, 2013b, pp. 35-66).[52] Thus, there is no environment in which objects float; instead, time and space are emergent properties of interacting objects. Therefore, objects *space* and *time* each other, not unfolding *in* time and residing *in* space. Morton's idea of the ambient and *interobjectivity* might therefore be able to pave the way for *counter-attunements* created by *shared rhythms* beyond human-human relations. To test this idea *LLV* [P3] explores the potentials of engaging in a practice where *affective attunement* between entities takes center of attention. Here sound art practice is appropriate due to its focus on attunements between spaces, objects, and ears (see [P3] pp. 251-252 for a discussion of sound art and music) forming a structural and atmospheric condition for the emergence of practices and experiences. Through several workshops we therefore experimented with different ways of facilitating *counter-attunement* by getting close to intensities through *ambient effects* by way of *shared rhythms.*

As described in [P3] the participants entered the caravan one by one; inside all they could see was a microphone and a button placed on the floor. They were informed that the recording of their voice reciting the poem would start when they stepped on the button. During the reading the input of the voice transformed large digitized landscape drawings of the sites in real time on a semitransparent screen in the middle of the caravan. The voice input made the drawings emerge from nothing, magnifying how the voice vibrated the landscape. Furthermore, a convolution reverb made at the site was added to the voice and played through speakers in front of the participant, mixed with a non-edited outdoor field recording also from the site.[53] Starting with the vocal delivery reverses the normal way of understanding a poem – interpretation before performance – as the participants were allowed no time to prepare. The vibrating landscape drawings excited by the voice made the participants aware of the shape and size of the space around them; to *voice* is also to *room* (Morton, 2007, p. 48). Furthermore, to *voice* is also to *time* through a rhythmic causality that emerges between voice and the algorithms of the landscape's transformations. The sensual aesthetic appearance of an object to another object emerges, dissolving the landscape as a neutral background for humans to act upon. The *interobjective* causality organizes space and time in a very literal and visual way in the caravan. We lose the words and hear the room, as voice and room are mutually determining; one does not precede the other.

The convolution reverb, the interactive landscape drawings, and the field recording act as *ambient effects,* the dual purpose of which is to underline the strangeness of listening and seeing your own voice interact, and also to create the illusion of a *here* and *now* that emerges from the causal relationship between the objects involved. This ambient illusion demands engagement and, in doing so, motivates participation, as there is no previously

[52] In *OOO* terminology the word *interobjectivity* replaces *intersubjectivity* in an extension of the traditional phenomenological vocabulary to include non-human entities.
[53] For a video documentation of the interaction between voice and drawings, see https://vimeo.com/24911427#

defined background or foreground, only a coexistence that emerges from the *interobjective* translations. The choice of introducing these *ambient effects* as a deliberate overhear in the caravan runs counter to normal recording practices of minimizing overhear from other objects as much as possible. It also points to the importance of regarding the aesthetic as something that emerges in the causal relationship between objects. The *amodal* mirroring between the voices and the vibrating landscape drawings sets the ground *for affective attunements* that facilitate a new ambient *here* and *now* or counter-attunement. This *counter-attunement* is counter to the expectations/experience of a normal recording session and thus counteracts the described feeling of being incapable of acting due to an oppressing atmosphere of absence. The transformation of the 758 voices into a site-specific piece for 24 outdoor speakers represents a continuation of the ambient translations in the caravan. The renderings of the timbral voices through the recordings have a strong ambient effect, pointing to the very medium of the voice itself and the recording as a recording. This undermines the normal distinction between the recording medium as a background and the voice medium as a material physicality in the foreground. In Danish and German this *tuning* of the ambient and the voice is present in the word for voice (*stemme/Stimme*) and correlates to the word for the atmosphere of a room (*stemning/Stimmung*). Both words refer to tuning as the way objects vibrate each other, as we represent the environment of other objects. Therefore, the timbre is not changed in post-production with wet effects such as reverb.

The transformations of the recordings are created through temporal and spatial negotiations between voices and algorithms within *Max/MSP.* The algorithms translate the recorded files through predefined parameters, both in the recordings and in the software, by placing up to 15 cues in all the voice recordings, according to the same parts in the different readings of the poem, different algorithms can be executed with different patterns. The algorithms execute both spatial patterns in the 24 speakers simulated in the software and a temporal unfolding of the voices triggered by the cue numbers.[54] The algorithms build on repetition and suspension, which play with familiarity and difference. Meeting repetition and rhythm through voices and speakers gives us an opportunity to face our own artificiality projected onto the outside world; the voices of the anonymous speakers become stranger through repetition and layering. The changing rhythms and repetitions present a kind of moving without moving by being suspended in the framing of an illusionary *here* and *now*. These sampling translations interrupt the flow of a prototypical chronological reciting of the poem from beginning to end, making us aware of the ambience *around* the poem. Through this inclusion of unintention, the inclusion of silences, pauses, and coughing evokes the illusion that the piece works by itself. The voice transformations are accompanied by rhythmically organized sound samples recorded at the site (e.g. wind in trees, birds singing, planes passing, pebble being stepped on, cars driving on pavement) as well as notes played on an old piano that is out of tune and prepared with multiple objects from the sites. This accompaniment seeks to get close to the intensities, rhythms, and structures of the recordings, as it is not the intra-musical parameters or harmonic concerns created by the composer that structure the sequences, but the intonation and rhythms of the voice transformations. Thus, the rhythmic patterns are not set as a fixed tempo or time signature beforehand, but emerge in the interplay between the rhythms of the voices and the rhythms of the sound samples. Likewise,

[54] Listen to stereo renderings of algorithms executing voices in different temporal and spatial configuration: https://soundcloud.com/marybell/1-lys-chorus, https://soundcloud.com/marybell/1-lys-delay, https://soundcloud.com/marybell/1-lys-repeat

arpeggios played on the sampled, prepared piano are structured through listening to the intonations in the cacophony of voices without a pre-prepared melodic and harmonic progression or based on a fixed key signature.

The presentation of *LLV* is divided into six six-hour parts from the six sites, each consisting of the voices from that specific area and chorus parts with voices from all the areas. The presentations unfolded over six evenings in September 2011, starting at 6 p.m. and ending at midnight, accompanied by a green laser beam. The 24 speakers were designed and built for the project in conjunction with *Dynaudio*. When the speaker was activated, a circle of LED lights illuminated the opening from which the voices could be heard. The speakers were designed in such a way that they would come forward from the background as *speakers* – that is, objects with their own physicality and translations – and thus become sculptures that co-defined the presentation sites. Therefore, the general observation that familiar objects tend to fall into the habituated background was challenged by the unfamiliar design of the speakers, provoking an awareness of the speaker as both object and environment. Unlike normal concert practice, the length of the pieces was attuned to temporalities in the landscape, the weather, and circadian rhythms. During the evening the sites transformed into an uncanny darkness, covering rather than discovering the poem and the voices. This covering was also represented in the voices, which changed over the evening, from high-pitched children in the beginning to grown women's voices at dusk and deeper male voices in the dark, pulsating the voice-activated light of the speakers. By presenting the anonymous voices that originated from and reconnected to the specific area, the local not only became the familiar, the familiar also became strange. The voices through the translations of the recordings, the algorithms, and the speakers spread out over a large area made it difficult to maintain an aesthetic distance to the landscape as a background. This challenged the dividing lines that we normally draw between nature, subject, and objects. Approximately 5,000-6,000 people visited the sites in the course of the six evenings, making their own compositions while walking around, sitting, or lying down, thereby defying the idea of a perfect sweet spot created for the listener. The piece is not primarily about human internal interpretation of the meaning of the poem, but about creating a "musical-social space for a while (hours and days) in which the project of attunement to the nonhuman is performed" (Morton, 2013a).

8.5 TRANSDUCTION

Reflecting on the knowledge gained from the experiments in *LLV*, [P6] argues that practice-based research should not be concerned with reducing phenomena and objects to consistent knowledge formations, but should instead turn to the inconsistent attunements within and between the objects in question. Steven Shaviro underlines that such perspective should be understood as:

> "The diametrical opposite of the 'naïve' assertion that things in themselves are directly accessible to us; the key point, rather, is that the world itself – the world as it exists apart from us – cannot in any way be contained or constrained by the question of our *access* to it. 'Man' is not the measure of all things. We habitually grasp the world in terms of our own preimposed

> concepts. We need to break this habit in order to get at the *strangeness* of things in the world – that is, at the ways that they exist without being 'posited' by us and without being 'given' to or 'manifested' by us." (Shaviro, 2014, p. 66)

Based on [P3], [P6] therefore suggests that the implicit human-centered perspective present in the existing understandings of knowledge production in artistic research must be expanded to encompass non-human forms of knowledge to get closer to these *affective attunements* in a broader network of entities. [P6] develops *transduction* as philosophical lab equipment or a research method similar to *carpentry*, as outlined by Ian Bogost, this being the practice of asking and exploring philosophical questions through artistic practice and performance (Bogost, 2012). Carpentry is thus transferred to the sounding arts through the conceptualization of *transduction,* evolving into a special branch of carpentry that offers both a physical and philosophical framework that can incorporate the translational, relative, and fragile workings of sound. On the one hand, *transduction* is an inevitable part of physical sound transmission, as it is always translated, converted, modulated, transformed, and transduced through different media, be it a microphone, an ear, or a loudspeaker. On the other hand, transduction offers a powerful way to think about the infrastructures through which the vibrating world is apprehended. We never hear the transducer itself – neither do the human's ears, the projector's metal structure, nor the wooden floor grasp the essence of the sounding transducer.

The thinking-doing mode of *transduction* presented in [P6] becomes important to understanding both the artistic (human and non-human) processes within sounding art, as in the case of *LLV*, but also as an initial contribution to the overall field of artistic research, because the framing proposed in this paper exemplifies and develops concrete implementations of how artistic research offers alternative forms of knowledge production. Thinking-doing across *transduction* gives us a construction that provides us with a theoretical framework in which the network and its relations become very central, but are also always negotiable and dynamic. E.g., time and space are constantly changing in relation to the medium through which sound travels – a perspective that can serve an intermediate function in increasing our insight into the sounding objects, which constitute our present auditory reality, by recognizing that they are not consistent entities exhaustible through human knowledge. In the present discussion about knowledge production in artistic research the proposed perspective forces us to coexist with a vast plenum of non-human objects. By taking this position we abandon the belief that we can distance ourselves from the world; and consequently our engagement with objects becomes not a matter of producing knowledge about the world, but instead an ongoing process of not-knowing or listening.

Engaging in *transduction* through *LLV* has revealed how *ambient poetics* can offer a path toward *counter-attunement* established through *ambient effects* by way of *shared rhythms.* Through the *shared rhythm* entities can then begin to *tune* the existing attunement differently in a process of over- and under-matching the *shared rhythms* by exploring the inconsistency and fragility of the translations between them. In this way, *counter-attunement* is achieved by breaking down habitual experience when the background comes forward, offering a new temporary *here* and *now*. The quality of the *shared rhythms* and, ultimately, the shared atmosphere is thus dependent on the capacities of both the humans and all other entities involved to engage in affective attunement.

CHAPTER 9
KIDKIT

Working with *LLV* [P3+P6] inspired me to look into the emerging field of *design anthropology* – as a bridge between artistic research and constructive design research – for the next experiment *KidKit (KK)* [P1+P2]. *Design anthropology* is concerned with the design of technologies that build upon and enhance embodied skills of people through attention to the dynamics between entities and the coupling of action and perception. *Design anthropology* thus focuses on the materiality, temporality, and relationality of design. Conceiving of users this way requires different ways of conceiving of, designing, and making things that "allow for people to develop skills (…). In doing so, a meaningful relation is made through use" (Gunn, Otto, & Smith, 2013, p. 2). I engaged in constructive design research, inspired by *design anthropology* in the experiment *KK* as a way to explore the specific hospital context, addressing a specific wicked problem based on the *attuning approach.*

Based on the insight gained in *LLV* the *attuning approach* should take into consideration that the creation of *counter-attunements* involves breaking down habitual experience through *affective attunements* by way of *shared rhythms* followed by *tuning,* the aim of which is to reconfigure background and foreground relations. The aim of *KK* was to further flesh out how this approach can be operationalized to facilitate empowerment and *ecological overhearing* in a specific situation in the hospital, and to transform it into a knowledge contribution relevant to the field I approach. In relation to the three phases of design research (as described in section 7.2) *LLV* functioned as the *motivational phase*, whereas *KK* engaged in the next two phases to make the knowledge from both experiments accessible to and arguable among peers through the *experimental phase* and the *evaluation phase.* During the experimental phase *KK* utilized the *attuning approach* in furniture as a program, based on a triad of a traceable genealogy (iterative design process), an intervention (transformation of situation), and an argument (knowledge in a form that is contestable to peers). In the evaluation phase data was collected through a multiple methods approach, combining observation, interview, contextual inquiry, and participant observation.

9.1 EXPERIMENTAL PHASE

9.1.1 Traceable Genealogy

The design research took place within the context of long-term activities in the neuro-intensive care unit (*NIA*) at *Aarhus University Hospital* in Denmark. *NIA* represents a typical neuro-intensive care unit in Denmark, where patients are hovering between life and death due to severe head and spine injuries. Each sterile ward has three beds; thus, each ward is filled with alarming sounds and staff in determined action. On the left-hand side of the main corridor is a small waiting room. Visitors often spend hours here, waiting for the right time to visit their relatives in one of the two wards, each holding six beds. The wards are located on the right-hand side of the corridor, each separated by a monitoring room with glass walls, where six to eight nurses and doctors constantly

monitor the patients. In addition to the ambient noise of conversations, equipment, computers, and phones coming from the monitoring room, the *soundscape* of the wards also includes the constant beeping of up to 15 alarms per bed, mixed with sounds from equipment that, when handled, can be quite loud. The sounds are not easily differentiated and emerge as a cacophony difficult to understand for others than the experienced staff. Therefore, the staff emphasizes that the *soundscape* of *NIA* represents the primary stressor of patients and visitors, who perceive it as both intrusive and alarming [P2].[55]

The design experiment evolved through iterative design processes and user studies and interviews to set the ground for the design choices, which had to meet high ethical standards.[56] Initially we used ethnographic observations in the ward and interviews with the staff to get a sense of the everyday problems they face. During the design process we discussed our concrete design suggestions with users: nurses and young children. In this process we discovered a growing wish among the staff at *NIA*, who wanted to motivate parents to bring their children to visit relatives based on the belief that it is important to involve children in the hospital stay of a relative in order to demystify the situation – fantasies are replaced by an experience of the actual situation. In addition, rather than feeling left out, the children might benefit from being included in the process. The nurses spent a lot of time informing relatives about the importance of this involvement, but more often than not relatives maintained the belief that the hospital environment was not suitable for their youngest children. Both the sick relative and the context of the hospital kept the parents from bringing their children. To understand how we might meet the worries of relatives facing such situations, this research investigated the bases of such skepticism and how we, in a respectful manner, can make hospital visits more child-friendly.

Nurses stressed that children brought to the unit had to be meticulously prepared in the waiting room for what they were about to experience, in particular concerning the many alarming sounds in the ward. The sudden shift in atmosphere from waiting room to ward often became an obstacle for a successful meeting with the relative. The actual change in atmosphere became the center of attention, even though all parties preferred this to remain in the background. Our main design challenge was to find an adequate response to this invisible obstacle between child and environment. The nurses typically tried to demystify the situation in the waiting room by drawing and talking to the children about the hospital apparatus. However, relevant tools for preparing the children in an appropriate way for the *soundscape* were lacking; it is difficult to communicate the effect hereof with only words and drawings. This often left the children standing frozen in the ward, as the unfamiliar sensorial impression inhabited the foreground of their attention, leaving no perceptual room for the meeting. Therefore, the wicked problem in this experiment was the nurses' lack of tools to prepare children for the alarming atmosphere experienced when visiting a hospitalized relative.

[55] See www.vimeo.com/62848306 to get an impression of the design context at *NIA*.
[56] For a detailed explanation of the different iterative phases of the design process see [P1].

Figure 8: Photos from NIA

9.1.2 Intervention

As a response to this situation the interactive furniture *KK* lets children become accustomed to the alarming sounds sampled from the ward while waiting in the waiting room. *KK* invites children to familiarize themselves with the alarming sounds they will face in the ward through the process of controlling and repeating them in an embodied and socially engaging way in the quiet waiting room. We seek to explore how introducing sounds from the hospital ward into the waiting room can be a helpful tool to facilitate a less stressful visit situation between the child and the hospitalized relative.

KK consists of five upholstered blocks, each with the dimensions 42 x 42 x 18 cm, stacked in two piles, where the topmost block in each pile is flexible. A touch interface is sewn into the surface of the topmost, green block. This interface consists of eight sound triggers made from touch sensors and a *Phidgets* board. Controlled by a computer, the alarming sounds, all recorded in the ward, are then played through a loudspeaker inside *KK*. The interaction refers to a well-known practice, where a push triggers an audio event as feedback, known from e.g. an audio sampler where sounds differ in rhythm, making the sequence more fun to play with.[57]

KK accompanies the child and nurse throughout the visit: from the waiting room to the ward and back again. After sitting in the waiting room the child can wheel *KK* into the ward, and through transforming actions it can be unfolded into a stairway, helping children to stand, at eye level, beside the hospitalized relative. The flexibility of KK allows for changes in form, and its interaction corresponds to the specific functions it serves during the different stages of the visit. *KK* is a fairly large piece of furniture, not a handheld device, because furniture physically relates both to body and space, thus emphasizing collective qualities. In this manner, *KK* creates a shared transitional space for the child, the relative, and the nurse helping them coordinate the visit. Furthermore, the size and materiality of *KK* challenge the child to be physically engaged, shifting focus away from the sudden shifts in atmospheres.[58]

[57] See audio trigger in use: www.vimeo.com/62849113
[58] *KidKit* in use http://vimeo.com/63073206

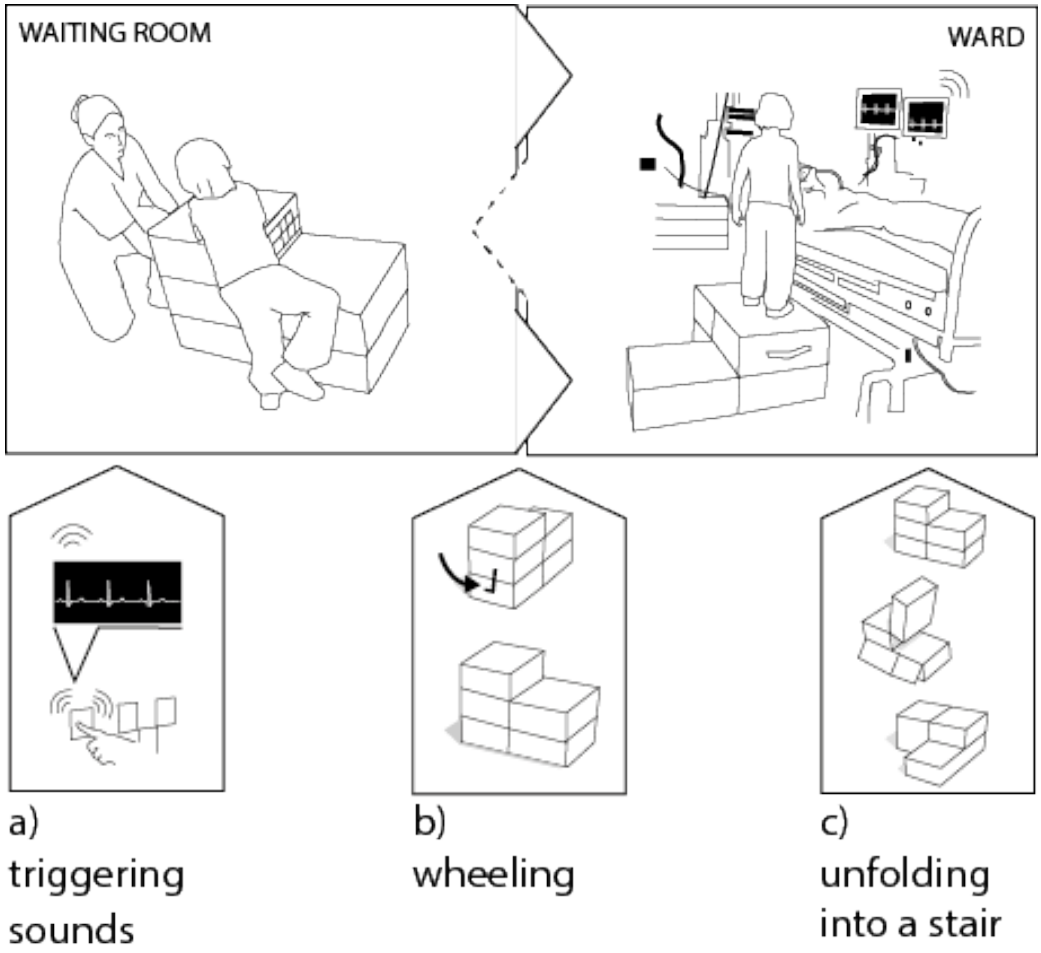

Figure 9: KidKit in different stages during a visit at the NIA

9.1.3 Argument

Following the insights from *LLV* this experiment approaches the atmosphere based on the rhythmic intensities conditioning the *affective attunement* of the visitors. This way of understanding *shared rhythms* changes the underlying presumption of the perceiver as merely adapting to the tonality of a place, and instead suggests that the atmosphere is not placed either inside or outside, but emerges in the shifting relation between the *shared rhythms* of the self, the other, and the environment. By continuing to focus on these different conceptualizations of *shared rhythms* in the design process and by understanding the basic dynamic identity of the atmosphere as connected to sound as a phenomenon, the temporal aspects become parameters accessible in the design process.

Henri Lefebvre uses *rhythm* as an analytical tool, describing how "everywhere where there is interaction between a place, a time and an expenditure of energy, there is rhythm" (Lefebvre, 2004, p. 69). The core concept of listening invites us to listen to the body, buildings, the environment in order to become more sensitive to these *rhythms* than to spaces, thereby expanding our awareness of phases, periods, shifts, and recurrences (Lefebvre, 2004, p. 22). By listening to the *rhythms* and shifts of a dynamic atmosphere, we can gain an attentive ear, enabling us to make sense of the dynamic atmosphere by differentiating the multisensory inputs hereof. Attentive listening is obtained through what may be described as a sort of meditational practice, connected to artistic practice, of engaging with the surrounding *rhythms* in order to resonate with them in a consonant way. We can only listen to and perceive our surroundings and their *rhythms* as fast or slow in relation to other *rhythms;* and given that we are always in a body, the *rhythms* of the body comprise an important reference in our experience.[59] Based on my research approach listening to *rhythms,* as a way to differentiate between the fluxes of impressions, represents an attuning process, which leads to perceptual learning through refined attunement. This ability of being affected by *rhythms* thus represents the necessary first step of *affective attunements* by way of establishing a *shared rhythm* that can then be *tuned* toward *counter-attunements.*

Within psychology *habituation* represents a basic psychological learning process showing a decrease in response to a given sense stimulus once the subject has been exposed to the stimulus repeatedly, indicating a loss of interest (Berk, 2009, p. 136). Thus, *habituation* is a natural process, where focus on particular aspects of the environment shift into the background of awareness, leaving room for other aspects to inhabit the foreground of attention. The phenomenon of *habituation* is often overlooked in investigations of how humans sense, and cope with, their surroundings (Horowitz, 2013, p. 44). Approaching atmospheric experiences from a *habituation* perspective acknowledges how our own habitual background continuously shapes our individual and contingent experiences of atmospheres. Moving into the discourse on sonic environments, Barry Truax stresses how our innate ability to shift sounds to the background of our awareness depends on habituation, which involves

[59] A simple experience from my own practice as a live-musician kept emerging: The different experiences of time and tempo when playing to a backtrack in either a rehearsal or concert situation. Even though the backtrack had a fixed tempo it was experience by the whole band as a much slower tempo in the concert situation compared with the same situation in the rehearsal room. I.e. our experience of time/space emerged from the complex relationship between the different bodily/social situations etc. supporting the view that there is no *shared rhythms* "in" the environment that can set the *shared rhythm* of our experience; instead rhythms and the experience of time are dependent on the *shared rhythmic* relations between the involved entities.

memory and associations. For our perceptual system to be able to shift specific sounds to the background of our awareness, they must be *habituated,* meaning that they are expected and predictable in a certain context (Truax, 2001, p. 21). This type of background listening, is comparable to *ecological overhearing*, and requires us to be able to easily detect and separate sounds from each other, so we do not have to consciously struggle with making sense of the environment, which can lead to a feeling of alienation or separation from the surroundings. It is therefore not only the perception of the specific characteristics of a sound that influences whether they are shifted to the background of our awareness, but also the way in which they are habitually perceived (Truax, 2001, p. 22). Thibaud underlines the importance of reflecting not only on the different categories of listening, but also on how and under what conditions we manage to shift from one type of listening to another. A design that responds to actively changing listening modes requires an alternative sound design strategy – not by redesigning the concrete sounds in the environment or covering them, though, but by altering the attitude of the users toward the existing sonic environment. For the designer to induce such a change by facilitating user coping with complex and alarming atmospheres, we need to understand how we influence the autonomous and conscious habituation processes for environmental sounds. Relations between different states of awareness are essential to our habituation.

Habituation in relation to sound and noise is often considered a negative adaptive behavior forced by stressful environments and leading to stress and fatigue in a "culture of tuning out" (Milena, 2004, p. 25).[60] We constantly "tune out" non-essential stimuli and focus on the things that really demand attention.[61] However, from the perspective of *affective attunement* and *ecological overhearing*, by way of *shared rhythms, habituation* should be revisited as an essential and ongoing refinement of skills to better cope with and attune to the world. [P1] suggests *embodied habituation* (*EH*) as a dynamic negotiation between the body and the atmosphere, where repetitive stimulation gradually helps us to shift certain environmental stimuli into the background of our awareness. To capture this dialectic relationship the concept of *middle ground experience*[62] is introduced as a way to accommodate the *attuning approach* to atmospheres, as established in [P3]+[P6]. *EH* points out that interaction designers should not approach the contextual setting of their designed artifacts as fixed ground, but instead as flows constantly evolving in-between the user's foreground attention and background awareness. In the example of astronauts preparing for flight in the introduction to the paper *EH* occurs through repetitive stimulations of the body. We cannot learn to be affected through intellectual exercises, and reading about spaceships is not sufficient training for astronauts.

[60] See e.g. p. 23: "Instead of being alert to sounds, people become passive listeners, habituated to noise and alienated from the urban environment by sonic alternatives such as personal music players, car stereos, personal mobile phones, and Muzak. We train ourselves not to pay attention to sounds and aural cues, to turn our acoustic environment off: 'Oh, that's someone else's cell phone, I'll ignore that,' and 'that's just Muzak, I'll tune it out.' Such reactions occur because of our habituation to 'background listening.' In addition, electroacoustic sounds occupy so much of the public sphere that our private space can hardly exist in that context, while truly public space inevitably diminishes. Silence is suddenly not a public right but an expensive and elusive rarity" (Milena, 2004).

[61] Very intense stimuli or loud noises may never lead to habituation.

[62] See [P1] for a detailed discussion of *MGE*, also in the research context of different interaction design programs, e.g. *Embodied Interaction, Tangible User Interfaces, Co-Experience, Peripheral Interaction, Affective Engagement, Spatial Sharing.*

As a further development of the perspectives in [P1] *embodied sound habituation* (*ESH*) is introduced as a design strategy in [P2]. Exploring how we can facilitate faster habituation processes within alarming atmospheres, a strategy has been developed by implementing different tactics in the concrete design project *KK.* The design of *KK* acknowledges how atmospheres emerge as temporal negotiations between the *rhythms* of the body and the environment in conjunction with our internalized perception of our habituated background. By actively controlling the sounds built into *KK*, the child can *habituate* them by synchronizing them with his or her own bodily *rhythms*. Hereby the child can establish, in advance, a familiar relationship with the alarming sounds in the ward, enabling the child to focus on the visit with the relative. In this way, *KK* was designed with the overall *rhythm* and structure of the visit in mind: First, *KK* assists children through the entire visit, becoming a secure anchor that can detract focus from the sudden shifts in atmosphere, thus helping the children become more sensitive to time than to spaces. Second, the temporal design allows for adaption to specific rhythmical functions, appropriate to the different environmental settings. Taking these aspects into account, the bodily *rhythms* of the children adapt in relation to their habituation process. The mobility of *KK* allows the child to bring something familiar with him or her into the ward, encouraging the child to take ownership of *KK* before, during, and after the visit as a familiar anchor in a confusing and unknown environment. The physical, bodily way of interacting with *KK,* through *rhythmic* folding and unfolding actions, invites the child to create meaning through embodied interaction [P2].

Épochè is implemented as a strategy for designing for *ESH* in the waiting room. *Épochè* refers to a practice presented by Pierre Schaeffer (and reworked by Michel Chion). Adapted from a phenomenological understanding of how the bracketing of a phenomenon can create a method for examining it, aside from one's associated assumptions and beliefs, the concept refers to the process of putting specific sounds in parentheses in order to actively create reduced listening circumstances (Chion, 2009, p. 28). Reduced listening can create a shift in listening, which thus no longer serves as a vehicle of meaning concerning the source. By isolating or moving the sound away from its source and out of the audio-visual complex to which it initially belonged (what Schaeffer calls acousmatic listening) and listening to it repeatedly, one can actively recondition one's habitual listening patterns and references. This will allow "us to clarify many phenomena implicit in our perception" (Chion, 2009, p. 31). Although the most natural mode of listening is to try to understand the sound by identifying its source, repeated reduced listening can "perhaps 'exhaust' this curiosity and little by little impose '*the sound object as a perception worthy of being listened to for itself*'" (Chion, 2009, p. 12). *Epochè*, through repeated reduced listening, can set the ground for habituating sounds quickly, thus changing one's attitude toward them, e.g. through developing a more musical perception in the waiting room.

This strategy is unfolded by presenting the eight sounds separately. One button triggers one sound file as feedback, made with touch sensors and a *Phidgets* board. Hidden beneath the upholstery, a computer and loudspeakers play the sounds that have been sampled directly from the ward. These sounds are based on a one-hour recording made in the ward, where the nurses presented all the sounds they found to be dominating – not only alarm sounds, but also noises made while handling equipment that was thought to be suitable for sampling. The different sound files last for a maximum of two seconds each, and the sounds are categorized into three

groups: Yellow areas play three different alarm sounds, red areas play two suction sounds from a respirator, and the blue areas play three dominating equipment sounds, e.g. the lid of the bin being shut. The eight sounds are quite different in pitch, timbre, rhythm, and expression. The feedback is immediate and can be triggered again and again when pushed, and the system can play several sounds on top of each other, if more than one trigger is activated at the same time. In this way, the child is able to create a rhythmic pattern corresponding to well-known beat structures, resembling a drum loop with various drums, and thus conditioning a musical interpretation of the sounds.[63] The embodied experience of controlling the concrete *rhythms* in one's own tempo can help the children to synchronize the sounds with their own bodily *rhythms*. In this way, the alarming sounds can be shifted to background awareness upon entering the ward, as they are now habituated as familiar, expected, and predictable in the context rather than frightening and uncontrollable [P2].

9.2 EVALUATION PHASE

KK was evaluated during actual visit situations – an example of research conducted in real-world environments put to the extreme. As such, we were not only evaluating our design artifact in the field; we were also dealing with users who found themselves in a very sensitive situation. *KK* was tested in the *NIA* for 11 months, and the evaluation period ended in December 2012. During this period nurses used *KK* as a tool when they accompanied children aged three to seven years visiting a hospitalized sibling or parent. The evaluation indications built upon qualitative reflections written by the nurses and were followed up in interviews, when possible. Furthermore, we attended one visit situation (participant observation). The evaluation of *KK* was complex, first because visiting a relative in a hospital environment represents a highly sensitive and critical situation for the young users (and their families). However, this should not be an obstacle for conducting research in such situations, but we have to accept that the results from evaluation in real-world environments are highly sensitive, and thus highly valuable, as we were approaching users in an exceptional situation. A majority of the responses we received from the interviews pointed to the fact that *KK* is a favorable instrument for nurses to establish valuable contact with the children. One nurse pointed to the fact that *KK* highlights a shared focus on the child in the waiting room: "There is no doubt that the conversation was between the child and nurse and not between the adults. It was nice, for me, to have a tangible starting point for the conversation." In line with this another nurse emphasizes, "The children are involved in the visit. It matters that we meet them on a children's level." Another insight points to the importance of establishing a space, where the children belong, either in the waiting room, moving into the ward, or next to the hospitalized relative. Nurses independently referred to *KK* as a "comfort zone" for the children.[64]

I therefore highlight the limited number of user evaluations as an important limitation in the evaluation. During the evaluation we realized that in order to get proper results in a sensitive environment like the *NIA*, we would need to be present in the ward. Showing up in the morning was not sufficient, though, as the nurses did not call

[63] Listen to the eight sounds from *KK* played in one sequence: https://soundcloud.com/journal-of-sonic-studies/jss6_hojlund_audioobject1
[64] See [P1] for further detailed descriptions from observations and interviews.

us when young visitors arrived. As a consequence, we were present in the waiting room as much as possible to make sure that we would attend these visits. However, due to the very low number of children visiting the *NIA* in the evaluation period, the evaluations can therefore only serve as indications. Another limitation is the general methodological challenge of evaluating atmospheres and affective attunement in general. Considering the affective character of the *attuning approach*, future work must aim to develop evaluation methods that can accommodate the aspects that cannot easily be articulated and captured using traditional qualitative methods such as interviews and observations. In this context the emerging field of *sensory ethnography* could serve as a fruitful method, as it both aims to reconceptualize the established methods through sensory methodologies and to highlight the role of technologies, as proposed by Sarah Pink (Pink, 2015).

CHAPTER 10
RESPONSES & CONCLUSIONS

In this chapter the findings from the experiments are discussed as responses to the hypotheses and research questions in light of the overall research problem (Part I) and research approach (Part II). The overview article ends with a conclusion, discussion and maps out limitations as well as points to future work, primarily focused on the current project *The Overheard* [P4].

10.1 RESPONSES TO HYPOTHESES AND RESEARCH QUESTIONS

Based on Parts I & II the experiments took an *attuning approach* and sought ways to facilitate *ecological overhearing* and feelings of control and safety to avoid enhancing sound-related annoyance through strengthening the quality of attunement between the environment and humans by way of *shared rhythms.* The three working hypotheses and corresponding research questions are therefore synthesized and answered next to provide recommendations and considerations for an unfolding of the *attuning approach* in practice through *attuning strategies.*

The proposed focus on enhancing the quality of attunement is not a defense for noise, but a call to develop a new relationship with noise, complementing the existing approaches in the field. The *attuning approach* suggests that *ecological overhearing* and *affective attunement* can establish the grounds for building a new relationship with problematic and unfamiliar complex *soundscapes* as in the hospital. The *attuning approach* deliberately breaks with the idealized idea that a beautiful and perfect *soundscape* is reachable through a dark ecological perspective that moves the focus from the mythical out there towards a focus on the fragile and dynamic here and now. This implies a break with aesthetic approaches that judge the quality of sounds and phenomenological approaches that determine the quality of *soundscapes* based on individual perceptions.

10.1.1 Response to hypothesis and research question 1

According to the *attuning approach*, atmospheres of absences in the hospital are understood and addressed as vaguely experienced multisensory presences, that can take on powerful oppressive atmospheric qualities felt affectively through embodied powerlessness, constraint and isolation. Thus, it is not the built environment in the hospital that radiates atmospheres of absences since they emerge through *shared rhythms*. Hospitals, and all involved entities, have individual intensive pulsations of movements and flows that interact with the pulsations of the individual body and social groups. The complex *affective attunements* are experienced phenomenologically as the atmospheric "more" whose distinct ("sterile" "absence" e.g.) quality is given *rhythmically. Amodal rhythms*

are affective cross-modal equivalences of intensities, forms and shapes grasping the bodies, and thus redeeming their "(...) capacity for affecting and being affected." (Deleuze 1988, p. 123). Being affected bodily by the *rhythms* is in this sense to be seized affectively by the atmosphere transduced through ones own bodily pulsations.

The *rhythms* open up the possibility for both positive and negative *affective attunements.* On the one hand, positive *affective attunement* can have the capacity for place-making, as the *shared rhythms* can have a unifying role in the affective exchange between entities that create the feeling of being part of a shared atmosphere. On the other hand, negative *affective attunements* have the capacity to tune the *rhythms* out of step and thus affect the body with an uncomfortable atonal intensity through over-matching or under-matching the body leading to exaggeration and isolation, embodied in users' responses. Negative *affective attunements* are thus effective for captivation and forced concentration that can lead to a complex mixture of bodily affects such as over-exertion, frustration and stress. To counter-act such feelings of displacement we therefore need diverse possibilities for actively engaging in place-making or dwelling[65] through positive *affective attunements*. The task of counter-acting sound-related annoyance in hospitals therefore also becomes a question of designing situations, where we can actively *fall in* with the existing *rhythms,* and if this is not possible, to empower the user to *tune* the *shared rhythms* through *counter-attunement* themselves. *Ecological overhearing* is considered as an atmospheric and affective mode of listening that help provide us with a sense of place. In places where we are able to choose what should be out of our direct listening attention, what we choose to *overhear* helps us integrate into the situation by keeping us in a *shared rhythm* and enhancing our feeling of control. In this way engaging in *affective attunement* through *ecological overhearing* is an activity considered an important coping and dwelling strategy to enhance the feeling of control safety. Perception is thus considered a mode of action based on skills and thus we can learn to *overhear* and consequently cope differently through education of our listening attention.

In normal everyday environments we actively design our environment to afford *ecological overhearing* to create reassuring atmospheres with, for instance, furniture, radios and hi-fi equipment, in order to mask unwanted sound and create a sonic climate that is perceived as pleasant (Hellström, 2003, p. 78). The ubiquitous use of music technologies today is regarded as a particularly effective device to which we turn in order to regulate ourselves and our mood in relation to the overall atmosphere (DeNora, 1999, p. 45). According to Annahid Kassabian, such musical practices facilitate *ecological overhearing* or what she terms *ubiquitous listening*, which plays a key role in conditioning *distributed subjectivity* – a condition that is non-individual and that renders identity as an emergent node in a constantly shifting field of sound, atmosphere and affect open to a network of listeners – to feel like part of a shared environment (Kassabian, 2013, p. 10). However, in the hospitals we are often not able to engage in *ecological overhearing,* obstructing the sense of control and connection to the environment [P5]. At home we have skills to design our *rhythms* and thus *ecological overhearing* ourselves, but when we are not home "we leave our rhythms" (Ingold, 2000, p. 332) and we thus need skills and possibilities to be empowered to fall in or tune the *shared rhythms* in unfamiliar situations to engage in *ecological overhearing*. According to an *attuning approach*, time and space are therefore not only considered something we are "in" but

[65] I adopt Tim Ingold's understanding of *dwelling*, referring to Heidegger, as an ongoing activity of making home. In the act of dwelling the self and world merge and thus dwelling takes organism and environment as a starting point rather than self-contained individuals (Ingold, 2000, p. 5).

also emerges as attuning atmospheres through our practical and exploratory encounters with other humans, things and non-humans. The spatial and temporal scales are therefore dependent upon the quality of attunement between our capacities and bodily situation and the affordances and attentional cues in the environment by way of *shared rhythms.*

The *attuning approach* therefore seeks to facilitate *ecological overhearing* that increase the diversity and possibilities for engaging in place making. The *attuning approach* thus considers an expanded capacity for co-existence through *ecological overhearing* as an important way to support well-being and health. *Affective attunements* and *ecological overhearing* provide a powerful framework that does not build on a polarity between the environment and the human perspective. Furthermore, it takes a starting point the unity of the senses in that the rhythmic parameters are *amodal* and can thus be shared and understood affectively across modalities. Seen through this framework sound-related annoyance in hospitals is deeply intertwined with a negative affective attunement and a lack of *ecological overhearing* possibilities, and counter-acting the experience of noise should therefore also take a starting point in counter-acting the negative *affective attunements* through facilitating *counter-attunements* and providing possibilities of *ecological overhearing*. We should therefore address sound-related annoyance in hospitals, not only in relation to the measurable *acoustic environment* and subjective *soundscape*, but also in relation to powerful atmospheres emerging by way of negative *affective attunements* felt as over- and under-matching *rhythms,* leaving us out of sync with the existing atmospheres*.* In this *view affective attunements* by way of *shared rhythms* constitute powerful conditions for the emergence and experience of atmospheres. Atmospheres should consequently be approached as a pulsating flow of attunements and intensities, which constitutes the rhythmical condition for the emergence of the unique atmosphere of different places.

10.1.2 Response to hypotheses and research questions 2 & 3

Attuning strategies are concerned with promoting a sense of control by facilitating and offering a diverse range of possibilities to engage in *ecological overhearing*, thereby enabling patients and other groups to feel empowered to *fall in* or *tune* the *shared rhythms*. The *attuning approach* therefore suggests that the strong separation of affect from cognition is problematic, as argued by Brian Kane (Kane, 2015). Affects should not be taken as something that comes "before" cognition, and therefore cannot be shaped and transformed by new habits and new skills. As Kane argues the strong division of cognition and affect will not break with Cartesian dualism but insert a new dualism between mind and body as he puts it: "To throw out the mind in the name of the body is not to overcome dualism, but to prolong it" (Kane, 2015, p. 8). Following this line of thinking the *attuning approach* suggests a need to adjust the understanding of affects from being purely unruly and pre-cognitive to be conditioned by atmospheres, which opens a path where affective attunement can actually help shape what and how we get affected[66]. In this way the process of *affective attunement* resembles Jonathan Sterne's *audile technique* (Sterne, 2003, p. 34) where our listening habits are not only mental, but involve bodily training that

[66] It must be stressed again that certain extreme affects such as a sudden explosions cannot be *tuned* by *counter-attunements.*

also shape our audile techniques. In this way *affective attunement* does not represent a rejection of representation but the interactions between cognition and affect - we acquire new skills through *habituation,* also cognitively, and after that learning process the body takes over. The bodily capacities constitute the basis upon which this learning process occurs, and therefore a focus on training and skills articulate the interaction between mind and body and do not set up an opposition between them.

According to the *attuning approach*, *habituation* is not considered as de-sensitizing but as a sensitivity that becomes internalized into the body as particular forms of attunement that can be re-configured (Ash, 2013, p. 45). In relation to listening, the key-concept *ecological overhearing* accommodate the interplay between cognition and affect, as it constitutes the primary atmospheric mode of listening open to *affective attunement* but also shaped by *habituation,* memory and expectations. In this view *ecological overhearing* provides us with something habituated to hear other sounds "in". We most often will not listen to the overheard attentively, but the overheard will shape the way we hear other sounds. The *ecological overheard* is therefore not a pure affective zone but is capable of reconfiguring habitual background and foregrounding relationships as a generative and active way to constantly refine attunement to the environment by resituating foreground and background relations dynamically.

Counter-acting atmospheres of absences, and other negative atmospheres, must therefore happen by way of providing *attuning strategies for* enhancing *ecological overhearing* that help re-*configure habitual affective attunements.* Thus *attuning strategies* should offer ways to gain competence to be able to respond adequately to such different problematic *soundscapes.* Therefore there is a need for considering different *attuning strategies* for different situations, as there is not *one* noise problem in hospitals that can be *solved*, but there are different noise problems that can be *managed* adequately if approached differently, through combinations of the existing approaches in the field with corresponding *attuning strategies.* As an example of how such a combination of the existing approaches and the *attuning approach* could take form, I suggest how Andringa, Van den Bosch & Vlaskamp's human-centered model of four types of *soundscapes* could serve as an analytical foundation, for reflecting on what operative attuning strategies to choose:

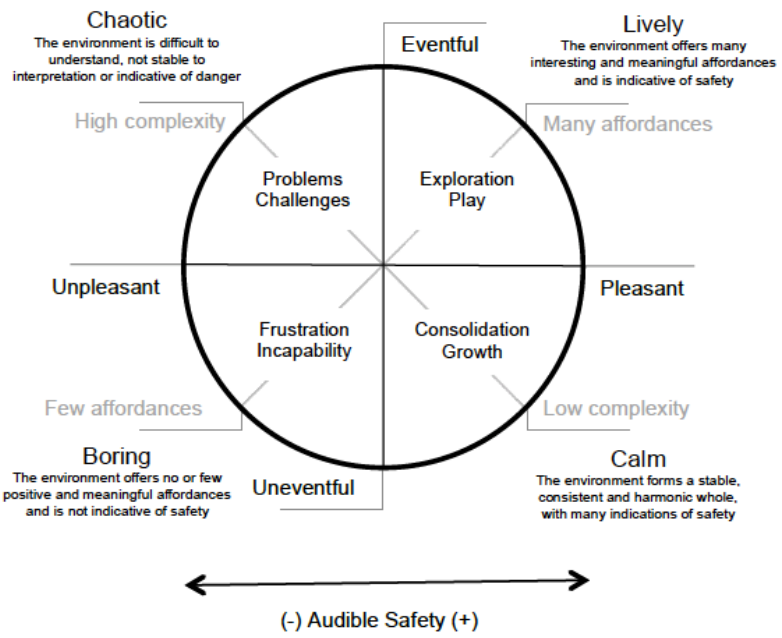

Figure 10: Four types of soundscapes and their basic dimensions, adapted from (Andringa, Van den Bosch & Vlaskamp, 2013)

Taking a *human-centered approach* based on this model could be used as a starting point to analyze the over-all character of the dominating *soundscapes* in the hospital, based on the four archetypes of *soundscapes Chaotic, Lively, Boring* and *Calm.* Based on the insights presented in Parts I & II, *soundscapes* in hospitals are likely to be characterized most often as either *chaotic* or *boring.* After this first basic step of analyzing the over-all character of a specific situation, taking an *attuning approach* would then point to different operative attitudes related to the different archetypes. The different *attuning strategies* thus provide considerations on how to move from either *chaotic* to *lively* or from *boring* to *calm*. According to the *attuning approach,* both boring and chaotic *soundscape*s will most likely miss *ecological overhearing* possibilities, leaving no possibilities to *fall in* or *tune* the *shared rhythms* to engage in *affective attunement.* In boring *soundscapes* because there are less *rhythms* to *fall in* as in the recording session in *LLV,* and in chaotic *soundscapes* because there are no possibilities to tune the chaotic cacophony of *rhythms* as in the neuro-intensive care unit. In both cases overhearing becomes a forced mode of trying to *tune out* and thus demands a great amount of attention. Therefore in both situations there is a need for offering diverse zones of *ecological overhearing* to create possibilities for the user to choose what to hear and what to overhear, to be able to re-configuring background and foreground relationships.

Flatley highlights the need for ruptures to short-circuit our habitual and "automatic modes of perception", as we often hardly perceive sound but rather recognize and know by way of habit. Therefore *zones of overhearing* should first seek to short-circuit or rupture our normal mode of recognizing and knowing so that we can become

susceptible to *affective attunement.* He suggests de-familiarization or making strange[67] as possible strategies, as these strategies will make us experience otherwise familiar objects anew, and at the same time catch sight of ourselves as subjects in the world, and thus able to engage in *affective attunement* and *counter-attunements*. I therefore suggest that *zones of overhearing* must create ruptures in the normal ways of listening as a first step to open the body to be vulnerable to *affective attunement.* The affective vulnerability is highly useful as a way to "cultivate a sensitivity that is necessary to become competent in a specific activity" (Ash, 2013, p. 37).

The *attuning approach* points to the potentials of enactive technology, art and design as tools for accommodating *zones of overhearing* by creating direct encounters with the existing *rhythms,* in which our engagement with them can set the ground for *affective attunement.* Jordan Lacey argues similarly that art, design and technology can actualize the affective to move beyond the already familiar or expected (Lacey, 2016), and thus various forms of sound installations and interactive sound technologies can offer ruptures that help us breaks with our habitual ways of being in the world. Technology should therefore not be hidden or neutral, but offer a direct way to make the environment respondent and malleable to our dwelling practice to enhance control. Equally art and design can work together with technology not as decorations but as tangible places for such encounters to unfold. In this way the divisions between technology as neutral and transparent tools opposed to art as objects for reflection in the imagination disengaged from the current lived experience become brittle. When art, technology and design goes beyond *re*-presentation or medium and instead becomes places for encounters, they can operate as a "rupture in our habitual modes of being and thus in our habitual subjectivities. It produces a cut, a crack. However, this is not the end of the story, for the rupturing encounter also contains a moment of affirmation, the affirmation of a new world, in fact a way of seeing and thinking this world differently" (Simon O'Sullivan as cited in (Lacey, 2016, p. 1)) The *zones of overhearing* thus represent places for ruptures as tangible and malleable interfaces that operationalize the co-creations of atmospheres for the involved groups in the hospital.

Zones of overhearing can make the *rhythms* tangible and malleable through a rupture of normal foreground and background relationships through *ambient effects.* Morton's term *remark*, adopted from Jacques Derrida, is thus comparable to the term rupture as the instance, where the background comes forward and the normal division between here and there becomes re-configurable. The rupture or *remark* makes us aware that there was an overheard background, transforming it from nothing into something. In this way ambient effects make it appear as if there is something in-between leaving it open to the listener to decide what is noise and what is signal - enhancing the feeling of control and empowerment. After the rupture *zones of overhearing* the artifact must then facilitate a *shared rhythm* through *amodal rhythmical equivalences* across modalities. As *affective attunement* requires a consideration of the interplay between both the affective potentials in the environment and the capacities of the users, the *zones of overhearing* should address both by both expanding the affective potentials in the environment, but similarly helping to strengthen the capacities of the listener and therefore also the refined attunement skills developed through perceptual learning as a way to transform habitual activities and habits. In

[67] He adopts Viktor Shklovsky's term "ostranenie" ("enstrangement").

this way the *attuning approach* suggests that habituation is tangible and rhythmical if the body is not to be passively *tuned* by the existing *rhythms.*

In boring *soundscapes* a diversity of slow *rhythms* can be introduced that can be shaped by the user, to be able to *fall in* with it. An example could be that the breathing exercise in the sensory delivery room presented in section 2.2.4 was enhanced interactively so that the breathing *rhythm* could shape the sound of the waves, as seen in the recording situation of *LLV* where the voice shapes the character of the visualizations.

In chaotic *soundscapes* introducing slow and calming *rhythms* would not be in coherence with the aroused and tense bodily state and *rhythms* of the user, which would make it difficult to fall into *shared rhythms*[68]. Experiences derived from our experiment indicate the positive effects of an active and engaging *habituation* process, which set the ground for a quicker *habituation* process as follows: The user is given an opportunity to not only attentively listen to differentiated sounds derived from a chaotic *soundscape* (*epoché - rupture*), but also to control them through embodied gestures (over- and under-matching), to synchronize them with her/his own *rhythm*, and be able to shift them to background awareness when faced with more important tasks. When a rapid *habituation* process is needed direct interaction with sound samples helps to turn the immaterial and transient into the malleable and tangible by increasing the perceived materiality of sound, as you create sonic textures with a palette of action sounds, which are designed through the relationship among gesture, artifact and sound. Conscious listening then becomes a way to re-configure new sounds into the *ecological overheard* and then *ESH* as design strategy invites the user to develop an attentive ear through controlling prominent *rhythms* of the environment in an active and embodied way and becoming capable of synchronizing them with his own bodily *rhythms.* The users now become co-creators, unfolding the atmosphere. The habituation process is actively aided, guided and accelerated by a design artifact. The advantage of designing specifically for this process is that the habituated sounds can move to the background of awareness (*ecological overhearing*), leaving perceptual room to what the user wants to take the foreground of attention, e.g. the meeting with the relative, but at the same time function as a *rhythmic* attunement to the place. Therefore in such chaotic *soundscapes* counter-attunement is needed, and thus a disjunction in the shared aroused *rhythm* should be facilitated, after which a process of *tuning* the *shared rhythms* by way of over- or under-matching through *ESH* can represent the last step. This four-step process of *counter-attunement* can thus pave way for a transformation of the shared *chaotic* atmosphere towards a *lively* one*. Habituation* typically happens almost automatically in environments where we spend a lot of time, through a gradual and slow adaption. In an unfamiliar environment as in the hospital, the normal process of *habituating* to the environment is likely to be obstructed.

[68] This consideration is in accordance with *Entrainment Theory.* Moens and Leman define entrainment as "the gradual fall into synchronism of two rhythms, such as when a locomotion pattern gradually falls into synchronization with a musical pattern" (Moens & Leman, 2015, p. 86)

10.1.3 Summary

Both the widespread experience of being in atmospheres of absences and simultaneously gaining an alarming sonic sensibility in the hospital are amplified by the inability to actively exert control (internally and externally) over sound-related stressors. This unfortunate situation can therefore not only be counter-acted through passive *insulation*- and *isolation-strategies*. *Attuning strategies* offer considerations on how to approach this gap through facilitating *zones of overhearing*, where users are invited to engage in the practice of atmospheric dwelling and place-making. Embedding diverse enactive sound installations and interactive sound technology in the hospital can facilitate such *zones of overhearing.* The zones become places for ruptures that diversify and strengthen the possibilities for engaging in *counter-attunements* by *tuning* the existing atmospheres based on two main attuning strategies:

Transforming Boring soundscapes into Calm ones: Enhancing *ecological overhearing* by making the affective capacities of the environment tangible and malleable by way of enactive *ambient effects* that can re-configure *habituated* background and foreground relationships.

Transform Chaotic soundscapes into Lively ones: Enhancing *ecological overhearing* by inviting direct ways for users to refine the attuning skills by way of either *controlling the rhythms,* or in situations where there is not a possibility inviting for *embodied sound habituation* through which new *habituations* and *attunements* become embodied.

The *attuning approach* positions habituation and *ecological overhearing* as positive ecological processes towards refined attunement with the environment. Based on these *affective attunement* processes the attunement becomes internalized as embodied attunements. As atmospheres are always in the process of emerging and transforming, attuning to the temporal aspect and *habituation* through repetitive actions inevitably has a neutralizing effect on the affective impact. The *attuning approach* should therefore focus on offering concrete tools to empower the users to actively structure and control the *rhythms.*

10.2 DISCUSSION & LIMITATIONS

In this dissertation I have adopted a constructive and pragmatic perspective on the topic of research, moving beyond a merely analytical or critical approach. The reason for engaging in the research theme in this way is twofold: First, as I have explained earlier, research in this area of research has traditionally been characterized by a negative discourse, which was shown to be inadequate (see e.g. Section 5.1). Secondly, I consciously chose an approach that could make my research relevant and useful for today's practice and practitioners, as I have found an extensive uncertainty and feeling of powerlessness in relation to this specific topic through my discussions with the people leading, but also implementing and experimenting with the unfolding of the new

paradigm of *healing architecture* in the building of the new Danish super-hospitals.[69] During the course of my PhD I have continually discussed the theme of my research with relevant practitioners in the field, through presentations, interviews and informal conversations in the Danish hospital context - among others with key figures responsible for the implementation of *healing architecture* visions in the building projects.[70] Through these discussions, three general reasons for the widespread uncertainty and powerlessness on this topic emerged; First, *healing architecture* visions are often reduced because of deficit cuts. Secondly, the moving beyond the *acoustic environment*, addressing the *soundscape* falls into a knowledge gap. The result is that, besides normal sound-proofing standards, active use of sound and music is not even a part of the discussion. At the same time they are often also aware of a general fear that the environment may become too quiet.[71] However, sound is considered to be a "dangerous" medium to use in a hospital context, due to its ubiquitous qualities, as the users cannot choose not to attend to it. Therefore, even though there is an awareness of the importance of issues related to the experience of sound-related annoyance in hospitals, there are very little existing tools and strategies available to address the shared *soundscape* in practice[72]. Therefore, active use of sound is considered to be potentially disturbing and stressing for patients and relatives, who are already in a stressful situation. Thirdly, integrated art focuses on implementing integrated visual and sculptural art in main waiting areas. Sound art, sound design or sound installations, are not considered possibilities, due to both the fear of increasing the noise and the lack of both common knowledge and proper research to support the inclusion of such sensory enrichments. Taken together, my experience from the many discussions I had is that whereas the *insulation strategies* are attempted being implemented through sound-proofing, zoning, and one-bed rooms, the *isolation strategies* are considered unsubstantiated by proper research, and there is therefore a reluctance to introduce, for example, music intervention as an implemented part of the construction process. This leaves the *soundscape* to be consistently overlooked and under-prioritized in the planning and construction of new Danish hospitals, resulting in the lack of active and positive sound strategies.

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69 This wish also lies behind my choice of working with an article-based PhD and my engagement in workshops, media and interviews, as a way to present my research to a broader audience "outside" the university. The broad spectrum of journals and conferences also reflects this wish.

70 An art historian at *Aarhus University Hospital*, an architect at the new *Rigshospital in Copenhagen* and the CEO from an art consultant company involved in several of the new hospital projects.

71 This fear is based on anecdotes, as for example one from a new hospital in San Francisco, where an efficient insulation strategy made the hospital too quiet. Therefore, measures had to be taken to introduce fitting background sounds to fill out the silence. I have tried to research deeper into this example, with no luck though, through email correspondences with El Camino Medical Center, San Francisco, KMD Architects, and lastly with Smith, Fause and McDonald Inc. who answered: "Sorry to disappoint, but we are unable to help you. The following should give you the appropriate background:
- The project was completed many years ago.
- Our primary acoustical engineer on the project is no longer working in acoustics.
- Our firm has worked with ECH for 25 years, has multiple current projects with the hospital and maintains an excellent relationship with our long term client.
- The particular issue you mention is not one we have formally studied and have only heard about anecdotally so we can not even confirm if an unusual condition actually exists.
- Had we been formally asked to study this aspect their facility, the results of our measurements and findings would be private and confidential client data unless ECH were to approve their release."

72 One of the interviewed recounts a specific situation that shows how sound is often overlooked, even though it often matters greatly to patients in different challenging situations. For example, in a workshop with users a couple wanted to prepare their child for being scanned for the first time by making a cardboard box scanner and playing the scanning scenario. Later when the child went into the real scanner she panicked because of its strange and loud noises, which she had not been prepared for during the workshop.

The contributions and findings offered in this dissertation are aimed at being relevant within this situation, by taking the first steps to bridge the gap. I have therefore chosen to engage in the research theme with a broad scope, which implies a risk of ending up with either too generalized and universal recommendations or too narrow and local ideas for solutions. I have tried to avoid this by offering sensibilities and concerns that could be taken directly into discussion on the topic. This has not been an easy task and I recognize that the responses offered in section 10.1 could be understood as too vague to guide a concrete design processes. However, I have made this choice also to stress that there is no "one problem" to "solve", as different situations at different times must be considered and addressed individually.

I find that balancing "generalized" and "local" strategies is a general problem in the current situation in Denmark. The established healthcare system have come to realize the advantages of *healing architecture* in relation to the new patient-centered paradigm as it simultaneously can meet the demand for efficiency improvement, seeing as safe patients are cheaper and discharged faster (Dirckinck-Holmfeld & Heslet, 2007, p. 200-202). The combination of *healing architecture* becoming part of a conscious healthcare agenda in Denmark and similarly the lack of knowledge on how to unfold in relation to sound and *noise* has placed my research in great demand in the innovative and experimental phases of new innovative projects. However, I also experienced how the success of the new paradigm simultaneously have put pressure on the demand for evidence, based on specific "accepted" quantitative methods, when turning experimental projects into solutions and operational recommendations for implementation. The narrow criteria for validity adopted from the medical area of the healthcare industry presents an obstacle for the inclusion of for example an *attuning approach.* I would therefore question if the intended shift of paradigm away from the hospitals we have known until today, to that of *healing architecture 2.0* in the future, is realizable in the area of sound and noise. As an example, my investigations into existing practice in Denmark shows that even though user involvement and patient empowerment are proclaimed to be important features of the new paradigm, most of the existing strategies today do not support these visions. In this way the "old" hospital paradigm with its *panaudicism* (see section 4.3) and listening hierarchy is intact and the indirect power is endured, and thus a paradigm shift of putting patients first is still way out of reach apart from "local" innovative experiments.[73]

On similar note researchers central to the *evidence based design* movement from Aalborg University recently published a report on art's potential in healthcare. They argue that the reason for the many cuts in art budgets that we see these years in Denmark in relation to the new construction of super hospitals, are closely related to the predominantly quantitative and overall sparse evidence for arts value and importance for health and well-being (Nielsen et al., 2016, p. 2). They claim that art's potential in healthcare is much larger and extend beyond

[73] There are few examples of initiatives aimed at offering the hospital patient some control over the acoustic environment that can be found in the fields of music therapy and music medicine. For example, patients at Aalborg Psychiatric Hospital are offered the choice between five different music genre-specific programs in the form of a sound pillow (Bonde, 2011, p. 130). In this way the *attuning approach* connects to recent developments in the field of music therapy under the name of Health Musicing (Bonde, 2011, p. 121), which is defined as the common core of any use of music experiences to regulate emotional or relational states or to promote well-being, be it therapeutic or not, professionally assisted or self-made. In this way, Health Musicing can be observed in any social or individual practice, where people use music experiences to create meaning and coherence in states and times of adversity.

what the dominating and statistical and quantitative methods can measure. Most importantly the dominating methods result in a theoretical focus on art's intrinsic values, missing the importance of the impact art has on the experience of place, social interactions and identity through the direct interaction based on use and experience (Nielsen et al., 2016, p. 6). They therefore take a pragmatic and practice-oriented approach, by combining different both quantitative and qualitative methods with different theoretical accounts, such as theory on atmosphere and place. They conclude that their research is related to what they observe as a general, qualitative "turn" in the field, recognizing the value of such research in the face of evidence-based institutional politics. However, the research is only sparsely focused on operational strategies apart from the recommendation "to promote an active use of art in the treatment and care of patient in health care in general" (Nielsen et al., 2016, p. 8) supplemented by different important themes to consider when choosing art such as context, colors, form and life. Furthermore, art equals visual arts, and other forms of art, such as sound art, are not mentioned.

I agree with their call for the existing field to stretch its methodological and disciplinary boundaries and break with the idea of evidence-based criteria as I have also argued in [P5]. At the same time, however, I would like to point to limitations and call for future work in the area of atmospheres, listening and non-representational research to offer concrete methods to evaluate based on the multisensory, affective and embodied perspectives. How do we take a starting point in our evaluations in the synesthetic and enactive as suggested by architect Pérez-Gómez in his book on attunement and architecture: "The qualities of diverse sounds, acoustic reverberation or absorbency, olfactory qualities and their combinations, and so on contribute just as much to the creation of atmospheres. The difficulty is that while it is easy to generate a list such as this, and some of these characteristics are relatively easy to control through instrumental design operations, our embodied experience where meaning actually appears is always *primarily* synesthetic and enactive." (Pérez-Gómez, 2016, p. 31). We experienced this challenge in the case of evaluating *Kidkit* despite our efforts to mix different methods, designates the limits to qualitative research based on observations and interviews by as there is still a question of how to "capture" the affective if it is not conscious and representational, challenging the idea that anyone can provide a complete account of their own listening experience.

Another limitation that I have tried to address is related to the fact that the existing methods are grounded in phenomenological approaches, centered in human perception, whereas to the *attuning approach* atmospheres and *affective attunements* are *shared rhythms* between not only humans but also between all involved entities. I have therefore explored how a *dark ecological* perspective could serve an intermediate function in broadening our insight into the sounding objects that constitute our present auditory reality, by recognizing that they are *not* consistent entities exhaustible by human knowledge. As pointed out in [P6] *object-oriented ontology, actor network theory* and other non-representational theories such as Tim Ingold's have influenced this perspective. Despite their mutual attacks on each other, especially in relation to e.g. the question *for* or *against* essence, they share many interests in both the wish to go beyond the polarization of subjects and object, and the need to rethink the role of practice and the value of art and aesthetics.

I chose to follow the *dark ecological* path, not to take a strong position in the essence or non-essence discussion, but rather because it highlights the instability and fragility of all entities, which seem so apparent when working

with sound (and humans). Exploring a *dark ecological* perspective has in this way helped me in two central ways: First, *dark ecology* and central terms from *OOO* such as *duomining* provides helpful lenses to consider and analyze the existing field and approaches through. Secondly, and consequently, this perspective helped me to flesh out how to approach atmospheres in the hospital breaking with the consistent view of categories such as *noise/silence*. However, I acknowledge the potential pitfalls in, for example, proposing an alien listening, described by a human, as in [P3]. This move is not meant to imply that all entities in the world have feelings that are conscious in the way that humans have. On the one hand I agree with Ingold's warning that assigning objects with feelings and intentions can easily end up in a divided model of the world, as it still implies that certain subjects and now also objects posses special agency over other things. On the other hand, as Jane Bennett puts it, I found that it was "worth running the risks associated with anthropomorphizing (superstition, the divinization of nature, romanticism) because it, oddly enough, works against anthropocentrism: a chord is struck between person and thing, and I am no longer above or outside a nonhuman 'environment'" (Bennett, 2010, p. 120).

I have therefore chosen to explore how a *dark ecological* perspective can open up a needed discussion about epistemic character of doing artistic- and constructive design-research. Both the heightened sensitivity towards the non-human and the breaking down categorical distinctions between humans and non-humans involve a needed modesty on the part of the researcher, in the sense that one should not assume that human beings are necessarily the most important player in shaping what happens within a situation. On this view these methods provide a way to get us closer to the *affective attunements* between entities, both human and non-human, and across *transductions*. Concepts such as *transduction* are not ideas divorced from the world, nor are they abstractions. From this perspective, concepts can be used in a productive way to generate connections between seemingly disparate realms in order to open up new ways to think. At the same time these concepts should not be considered prescriptive. If methodology is a series of choices about what information and data we attempt to gather and how that data is analyzed, then transduction, as research method encourages a focus on the intensities of material relations, in which humans and their sense capacities are only one part [P6].

I would therefore end by proposing that considering the *attuning approach* in a *dark ecological* perspective calls for certain consequences from an operational and professional point of view, as follows:

1) The sonic designer/artist should not only be brought in late in the process to address technical, architectural, social, cultural and perceptual aspects as well as handling experiential qualities with regard to the actual listening situation. She/he should also be a part of defining what questions and basic assumptions the actual experiments should address – *the entrance level*, made together in an interdisciplinary team together with both music therapist, acousticians, architects, designers and health practitioners.

2) The main task for the sonic designer/artist is to expand the *affective attunement* potential in the concrete design contexts through *attuning strategies,* as she/he differentiate sounds by their diversity of affective capacities more than by their specific character and loudness. This position opens up to designing enactive listening and corporeal experiences that increase the possibilities for transformative encounters in the hospital.

3) She/he must encourage the team to rethink the role of technology, to get away from both *substantivist* and *instrumentalist* understandings that consider technology as cut off from the direct material context of use, either considered as neutral tools or negative and destructive powers that "in-itself" are alienating (see section 3.1). Taking a post-phenomenological approach to the use of technology acknowledges the ambivalent and multistable status of technology. Through this lens technology can be a part of creating engaging artifacts, and in this way function as material and sensible objects, that involves the user in its functioning. In this view aesthetics is not understood as decoration but concerns our practical dealings with engaging artifacts and hence the choices of what technology to develop and design are not only a tech affair, but a central part of the development processes.

10.3 CONCLUSION

> 'Unnecessary noise, then, is the most cruel absence of care which can be inflicted either on sick or well' (Nightingale, 1946, p. 27).

This quote recurs frequently in both public and academic presentations on the growing *noise* problem in the modern Western hospital. The quote is taken from the book *Notes on Nursing: What It Is, and What It Is Not* from 1859 by Florence Nightingale, the founder of modern nursing. As presented in [P5] the two dominating approaches in the field, respectively the *noise reduction approach* and the *human-centered approach,* cover the two most used interpretations of the quote, as follows: The first interpretation used by the *noise reduction approach* uses the quote without an intratextual context. According to this interpretation of the quote, the word *then* has to be ignored, after which the word *unnecessary* is taken to directly support the main argument of the approach; the reduction of noise levels is *the* paramount concern in fighting the *noise* problem in hospitals. The *human-centered approach* opens towards a second interpretation of the quote, taking the context of the chapter where the quote appears into consideration. The famous quote appears in the middle of the fourth chapter *Noise,* which begins: "Unnecessary noise, or noise that creates an expectation in the mind, is that which hurts a patient. It is rarely the loudness of the noise, the effect upon the organ of the ear itself, which appears to affect the sick" (Nightingale, 1946, p. 25). In this first sentence of the chapter "unnecessary" is defined as having nothing in particular to do with the loudness of the *noises,* an interpretation that is underlined in the following sentence: "Unnecessary (although slight) noise injures a sick person much more than necessary noise (of a much greater amount)" (Nightingale, 1946, p. 27). In this sense the *human-centered approach* considers *noise*, from the perspective of the subjective experience of patients, visitors and staffs, switching its focus from *noise* to *sound-related annoyance*. This shift means considering expectations, subjective vulnerabilities and a range of other factors that does not only relate to the loudness of the sounds.

However, research has shown that the healthcare industry still struggle to achieve any significant gains based on these approaches. My criticism of the short-comings of *the human-centered approach* (that build on ideas

developed in *acoustic ecology* and the *soundscape* movement), are based on the observation that even though it considers contextual factors as important for the experience of noise, it is still not effective to respond to the complex *soundscape* they seek to approach in practice. I argue that this situation is closely linked to a reductionist framework underlying the field, which is incapable of addressing the complex multisensory and atmospheric conditions, which play important roles in obstructing or facilitating the feeling of being an active and integral part of the environment. My work lies in the continuation of this trajectory, but I respond to the shortcomings by arguing for the inclusion of a third interpretation of the quote and consequently the development of a third approach termed the *attuning approach*. This third interpretation calls for a rethinking of some of the basic assumptions and even such basic questions as if there indeed is "one problem" with noise and if not, then there is no simple problem to be "solved".

The third interpretation of Nightingale emerges when considering the quote in relation to the rest of the chapter on *noise* as well as the overall message of the book. Throughout the first pages of the chapter on *noise* Nightingale unfolds the argument that sound only becomes *noise* and thus *unnecessary* when it appears to be unresolved and meaningless, but demands an unfair amount of attention. She uses the startling effect of sudden sounds in relation to a quiet background and the unresolved effect of overhearing fragmental conversations and *acousmatic sounds*[74], while confined in bed as illustrative examples. This state of affairs gives rise to a frightening feeling of confusion that counteracts the healing process. The word *then* in the famous quote mentioned above thus takes on an important role as a reference to these pages on the meaning of the word *unnecessary.* The chapter on *noise* is consistent with the main argument of the book that the overall environment for healing has a huge impact on the sick (Nightingale, 1946, p. 5). The *noise* problem should therefore be considered in interplay with the general lack of positive multisensory stimulations and possibilities to actively cope, which together facilitate attentive listening modes foregrounding sound-related annoyance as a main stressor. The suggested third interpretation calls for a third *attuning approach* that highlights these non-acoustic, multisensory and contextual factors are central parts of the problem with *sound-related annoyance* in hospitals, and therefore the discourse surrounding listening cannot be separated from the actual practices of hearing, listening, overhearing and seeing (Ingold, 2011, p. 286). These concerns are supported by alternative research on the experience of *sound-related annoyance* in hospitals as presented in Chapter 4.

My call for accommodating three complementary approaches in the field, resonate with Pascal Amphoux's three different operative attitudes, which he proposes should all be equally engaged with when managing complex *acoustic environments* in urban space (Hellström, 2003, p. 169). The *noise reduction approach* fits the first attitude, termed *Diagnosis of the Environment*, which focuses on protection from noise pollution. The *human-centered approach* fits the second attitude, termed *Managing the Milieu*, which focuses on offensive strategies to manage conflicts, regulate social interaction and equip people with the instruments needed to control a private sonic milieu. I argue that there is an absence of a plan for the third operative attitude in Danish hospitals today termed *Creation of the Landscape,* which focuses on creative operations to stimulate consciousness of the

[74] *Acousmatic sounds* refer to sounds that have no immediate identifiable causes.

acoustic space through sonic design. With a focus on the relation between listener and environment and on how listening perception operates when acting in a built environment, such work should concentrate on how the environment activates us and on how we activate the environment through listening (Hellström, 2003, p. 37). Furthermore, practical and operational strategies to unfold this third approach in practice are missing.

The aim of this dissertation has therefore been to address this gap by introducing an *attuning approach* in the field that offer reflections and considerations in relation to the absent third operative attitude. The *attuning approach* specifies the main concerns when designing *attuning strategies* to facilitate ways of feeling like an integral part of the environment, which are currently missing in the field. The *attuning approach* is based on a non-representational framework, allowing research that addresses the gap, but does not fit within the reductionist framework to be included in the field. This research reveals how the combination of the general atmosphere of absence, confinement in bed and lack of control creates an intense form of sonic sensibility in which the dynamic relationship between the patient and the *acoustic environment* plays a key role in creating or obstructing a healing environment. However, the nature of the *acoustic environment* creates an affective state of passive vulnerability that calls for attentive listening modes dominating the organization of the experience of being a patient, while less attentive hearing modes that could allow for active attuning strategies for successful coping are obstructed.

Within the last four years, my work has matured in the transitions between experimenting, reading, writing, performing, evaluating and analyzing. The practice-based research approach adheres to both constructive design research tradition and artistic research tradition, where adopting experimentation in concrete situations affects the quality of the particular knowledge outcomes. However, to move beyond the particular, constructive design research also has a suggestive nature, offering ideas, new concepts to inform the design and research practice on diverse levels. Through the experiment I have sought to let the situations, materials and involved speak for themselves to protest against the dominance of control in academia to control ones subject of study (Cobussen, 2016, p. 5).

Through practice-based experiments, both inside and outside the hospital context, I have explored and developed *attuning strategie*s based on the belief that health and well-being are both deeply intertwined with an expanded capacity for interconnection and expression (Lacey, 2016, p. 40). *Attuning strategies* aim to offer new opportunities for transformation of existing *affective attunements* and atmospheres in different contexts and modulate the supposedly fixed relationships among environment, sound and individuals. *Attuning strategies* creates a rupture using different methods to amplify and revealing structures that normally go unnoticed. After the rupture, *affective attunement* can generate new sensorimotor-based experiences through *ecological overhearing*. As the *attuning approach* considers action and perception as interwoven, *attuning strategies* should therefore also design them as one "because they are lived as one" {Franinović & Salter, 2013, p. 50). *Attuning strategies* therefore aim to transfer the feeling of control into the hands of the users and thereby raises awareness about the contributions they are making to *attune, fall in* and *counter-attune* atmospheres to better cope and *habituate* in different challenging environments.

Based on my *attuning experiments* I argue that all three interpretations of the famous Nightingale quote should be taken into consideration, and consequently addressed in practice, preferably through a reflective combination of three approaches to make them complement each other as best as possible. To achieve a fruitful combination of the approaches, I have suggested that the field adopts *reflexive epistemological diversity,* which would allow different scientific traditions and philosophical frameworks to work together, despite of their different foundations. I do not imagine that this is an easy task, but I argue that it is a necessary step for the field to develop. I have therefore offered a preliminary example of what adopting *reflexive epistemological diversity* in practice could entail in the previous section (10.1). Reflecting on the epistemological differences between the *human-centered approach* and the *attuning approach* pointed to the potential of first taking an overall model of *soundscape* categorization as a starting point based on the *human-centered approach.* The adequate *attuning strategy* could then be chosen, based on the analysis done based on the model.

Eric Clarke has observed that the relationship between analysis and a newly applied theory can imply a danger of being temporarily impressed by a substitution of terminology, or a reframing of some kind or other, only to discover that nothing has really changed. According to this view, applying a new theory to analysis has a potential circularity risk (Clarke 2005: 201). Therefore, Clarke argues that it is worth considering what such a reframing might be able to achieve, regarding the revealing of relationships and perspectives that were previously hidden and even unsuspected, and help to explain phenomena that remained inexplicable by presenting them within a different conceptual framework (Clarke 2005: 202) [P3].

In this light, I argue that the *attuning approach* can help to explain findings that would remain inexplicable and counter-intuitive to the existing approaches. For example, the surprising findings presented by Mette Folmer, that patients in a single-bedroom experience more sound-related annoyance, than patients in a shared ward (see section 4.3). Seen through the lens of the *attuning approach* the patient in the single-bedroom has limited possibilities for *ecological overhearing* and thus *affective attunement* compared to the patient in the shared ward. The patient in the single-bedroom therefore has limited possibilities of attuning to a general shared atmosphere through *shared rhythms,* and thus might feel more isolated and cut-off from the environment - an interpretation that resonates with a statement from a patient describing the positive experience of being in a shared ward, compared to a single-bedroom: “If you were in a private room, one might lose the sense of his surroundings. That wouldn’t be nice. You measure yourself, a bit, with your surroundings." (Cited in Folmer, 2014, p. 46, my translation).

10.4 THE OVERHEARD [P4]

I will end by briefly introducing a project Morten Riis and I are developing with a range of collaborators to explore and develop the *attuning approach* in other contexts, outside the hospital. Our project *The Overheard* is unfolded throughout 2017 as a part of the *European Capital of Culture Aarhus 2017*. *The Overheard* will invite the citizens to actively tune into the overheard surroundings, and begin to rethink traditional distinctions between sound, music, noise and environment. The aim is to develop an attentive ear, and inspire everyone to form a new relationship with everyday noises. This vision will be unfolded through interconnected parts that will enable everybody to mix and create their own ongoing real time soundtrack to their lives throughout 2017. The two main parts are six mechanical and electromechanical outdoor sound sculptures around the Central Denmark Region, and a webpage that stream live audio from the locations of the sound sculptures.

Figure 11: Test website for the Overheard, launch 1. March 2017 at www.overheard.dk

The sound from the locations are streamed through a number of mobile listening devices (*Audio Satellites*) from which sound is distributed in real time to a server and made available for listening at the website. The *soundscape* can only be heard in real time, and is not recorded. At the website users can make a personal mix of the sound streams from the locations. The proposed *soundscape* mixer is compatible with current digital devices such as smartphones, tablets and computers (see [P4] for tech and related work). The project is developed based on the *attuning approach* aligned with Marcel Cobussen's recent call for a "new" sonic ecology where sound artists and artistic researchers are central to the process of re-imagining public urban spaces as sites that "simultaneously provide for daily needs as well as facilitate environmental comfort by affecting the moods and emotions of the ones traversing these spaces" (Cobussen, 2016, p. 10). Art is thus invited to become functional again, through micro-political interventions that contribute to a more pleasant life. However, this also asks for a rethinking of the concepts *art* and *artists*, of their role in our current society, of their contribution to urgent

issues. The *Overheard* in this way also aims to be a critical practice (Thibaud, 2014, p. 290) focused on challenging and discussing existing strategies for aestheticization of public places. Therefore we initiated the *Overheard LAB* that uses *The Overheard* as a platform for discussing such issues across diverse disciplines, intitutions and sectors taking a positive starting point. The aim is to develop a broader understanding of how to address the challenges complex and shared *soundscapes*, recalling the words of Max Neuhaus:

> "Obviously we need to be able to rest from sound just as we do from visual stimulation, we need aural as well as visual privacy, but silencing our public environment is the acoustic equivalent of painting it black. Certainly just as our eyes are for seeing, our ears are for hearing"' (Neuhaus, 1994)

Figure 12: Collage of the sound sculptures for The Overheard, photos: Tõnu Tunnel, Olaf Zhiga, Zimoun, Frode Gundorf Nielsen

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PART IV

INCLUDED PAPERS

[P1]

Sofie Kinch & Marie Højlund (2013)

Kidkit Guides Children into Alarming Atmospheres: designing for embodied habituation in hospital wards

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[P2]

Marie Højlund & Sofie Kinch (2014)

Alarming Atmospheres: Embodied Sound Habituation as Design Strategy in a Neuro-Intensive Care Unit

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[P3]

Marie Højlund & Morten Riis (2015)

Wavefront Aesthetics: Attuning to a dark ecology

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[P4]

Morten Breinbjerg, Marie Højlund, Morten Riis, Jonas Fritsch & Jonas R. Kirkegaard (2016)

Audio Satellites: Overhearing Everyday Life

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[P5]

Marie Højlund (2016)

Beyond Insulation and Isolation: towards an attuning approach to noise in hospitals

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Marie Højlund & Morten Riis (2017)

Inconsistent Transduction: Not-knowing Through Sounding Art in Artistic Research

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Note to paper: The beginning and ending of the section "Object-Oriented Ontology and Causal Aesthetics (p. 4-5) are similar to parts in the section "2. Object-Oriented Ontology" (p. 250-251) in [P3]. References to [P3] ought to have been included in the published version of [P6].

Kidkit Guides Children into Alarming Atmospheres: designing for embodied habituation in hospital wards

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ABSTRACT
This paper presents the concept of Embodied Habituation as an architectural approach to designing contextualized technologies. It does so by identifying *Middle Ground Experiences* acknowledging how spaces are inhabited with ambiguous qualities that affect people emotionally. The research is based on the development and evaluation of Kidkit, which is interactive furniture designed for young children who are going to visit a hospitalized relative with fatal injuries for the first time. Kidkit empowers the child to engage and be present by shaping Middle Ground Experiences in the hospital ward environment that is full of intimidating medical equipment and alarms. The evaluation results indicate collective rewards gained when children succeed in Embodied Habituation. Finally, the paper discusses how Middle Ground Experiences inevitably establish grounds for how we design for spatial experiences within the interaction design community.

Author Keywords
Embodied Habituation; Middle Ground Experience; Atmosphere; Hospital; Interactive furniture; Sound.

General Terms
Human Factors; Design.

INTRODUCTION
"I feel that there are two different ways of experiencing this place, because when I have been off for a longer period, the place affects me in a different way than in everyday work life. After a holiday I can often have this… my gosh, do I really have to go in there?" [Sabroe, interview]. The quote explicates how an experienced nurse encounters the atmosphere of her work environment as a double-take experience. The ward, in which she is working, is a neuro-intensive care unit and by all means an extreme environment as patients are admitted with emergency and hovering between life and death. On one hand, the nurse habituates the stimuli in the ward due to her profession; on the other hand, she recognizes how the unit is inhabited with a certain, almost paralyzing, atmosphere, when she has been off for a longer period of time. This experience points towards habituation i.e. how the emotional impact of a contextual space changes over time [4]. Habituation is a natural process responding to how the human brain is attracted to novelty [ibid]. Despite increasing interest in socio-spatial [10], as well as architectural [12, 22] qualities within the field of interaction design, the habitual impact of our experience with contextualized technology calls for further investigation.

In philosophy, embodied experiences of space is examined by Bachelard [3] and in his book 'The Poetics of Space' he points to the fact that poetics is a way to probe the impact of human habituation on geometrical form. In this manner poetics refer to the 'impurity' of experience that goes beyond an objective description [24]. Poetic experiences of space is in this paper referred to as atmospheres and following philosopher Böhme [5], atmospheres are not reserved pleasurable experiences as space can be inhabited with all sorts of them including those of e.g. terrifying and oppressive character [ibid]. To design for 'the flux of lived experience' we emphasize that atmospheres exists as dynamic entities in-between space and body and we refer to Lefebvre's rhythmanalyses [21] as well as Abraham's notion on 'rhythmizing consciousness' [1] as ways to deal with how spatial entities affects us over time.

In this paper we propose the concept of *Embodied Habituation* (in the following EH) as an architectural approach to designing contextualized technologies. EH recognizes how we are affected by the environmental setting over time as repetitive embodied stimulation gradually reduces the strength of a response. To exemplify our point we refer to flight training equipment for astronauts. In order to preparing themselves for the flight, they use simulators to embody the feeling of being inside a spaceship. In this environment the astronauts are learning to resolve all such problems that might occur during their stay in space. The flight simulator becomes a tool for EH as

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it repeatedly exposes the astronauts to stimulus, e.g. weightlessness, in order to shift these stimuli into background awareness. An interesting point is that the artificially created set-up does not diminish the usefulness of the EH approach. So how do we design for EH, when it is not physical factors such as weightlessness, but instead experiential factors as intrusive atmospheres of ward environments that we have to learn to embody? The paper is outlined as follows; first, we are positioning Middle Ground Experiences within the field of interaction design to set the ground for designing for EH. Then, the explanatory scope of EH is illustrated through the design case Kidkit. Finally, the method of EH is discussed and this is followed and concluded by a description of Middle Ground Experiences as new architectural perspective on interaction design.

RELATED WORK

Within the last decade an architectural perspective on pervasive computing has been of increasing interest to interaction designers, emphasizing that a basic premise of designing digital artifacts is that they shall be experienced on the scale of the body among co-present, collocated people [11, 20]. In this paper we shed light upon the experiential aspect of the context with particular interest in bodily awareness in space. We stand upon the shoulders of the tradition of Tangible User Interfaces, which has been occupied by an interest of designing for the sensing body [9] and also investigated the difference in designing for foreground attention and background awareness [17]. Initially, Ishii et al. [17] present peripheral interaction as a way to integrate technology in space and through the design case *AmbientRoom* they investigate how to design for background awareness through "a personal interface environment designed to provide information for background processing" [14, p.173]. Hence, referring to space as personal, three-dimensional structure, neglecting the value of the room, as a social and atmospheric space.

To stage our position we first present 'artifact oriented experiences' referring to Embodied Interaction [9] and Co-experience [3]. Then, 'experience oriented environments', referring to Affective Engagement [12] and Spatial Sharing [9]. However, these approaches do not appropriately cover our intentions of embracing the atmospheric qualities of space whereas we introduce Middle Ground Experiences to advance a better understanding of bodily awareness in space and serving as resource when designing for EH.

Artifact oriented experiences

In the following we refer to the concepts of Embodied Interaction and Co-experience coined by Dourish [9] and Battarbee [3] respectively. Both paradigms advocate for how tangible and social computing take advantage of the user's embodiment in the real world when interacting with the system. To follow the aim of the present paper, we analyze these paradigms in the light of how they respond to the contextual setting of the experience.

Dourish's emphasizes that the quality of embodied interaction is found in the relation between the tangible artifact and the physical and social experience it entails [9]. He points to the fact that designers increasingly need to understand that interaction is intimately connected to the setting in which the interaction occurs. However, the idea of setting is vaguely explored by Dourish e.g. "the physical environment are arranged so as to make certain kinds of activities easier (or more difficult) and in turn, those activities are tailored to the details of the environment in which they take place" [9]. Dourish refers to physical environment as a functional space, a frame in which the embodied experience occurs.

Lets then consider the definition of Co-experience by Battarbee [3], which describes experiences with computational products in terms of how the meanings of individual experiences emerge and changes, as they become part of social interaction. The investigations of the concept remain in case examples among people situated in physically distant locations using e.g. mobile phones [ibid]. Thus Co-experience shed light upon relevant social aspect of user experience design but does not fully consider the role of other participants, their bodily relations and the environment in which the experience emerges [3, 11].

Experience oriented environments

To go further into the poetic qualities of space as introduced in the beginning of the paper we are dealing with processes in space [2] as well as how these affect our consciousness [1]. We follow these entangled processes firstly presenting the notion of Affective Engagement [12] referring to relational processes that can be transmitted in between people and environment. This is then followed by a recent DPPI contribution on Spatial Sharing [11] that inevitably points towards the collective gains of approaching user experience design from an architectural perspective.

Building upon Massumi, Fritsch offers Affect Engagement as possible resource when designing interactive environments [12]. This is a new perspective on affect to HCI contributing to moving away from previous understanding of affect as something, which can be transferred from an object (or a system) to a user [ibid]. However, due to the autonomy of affect, Fritsch argues that it does not make sense to talk about affect as part of either a person or a system. Instead, affective engagement is unformed and unstructured relational accounts that can be transmitted in between bodies [ibid]. The idea of affective engagement provides an understanding of how we orient ourselves in the world from a range of complex experiential dimensions, including nonconscious levels of experience such as passion and visceral reactions [ibid]. Thus affective engagement provides us a vocabulary for talking about how we experience interactive technologies in the world. However, we stress that from an operational design perspective it is difficult to grasp the complexity of Affective Experiences.

Another approach, which is highly relevant in this paper, is the paradigm of Spatial Sharing introduced by Fogtman et al. [11], which deals more extensively with the social aspect. With point of departure in architectural theory as well as interface design paradigms, Spatial Sharing emphasizes the potential of designing computational interfaces as architecture—as physical space offers us to look at the space in-between artifact and users [ibid]. Thus, we acknowledge that it is it not the artifact that is in focus when we interact with it; as the physicality of the artifact, slides into background to give room for the interaction accruing between people thus accentuating the created space between the participants via the computer [ibid]. The paradigm argues for approaching computation as architecture in the sense that people share it; "It is not *my* space but *our* space and we find ways to negotiate the sharing based on our common cognitive background" [11]. Spatial sharing emphasizes physical interaction among collocated people and we build upon this going further into how affective relations among people collectively affect the interaction vice versa.

Middle Ground Experience

Initially, the field of interaction design has been occupied with an interest of designing technologies for foreground of attention, later expanded to encompass background awareness [17]. In the following section we raise our concerns on how the in-between is left unarticulated [18] and refer to the Middle Ground Experience (MGE) drawing upon architectural [24, 26] as well as philosophical notions on atmosphere [5, 6]. To begin with a clarification is needed on our understanding of space.

Following Harrison and Dourish's distinction between space and place to the interaction design community, where 'space' refers to 3-dimentional structures of the world and 'place' refers to the experienced meaningful reality [10] we emphasize that MGE is not a relational account of mathematical 'spaces'. Rather, we approach the in-between as the way poetic qualities of space affects our being in it. We refer to Böhme's notion of 'the space of bodily presence' being the space within which we each experience our bodily existence [6]. "It is 'being here', a place articulated absolutely within the indeterminate expanse of space" [5 p4].

It can be difficult to point towards which elements constitutes the MGE as it is a complex fusion of countless factors which are immediately and synthetically grasped as overall atmosphere, ambiance, mood [24]. Acknowledging a spatial timbre created in-between subjects and object helps us to articulate how we do not perceive the MGE, but rather perceive on the basis of it [25]. Thus objects as well as other people being present in a certain space are all contributors of the MGE. The MGE is multisensory, and although it is experienced deeply subjective, it is common to all subjects and Böhme refer to atmosphere of a space as an 'quatsi-objective' experience as it is in-between us and in us at the same time [5]. Thus the MGE is not a personal feeling of a place, but rather 'an affective tonality' to use Massumi's words [14]. The MGE is never static, and to highlight the dynamic of it how we build upon Thibaud [25], who emphasizes how the temporal dimension give life to environments. We do not passively sense the MGE, as it sets the tone of a situation but resonates with the sensing bodies in a constantly shifting consonant and dissonant relationship [ibid]. This approach can help us to rethink how we over time get accustomed to a given contextual setting. To sum up, the value of MGE to the interaction design community is acknowledging how physical space collectively affects our bodily being in it and how the shared experience evolves due to physical factors thus it can be manipulated through technologies and people.

RESEARCH PROBLEM

The presented approach of MGE points towards an unleashed potential of approaching user experience design with respect to how our interaction with technology as well as with each other is affected by the contextual space. This concern points towards gains of approaching user experiences from a philosophic perspective emphasizing the notion of atmospheres. As pointed out by Dalsgaard et al. [7] remarkably few have been occupied with this interest within the field of interaction design. Therefore an expanded notion of the Böhmian atmosphere related to HCI practice is suggested, by supplementing the notion of atmospheres to encompass technological, social and temporal concerns [ibid]. Concerning temporality they highlight that the atmosphere should be constructed as a processual and not static phenomenon "implying that the dimension of time is essential to understanding atmosphere" [ibid]. However, the temporal aspect is not further articulated as it is sub ordered in more palpable concepts such as space and technology. We emphasize this to be a problem and highlight how the dynamic aspect is essential when designing interactive technologies for an atmospheric context [16]. In the following we are presenting a design case, where the context inhabits a thick atmosphere, which to a majority of people is immediately experienced as intrusive and stressful. Thus we are interested in how to 'soften' the experience of the atmosphere. A critical question to explore is "how can collating the Middle Ground Experience with the concept of Embodied Habituation deal with the contextual experience in the perspective of how user experiences unfolds over time."

DESIGN CASE: KIDKIT

The methodological approach for designing for EH is in the following unfolded in an environment where the Middle Ground Experience seems extreme as it can bring first time visitors into state of alert. The design research has taken place within the context of long-term activities in a neuro-Intensive care unit, (in the following referred to as NIA), Aarhus University Hospital in Denmark. To give a brief impression of NIA; patients are admitted in emergency e.g. traffic casualties, and they have a heart condition, see

Figure 1. The sterile ward environments host three beds each; thus each ward is filled with alarming sounds and staff in determined action. The Middle Ground Experience is extremely tense in the wards giving the severe circumstances of the patients and following their relatives as pointed out in [13].

The design case has evolved through iterative design processes and user studies and interviews to set the ground for the design choices responding to high ethical standards. Initially we were informed by ethnographic observations in the ward and interviews with the staff regarding what problems they are facing in everyday life. During the design process, we discussed our concrete design suggestions with users, namely nurses and young children.

Design problem

In the design case we are concerned with the dilemma of bringing young children to meet a relative with fatal injuries in the alarming ward environment. On one hand parents do not think NIA is an appropriate place for children as a nurse explains: "Many parents are, certainly, fearful to bring their children here, and they are not pleased to do it, and that is, of course, understandable. They want to protect their children" [Sabroe, Interview]. On the other hand visiting the hospitalized relatives helps children to demystify their imaginations and diminish traumas in later life [15]. Staff at NIA follows recommendations [ibid] that children from three years onwards shall be informed and involved in the process of illness of a relative since young children often imagine a situation much worse than reality. Nevertheless, nurses most often need to encourage relatives to bring their young ones to NIA and it can be complicated as it requires mental energy to handle children between three and seven years, when a near relative has fatal injuries. The reason is, that children at this age do not comprehend the absolute concept of 'never again' and as such the fact that a dead relative is not coming back [ibid]. This is often confused with the fact that young children are not mourning; they do, they just do it in another way; in a different pace [ibid]. Nevertheless children who are going into NIA need to be meticulously prepared. Because is not unusual that young first time visitor's respond to the environment by panicking [Stylsvig, former psychologist at NIA, interview].

In the ward, children are meeting a hospitalized relative eclipsed in medical apparatus and monitors and "because the hospitalized look alienated to the children, it is important that they meet the equipment as a friend" [Stylsvig, Interview]. Today, nurses emphasize to create a sense of connectedness with the children immediately after they have arrived. They use their intuition and humor, if appropriate [Sabroe, Interview]. But there are no specific procedures accompanying the visit situation. One tells that she tends to make drawings to explain the equipment to the child before entering the ward [Stylsvig, interview]. Another brings a draining tube, to show some of the equipment before entering [Moeslund, Interview].

Figure 1. Design context is NeuroIntensive care unit

What appears as a design problem is, that tools are lacking for preparing the children on entering the ward as well as assisting the children during the visit in the ward. Potentially, we emphasize that an initiative that accommodates the visit can have contagious effect on parent's willingness to bring their children to visit the hospitalized.

Designing for embodied habituating in NIA

When children enter NIA to meet a hospitalized parent or sibling, for the first time, they embody a lot of conflicting feelings and expectations, like fear, curiosity, excitement, love, anger and hate [Stylsvig, Interview]. They are entering a situation that is difficult to understand and at the same time confronted by life and death in an environment that by all means evokes bodily state of alertness. In order to accommodate the best possible visit situation and make the children feel comfortable we use EH as method. This allows us to articulate the MGE and how it affects children's shifting awareness in the ward.

In order to investigate how children gradually can become familiarized to the ward environment, a prototype initially helped us to clarify our design intentions and discuss these with potential users (two nurses and two four-year-old girls). The prototype is 'a magic cube', see Figure 2, which continuously unfolds thus exposing ten relevant pictures for discussing the circumstances of being visitor in NIA, e.g. an ambulance, holding hands, ward interior. Through this prototype we gained insight on, at least two important aspects of, how to approach EH in NIA.

In order to prepare the children the nuses have to demystify the environment before entering. In the cube-prototype we use visual representation, however, through discussion with the four-year old users, we realize, that this way of demystifying leave only little space for imagination; the children passively receive information instead of being constructors of it. As consequence, we choose another material: instead of visual representations, we emphasize how the sounds of the hospital equipment are more appropriate for preparing young children on the ward environment. According to the staff [interviews] and relatives [13] these are the primary stress factor, as the alarming sounds exist in constant cacophony. We present

Figure 2. The magic cube

the sounds by letting the children tune into the alarming sounds, as we refer to the concept of 'peepholes' [8] that allows children to access only a small part of a complex situation, and thereby stimulate curiosity, imagination and exploration. Thus, by comprehending small bits of information at a time, the children are gradually synchronized to the new environment.

Another insight from 'the magic cube' is the sense of belonging in the ward, through 'the magical cube', we realized that a small interface potentially exclude others from participating in the conversation in the waiting room. Furthermore, the cube does not assist children into the ward in a meaningful manner, neither it assists the meeting with the hospitalized. Thus we emphasize the importance of designing a digital artifact, which not only introduce the ward environment before entering, but also engage children in an embodied and meaningful way. Following Antle [2] we emphasize that the digital artifacts shall be tuned to children's developing abilities and how they create meaning through action. Furthermore, designers of interactive technologies for children, may find success in looking into children's own worlds referring to known materiality's and known practice [ibid].

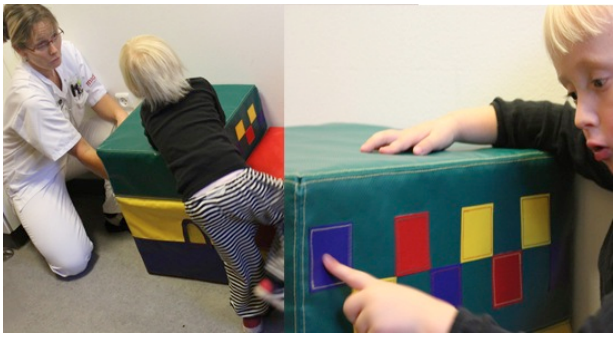
Ethical concerns on the design problem

The design problem can be approached from at least two perspectives, pointing to either technical or moral answers [11]. If we approach the alarming sounds as a technical problem, the answer would be to eliminating the alarming sounds. If we approach the alarming sounds from a moral perspective we dissolve the problem, as we instead recognize the alarming sounds and use these as material [ibid]. Pointing towards a moral design approach, Kidkit raises questions on how to design a digital artifact that in a respectfully manner facilitate the meeting between the patient and the child.

In the design process we are discussing whether the artifact shall appear as 'a friend' e.g. a cute, animated figure exemplified by 'a snail' that with its reactable feelers guide children towards the of bed the hospitalized. However, approaching the design as 'a friend' raises a number of concerns e.g. target group, symbolism and trust. Further, 'the snail' is designed for focal attention when entering the ward and when discussing this with a nurse, she proclaims "This isn't going to happen. We show the child where the hospitalized is." Thus to accommodate the sensitive visit situation we argue that the artifact has to appear as 'a tool' assisting the nurse as well as children when entering the alarming atmosphere environment.

Form and interaction technologies

Kidkit is an interactive, mobile and transformable piece of furniture, which is designed for children to habituate the ward environment by making them familiarized with the alarming sounds while being in the silent waiting room. Children can wheel Kidkit into the ward and through transforming actions it can be unfolded into a stairway, in the ward helping children to approach the hospitalized in their own pace. To get a complete impression of Kidkit, we recommend to see our video scenario on



http://vimeo.com/63073206.

Figure 3. Demystifying the alarming sounds

Figure 4. Unfolding Kidkit into a stairway

Figure 5. Kidkit facilitates different situations

Kidkit has the shape of five upholstered blocks, each having the dimensions of 42 x 42 x18 cm stacked in two piles, whereas the upper block in each pile is flexible. On the upper, green block of Kidkit a touch interface is sewn into the surface, see Figure 3. The interface is consisting of eight sound triggers, made from touch sensors and a Phidgets board. Through a computer, the sounds are played through a loudspeaker. The sounds have been recorded in the ward and are categorized in three groups; yellow represent three different alarms, red being two suctions from a respirator and blue are three 'metallic' sounds e.g. closing the lid on the bin. The interaction refers to a well-known practice, where a push triggers an audio event as feedback, known from e.g. an audio sampler where sounds differ in rhythm, which makes the sequence more fun to play with.

The material of Kidkit is hard foam in order to accommodate comfortable seating, secure standing and lightweight transforming actions, see Figure 4. The upholstery is tarpaulin that comes in four colors; red, green, blue and yellow. Tarpaulin allows for cleaning with alcohol, which is required in hospital environments. Yellow nylon straps on the vertical side of the blocks indicate the affordance of flexibility. Wheels are revealed through a handle on the side of Kidkit, making it possible to lift and lower the furniture when wheeling it from one space to another.

Kidkit is interactive furniture, and not a handheld device, because furniture physically relates equally to body and space thus emphasizing collective qualities. Figure 3, 4, 5, illustrate how Kidkit facilitates different positions both according to the relatives bringing the child, the child and the hospitalized and also for the nurse, assisting the visit. In the ground-position, Kidkit appears as seating for two, allowing the child to be physically close and at eye level with an adult because intimacy is of utmost importance during the visit in NIA, see right hand side of Figure 5.

Embodied habituation through Kidkit

Figure 6 illustrates how Kidkit is a tool for making the entrance into NIA less dramatic, firstly by listening to the alarming sounds by pushing the triggers. This action brings background phenomena of the ward into focal attention in the waiting room. By allowing children to control the alarming sounds, they are familiarized with these before entering. Furthermore, Kidkit allows children to transform the furniture into a stairway configuration.

Bringing the artifact into the ward creates a secure background space for the child. Kidkit is designed both for foreground attention and background awareness, and these different state of minds are underlined by the colors of the furniture, thus it both appear in strong colors in the waiting room; see Figure 3, and in gray scale, when unfolded in the ward, see Figure 4.

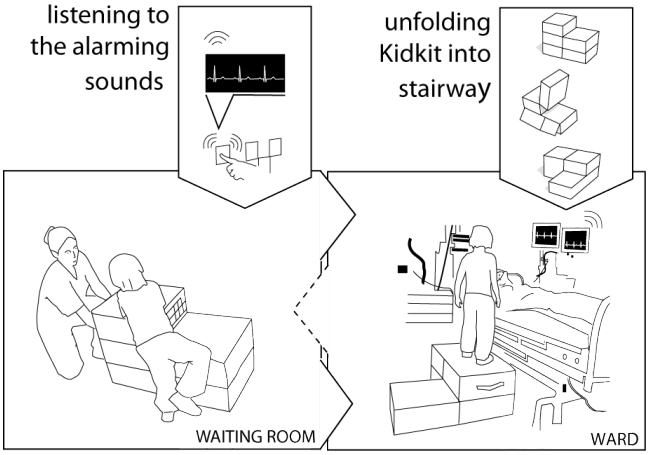


Figure 6. The design principles for EH in NIA

Methodological approach for evaluating Kidkit

Conducting research in real world environments is put to the extreme when evaluating Embodied Habituation through Kidkit. The Middle Ground Experience is very unique in NIA and we analyze the use of Kidkit in real visit situations. As such, we are not only dealing with evaluating our design artifact in the field [19], we are also dealing with users who are in a very sensitive situation. Kidkit has been tested in NIA for eleven months when the evaluation ends by December 2012. During this period Kidkit has been assisting nurses to accompanying children between three and seven years to meet a hospitalized sibling or parent. The evaluations indications build upon qualitative reflections written by the nurses and followed up by interviews, when possible. One time, we attended a visit situation ourselves.

All evaluation indications we gained through having Kidkit in NIA for 11 months are relevant to us. In the beginning of our evaluation we were facing a problem that nurses did not turn the furniture on meaning that they did not introduce the sounds to the children as intended. Most likely this was caused by lack of communication which we have taken note of. Another aspect is that Kidkit was 'unknown' and to some nurses it seemed complicated to integrate in everyday work practice [Moeslund, interview]. Initially we were invited to join all user test, however in everyday practice we were told that it was "confusing" [Løth, Interview] to invite us, not pointing towards our presence in the ward, but rather the procedures of making the phone call knowing that this would possibly be connected to a lot waiting time. We have emphasized that this was "no problem at all". However, to exemplify the concerns the nurse refers to, we have experienced that a test of Kidkit was cancelled, simply because the hospitalized died before the young visitors arrived.

The evaluation of Kidkit has been complex, first of all because evaluating children in a visit situation in ward environment is a highly sensitive situation as the young users (and their family) are in crises. People find it

inappropriate to be filmed or interviewed in such a sensitive situation, which makes it complicated to document the research results. Following we have been dependent on the nurses and their willingness to participate. As evaluating Kidkit has been an additional activity in a stressful work environment, we are aware that evaluation of Kidkit has been given low priority in comparison with taking care of the severe patients. However, the circumstances for doing research among people in crises should not be an obstacle in it self, but we have to accept that the evaluation results in real world environment are highly sensitive, thus highly valuable, as we are approaching users in an exceptional situation. Following Latour [20], Kidkit exemplifies how design research has to be 'interesting' it has to be 'risky'. Thus when conducting practice based research we have to acknowledge the complexity as it is "engaging what a thing is in the fate or destiny of many other things as well" [ibid p215]. Latour emphasizes that instead of validating research as distance between the observer and the observed, we shall look at the contents of the world 'before and after' the inquiry [ibid]. In the following we go further into how Kidkit affects children as well as the nurses relation to them in everyday practice.

DESIGNING FOR EMBODIED HABITUATION

Our aim of designing for Embodied Habituation is in the following presented through the evaluation results we gained in NIA. We reflect upon nurses' overall experience of the visits; and how children are able to handle visiting the hospitalized relative in the confusing ward environment. Following the evaluation indications, we then present how Embodied Habituation serves as method to colleagues within the field of interaction design.

Evaluation indications on embodied habituation

To illustrate how Kidkit in our perspective has facilitated EH we present a visit situation where a seven-year old is going to visit his hospitalized little sister. We are ourselves present during the visit, and when the brother is introduced to the sounds in the waiting room; the nurse emphasizes how the conversation provides him strong insight into the sounds of the apparatus; thus Kidkit helps the brother for EH in the ward, while being in the waiting room. "Are these sounds coming into Julia (sister) right now?" he asks when he releases the sounds on Kidkit. The nurse explains; "The equipment is noisy because it wants the nurses to look at it. It does not make noise, because your sister or the other patients are in pain" The conversation points towards how EH can be influenced by preferences and attitudes towards the sound. If we know that a sound is not dangerous, we are more likely to accept the existence of it, thus, the conversation demystifies the sounds and helps the brother for EH as he is told that the sounds are not dangerous. In the ward, the seven-year-old does not seem to notice any of the alarming sounds. He feels calm, he is telling stories and holding his hospitalized sisters hand, see Figure 7. However, after the visit, we ask him, if he recognized any of the sounds from Kidkit, while being in the ward. "Yaehh.. I heard the dododododo sound" he says and self-confident he repeats the rhythm of the alarming sound. Our evaluations indicate that the seven-year old brother is learning to be affected and Kidkit is tool for EH in the new environment as it conveys a linkage between the brother and the ward. Once children have heard the alarming sounds so many times that they feel the sounds to be familiar and not interesting, the children have the ability to put them into background of awareness because they are expected and predictable in the context. This example is underlined by similar visit situations pointing towards a difference in children's ability to socialize when they have been introduced to the sounds of the ward beforehand.

A majority of the responses we receive from our interviews point to the fact that Kidkit is a favorable instrument for nurses to establish contact with the children. One nurse points to the fact that Kidkit highlight a shared focus on the child when being in the waiting room; "There is no doubt that the conversation was between the child and nurse and not between the adults - It was nice, for me, to have a tangible starting point for the conversation". And in line with this, another nurse emphasizes; "The children are involved in the visit. It matters that we meet them on a children's level." To give a few examples on the play practices Kidkit entails one child enters the ward sitting on Kidkit 'driving a train'. Another example is given when a son and daughter are going to visit their father who is hospitalized. They are around two and five years old. When the son is wheeling Kidkit into the ward, the nurse emphasizes that the situation is 'well-known'. The son tells his mother "I know this one". The fact that he takes ownership shows that he is confident and not scared on entering the ward and he becomes 'more' than a visitor because he is in charge of the situation himself.

This being said, we also see examples where the nurses are split between handling adults in crises and the children. To give an example; two brothers are going to visit their hospitalized mother. The Middle Ground Experience in the waiting room is extremely tense as the farther is in crisis and "the boys are not in focus, they are just there". When the nurse turns Kidkit on and presses a button "they are immediately there, both of them, and they actually thought it was funny and smiled when it said something…" The fact that the boys are smiling indicates that they are hearing the sounds as rhythms and not as alarms they should be afraid of. "Both boys are very interested in one particular sound, it was always this 'dododododo' they were searching for. They were sitting on each block of Kidkit while investigating the sounds " the nurse explains. Thus Kidkit has become object for shared exploration, and it frames a gameplay among the brothers in a confusing situation where their father is in crises and not in a state of preparing his sons on meeting their critically ill mother.

Figure 7. 7-year old boy visits his hospitalized little sister

Another insight is the quality of establishing a space, where the children belongs, either being in the waiting room, moving into the ward, or next to the hospitalized. Nurses independently refer to Kidkit as a 'comfort zone' for the children, which is remarkable in this environment. Three examples are in the following given on Kidkit as a comfort zone; In one example, Kidkit facilitates a safe ground for two girls, a daughter and a niece, both seven years old. The nurse explains: "They say no, when I ask if they want to wheel Kidkit, so then I do it, but both of the girls are walking on each side of it when we enter the ward". In this situation we see that the nurse is guiding the children into the ward through wheeling Kidkit. In another example is a six-year-old girl visiting her little sister. When she places Kidkit next to the hospitalized, she unfolds Kidkit and spontaneously she steps up. Curiously, she looks at her sister and places a present on the bed. Then, she steps down again and talks to the nurse about her sister's situation. Later, the girl steps up on Kidkit, she looks at her hospitalized sister and claims; "Her face is not in a very good condition" Thus Kidkit allows the sister to approach the hospitalized in her own pace. Third example is illustrated in Figure 7, where aforementioned 7-year-old brother is sitting on Kidkit next to the nurse and his hospitalized sister. After the photo is taken, the mother tells that her son is lying up side down playing mobile apps next to the bed. "It did not look comfortable, but he insisted to be on Kidkit" she tells. Thus Kidkit appears to be a comfort zone even when the environment is demystified and he is entertained by playing a game.

Embodied Habituation as method

In everyday life, the change of attitude via habituation usually happens almost passively in environments where we spend a lot of time, through a gradual and slow adaptation [4]. EH follows the phenomena of 'habitual contexts', which is introduced by McCullough in his book; Digital Grounds [19]. McCullough stresses the importance of how background processes in architectural space continuously influence the way we interact with technology [ibid]. EH points towards how interaction designers shall not approach the contextual setting of their designed artifact as fixed ground but instead as flows constantly evolving in-between user's foreground attention and background awareness. Referring to the example of the astronauts preparing themselves for flight in the introduction of the paper EH happens through repetitive stimulations of the body. We cannot learn to be affected through intellectual exercises and according to aforementioned example; reading about being in a spaceship would not be sufficient training for the astronauts. EH is a dynamic process of getting accustomed to a particular context, thus we need to expose ourselves to the stimuli through repetitions . To coin the term; Embodied Habituation exists as dynamic negotiations between bodies and space and repetitive stimulation will gradually help us to leave certain environmental stimuli into background awareness. Other people as well as digital artifacts can obstruct as well as accentuate the natural process of Embodied Habituation

In the Kidkit design case, we are occupied by an interest of designing for children to accelerate their process of EH and as such habituate faster than normal in NIA. This is needed because children enter a confusing and stressful Middle Ground Experience where various stimuli content for their focal attention. If we do not help children to leave sensuous stimuli into background awareness, the environment will inevitable take away attention from the aim of the visit, that being to communicate with the sick relative. Kidkit illustrates how to use EH as method, however it is produced through a local understanding in NIA and we acknowledge how the Kidkit design approach cannot be applied uncritically to other design contexts. Thus designing for EH in other contexts, hosting other types of Middle Ground Experience, calls for other design concerns than presented in the Kidkit case.

DISCUSSION

Our design case has demonstrated the concept of designing for Middle Ground Experiences underlying EH as method. Further we have argued that Middle Ground Experiences represent an architectural approach to designing for contexts by acknowledging the atmospheric qualities of place. By focusing on how a shared ground affects the way we interact with technology vice versa we align ourselves with recently developed paradigms of Embodied Interaction [9], Co-experience [3] and even more specifically with Affective Engagement [12] and Spatial Sharing [11]. On the face of that we will now discuss further how our approach differs from those proposed by Dourish, Batterbee, Fritsch and Fogtman et al.

Kidkit is interactive furniture; a tangible, movable artifact designed for all the senses. Following Dourish' argumentation on Embodied Interaction [9] Kidkit may seem as a good example of a Tangible User Interface. However it goes beyond the intentions of both Dourish by actively incorporating the contextual space in the design

process and how such qualities can infuse our relations with tangible devices. Following Battarbee's argumentation on Co-experience [3], we argue that the aim of Kidkit is to establish a better experience among people; being the child's relation to the nurse as well as to the hospitalized. The question is then, whether Co-experience covers the social experience Kidkit entails? Following Batterbee's argumentation Co-experience is created over physically distant locations e.g. telepresence environments. Therefore we emphasize that our concept of Middle Ground Experience is shared experience in situ and cannot be experienced from elsewhere.

Our approach shares prominent theoretical beliefs with Fritch [12] as well as Fogtman et al. [11] regarding our awareness on how subconscious processes affect the way we interact in interactive environments. Fritsch points towards concerns on making Affective Engagement operational [12] and we will argue that approaching Affective Engagement as flows in the Middle Ground helps us to contextualize these phenomena and approach those through multisensory means. Thus, Middle Ground Experiences articulate how Affective Engagement is a shared ground, and also how this can be manipulated through physical as well as social effects. Following Fogtman et al.'s argumentation on Spatial Sharing [12] we point towards computation that can be experienced as architecture as it establishes a social space among people; a space where the interaction and not the artifact is in focus. We go further, as the shared space is not only accentuated by the physicality of the artifact but through all means, digital as well as analog; participating users as well as other people and how all these entities together affect an overall timbre of a common Middle Ground Experience. We acknowledge how the Middle Ground affects our shared experience and how this 'in-between' evolves over time thus affecting our interaction with the digital artifact vice versa. A starting point for designing for Middle Ground experiences is therefore acknowledging its complexity [25].

The Middle Ground Experience refers to the intertwining between people and the world, and when Merleau-Ponty [23] refers to the "halfway" we see another way of approaching the grey area between people and things. Merleau-Ponty explains; "People negotiate their way through this halfway with their eyes, ears, hands, and body, as well as their sense of space and movement and many kinds of things they are barely aware of. Although everyone lives in the halfway every second, there are only few words to describe it" [19, 23]. The quote points towards the difficulty of handing Middle Ground Experiences; however as pointed out by [19] designers trained in the arts shall keep in mind that they are trained to capturing fleeting moment. It can be a challenge turning the ephemeral Middle Ground structures into words and conduct research results within the ambiguous phenomena for several reasons[20], as exemplified in the case. To grasp one part of the complex whole, we introduce Embodied Habituation as a holistic perspective on the digital artifact. Designing a technical solution "solving the problem" has not in itself been the aim of the case rather we seek to approach the research problem with the aim of designing meaningful technology. Kidkit is a balanced way of articulating the design where there is no differential treatment of interactive vs. non-interactive elements, instead we emphasize that it is about the whole and one where the genuine orientation to the Embodied Habituation motivates all design choices.

LIMITATIONS AND FUTURE WORK

In order to qualify our claims, and to reflect on the results, we now discuss possible limitations of the study, which include the size of design examples as well as the number of user evaluations. One possible limitation of this work is that we present one designed artifact and its evaluation, instead of exploring variations of artifacts. While it would also be beneficial to test multiple options with the users, the value of bringing the artifacts into the wild and gathering thick descriptions of the experience was much more valuable. We could imagine building upon the current results and bringing those findings into future design cases, yet evaluating one prototype does not diminish the findings in the present paper.

Another limitation of our work is the number of evaluations, and during the evaluation process we extended our deadline twice, because of lack in proper results. During the evaluation we realized that in order to get proper results in a sensitive environment like NIA, we would need to be present in the ward. Thus showing up in the morning was not sufficient, as the nurses did not manage to call us, when young visitors arrived. As consequence we made ourselves present in the waiting room in NIA to make sure that we would attend the visits. This is very time consuming as nurses reckon that children approximately are coming to NIA once a week, however, we emphasize that this is actually acquired in order to gain proper user evaluation results on Kidkit in its environmental setting.

CONCLUSION

In this paper we have identified and presented the concept of Middle Ground Experience to articulating how atmospheric qualities of space has been neglected within the field of interaction design so far. We draw upon relevant paradigms of embodied and spatial interaction and to scan the missing in-between of foreground of attention and background awareness and establish our contribution in architectural as well as philosophical notions of atmosphere. In order to design for middle ground we present Embodied Habituation as a methodological approach and provided an example case to illustrate.

The example case Kidkit investigated how to design for empowering children to enter a burdensome Middle

Ground Experience - in this case, visiting a relative in a neuro-intensive care environment. We point towards the collective gains when children succeed in Embodied habituation thus emphasizing how the Middle Ground Experience can be manipulated through technologies to affects the behavior of collocated people.

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ALARMING ATMOSPHERES - EMBODIED SOUND HABITUATION AS DESIGN STRATEGY IN A NEURO-INTENSIVE CARE UNIT

Marie Højlund, Sofie Kinch

Abstract

Nurses working in the Neuro-Intensive Care Unit at Aarhus University Hospital lack the tools to prepare children for the alarming atmosphere they will enter when visiting a hospitalised relative. The complex soundscape dominated by alarms and sounds from equipment is mentioned as the main stressor. As a response to this situation, our design artefact, the interactive furniture Kidkit, invites children to become accustomed to the alarming sounds sampled from the ward while they are waiting in the waiting room. Our design acknowledges how atmospheres emerge as temporal negotiations between the rhythms of the body and the environment in conjunction with our internalised perception of the habituated background. By actively controlling the sounds built into Kidkit, the child can habituate them through a process of synchronising them with her own bodily rhythms. Hereby the child can establish, in advance, a familiar relationship with the alarming sounds in the ward, enabling her to focus later more on the visit with the relative. The article discusses the proposed design strategy behind this solution and the potentiality for its use in hospital environments in general.

1. Introduction

Many parents are, certainly, fearful of bringing their children here, and they are not pleased to do it, and that is, of course, understandable. They want to protect their children. (Nurse at the Neuro-Intensive Care Unit at Aarhus University Hospital)

Through a design project, we seek to explore how introducing sounds from the hospital ward into the waiting room at a Neuro-Intensive Care Unit can be a helpful tool in facilitating a less stressful visit situation between a child and the hospitalised relative. The project is a response to a growing wish amongst staff at NIA, the Neuro-Intensive Care Unit at Aarhus University Hospital, to motivate parents to bring children to visit relatives, with the understanding that it is important to involve children in the hospital stay of a relative, as they need to demystify the situation – fantasies are replaced by an experience of the actual situation – and they can benefit from being included in the process instead of feeling left out (Heslet 2010). Today, nurses spend much time informing relatives about the importance of this involvement, but more often than not, relatives maintain the belief that the hospital is an environment not suitable for their youngest children. Not only the meeting with a sick relative, but also the context of the hospital keep parents from bringing their children. To understand how we might meet the worries of relatives facing the visit situation, this research investigates what sets the grounds for such scepticism and how we, in a respectful manner, can prepare the visit in order to make it more inviting to bring children. The video below gives an impression of the design context:

VideoObject1: Impression of NIA

NIA represents a typical Neuro-Intensive Care Unit in Denmark where patients are hovering between life and death due to severe head and spine injuries. On the left-hand side of the main corridor is a small waiting room. Visitors often spend hours here, waiting for the right time to visit their relatives in one of the two wards, each holding six beds. The wards are located on the right-hand side of the corridor, each one separated by a glass monitoring room, where 6-8 nurses and doctors constantly monitor the patients. In addition to the ambient noise of conversations, equipment, computers and phones coming from the monitoring room, the soundscape of the wards also includes the constant beeping from up to fifteen alarms per bed, mixed with sounds from equipment that, when handled, can be quite loud. The sounds are not easily differentiated and emerge as a cacophony, difficult to understand for others than the experienced staff. Therefore, the staff emphasises that the soundscape of NIA represents the primary stressor to patients and visitors, as they perceive it as both intrusive and alarming. This experience is supported and documented in several studies made in similar

hospital environments, showing how unwanted sound, or noise, is a general problem in the modern hospital (Falk and Woods 1973; Baker 1984; Meredith and Edworthy 1995; Berg 2001; Rice 2003; Busch-Vishniac et al. 2005; Edworthy and Hellier 2005; Ugras and Öztekin 2007; Wainwright and Wynne 2007).

The nurses insist that children who are visiting NIA for the first time should be meticulously prepared for what they are about to experience before entering the ward. Otherwise they might become anxious, or even panic, which inevitably obstructs the aim of the visit. The nurses typically try to demystify the situation in the waiting room by drawing and talking about the hospital apparatus. However, relevant tools are lacking to prepare the children in an appropriate way for the soundscape, as it is difficult to mimic its effect using only words or drawings. This often leaves the children standing, frozen, in the ward, as the unfamiliar sensorial impression inhabits the foreground of their attention, leaving no perceptual room for the meeting. Therefore, in response to this concrete challenge, we initiated the development of the design artefact Kidkit, which invites children to familiarise themselves with the alarming sounds they will face in the ward, through the process of controlling and repeating them in an embodied and socially engaging way, with interactive furniture in the waiting room.

With specific attention for how the multiple sensory inputs of an environment affects the way we feel, behave and interact with others, the notion of atmosphere is presented as the overall theoretical approach when designing a tool to help children prepare for engaging with environments in which the soundscape forms an obstacle for social relations and/or a relaxing bodily state (Thibaud 2011). A focus on atmospheres underlines the impact of these impressions on the people involved, relevant to the view of a hospital setting as a place filled with unfamiliar sense impressions. From a design point of view, the concept of atmosphere is to be understood as a dynamic shift between those factors that might inhabit the foreground of the subject's attention and which might later inhabit her background awareness. The relations between different states of awareness are essential to the way we habituate ourselves to a place. Habituation is an often-overlooked phenomenon when investigating how humans sense, and cope with, their surroundings (Horowitz 2013: 44). Building upon habituation to atmospheres, ascribing to a dynamic perspective inspired by Henri Lefebvre's (Lefebvre 2004) concept of rhythm, we introduce *embodied sound habituation* as design strategy. Exploring how to smooth the way for a faster habituation process within alarming atmospheres, a strategy has been developed through implementing different tactics in the concrete design project, Kidkit.

In a broader perspective, embodied sound habituation represents a design strategy that challenges the growing field of solutions aimed at improving the quality of hospital environments through positive distractions (Hamilton and Shepley 2012: 165). Instead of offering a momentary distraction from the environment, embodied sound habituation aims at imposing a change in the attitude of the user towards an existing situation. Guiding the user to become an integrated and meaningful part of the existing environment is relevant in situations where it is not desirable to be distracted from the social and spatial surroundings, e.g. when interacting with others.

2. Related work

In the current discourse surrounding the planning and building of new Danish hospitals, there has been growing attention as to how the hospital environment and its sensory impressions can have an unintended negative effect not only on patients, but also on staff and visitors (Folmer, Mullins and Frandsen 2012). Several publications appeared concurrently, proposing recommendations as to how hospitals might accommodate more healing and pleasant environments through evidence-based research and design (Frandsen et al. 2009). This approach can be seen as part of a larger international paradigm shift in the design of the modern hospital: from functionalism towards a growing interest in improving the physical environment in such a way that it supports user needs, preferences, and sensibility.

Along these lines, current research in the acoustic arena also addresses various aspects of how to improve the existing hospital environment, e.g. altering room acoustics by decreasing reverberation time (Berg 2001). Researchers addressing human-related factors in alarm design offer an important contribution, with the aim of developing new standards for alarm sounds that are patient- rather than equipment-centred (Edworthy 2000). Building on studies that demonstrate how a typical medical environment is dominated by too many alarms that are "too loud, too insistent, and tend to disrupt thought and communication at the very time that it is vital" (Edworthy 1994: 15), a more ergonomic way of constructing auditory warnings is proposed (Kerr 1985; Stanton 1994; Meredith and Edworthy 1995; Edworthy and Hellier 2005).

In addition to the improvement of the existing physical environment, healing architecture and design introduces a holistic perspective aimed at improving the overall atmosphere, by implementing, for example, art and designed light (Daykin, Byrne, Soteriou and O'Connor 2008).[1] Within the field of lighting design, new studies investigate, with attention for the user's

socio-cultural background as well as knowledge of what homey light might mean to various users, how an atmospheric approach to the quality of light in the hospital ward can be applied to create a model for a pleasurable and variable indoor light atmosphere (Stidsen 2012). However, it is difficult to find similar durable and comprehensive sound design alternatives, which address the shared atmosphere. Strategies such as music therapy and music intervention do not generally address the shared social atmosphere, but focus rather on creating a momentary island of rest for a single patient, precluding interaction with others. Research lacks descriptions of the long-lasting effects of healing music, and it is suggested that the impact of such interventions is limited to short periods of time (Nilsson 2009).

Considering the very nature of atmospheres and the way humans experience the world in a multisensory way, there seems to be an apparent lack of solutions created in an interdisciplinary collaboration. Therefore, we stress that the time is ripe to approach the design of ward interior from a multisensory point of departure.

3. Methodology

In the broad interdisciplinary field of human-computer interaction, referred to as Constructive Design Research, researching through design is the preferred method. A method where the "construction - be it product, system, space, or media - takes centre place and becomes the key means in constructing knowledge" (Koskinen, Zimmerman, Binder, Redstrom and Wensveen 2011: 5). This includes a process of engaging with so-called "wicked problems", that is, real-world problems extracted from messy situations, with conflicting interests and multiple perspectives that are not reductively solvable (Stolterman 2008). "Wicked problems" are found by studying the world and can be mitigated through the process of design to transform a situation from its current state to a preferred state. The contribution is a novel integration of theory, technology, user need and context (Zimmerman, Forlizzi and Evenson 2007). Thus, the research artefact is designed to elicit new knowledge, in the process of addressing a particular problem (Stolterman 2008).

We initiated and have been responsible for the development of the design project Kidkit as well as the subsequent evaluation among NIA users. In the design process, user studies provided the basis for our design choices. The development of Kidkit has evolved around observations, sound recordings, and photo and video documentation in the ward. We have made walks with nurse commentary in order to capture the atmosphere of the ward. Further, we have conducted interviews with several nurses as well as a psychiatrist regarding

children's behaviour in the ward environment. Moreover, we have continuously tested the prototypes on children. Evaluations of real visit situations, where the nurses introduced children to Kidkit before visiting a hospitalised relative, were conducted.

Kidkit was developed through an interdisciplinary collaboration. While acknowledging the difficulty in extracting and analysing specific aspects of an integrated whole, this article focuses specifically on the sound design aspects, exploring embodied sound habituation as a possible conceptual tool when designing for atmospheres in which sound forms a primary stressor. The final prototype has evolved through an iterative design process, where sketching, modelling, prototyping and user-involvement laid the groundwork for the design choices made. A thorough explanation of the design process and evaluation is presented elsewhere (Kinch and Højlund 2013). Hence, while we leave the comprehensive evaluation data out in this article, relevant field notes (in italics) will appear throughout the article as informative impressions derived from our interviews, observations and evaluations. One specific observation of Kidkit in use is described in detail, as it specifically addresses how our sound design strategy is unfolded in a real life scenario.

4. Developing Embodied Sound Habituation as Design Strategy

The Concept of Atmospheres

Using the concept of atmospheres as our theoretical starting point, we pay attention to the multisensory stimuli of a particular place and try to understand the affective impact of these stimuli on the people involved, a process we found particularly relevant in the hospital setting, filled with new and unfamiliar sensory impressions. The concept of atmospheres addresses the lived experience of people situated in a particular place. According to the German philosopher Gernot Böhme, atmospheres are constantly emerging in-between subjects and objects (Böhme 1993). The atmosphere belongs neither in the sphere of the object nor in that of the subject; rather, it is a co-presence that exists within the terms of the subject/object engagement. The German expression "sich befinden" and Danish "at befinde sig" contains this double in-situ relationship in the sense that they refer to both being somewhere as well as to how one feels about being there (Albertsen 2012: 2). Perception is therefore understood as an embodied and temporal practice. Thus, atmospheres are not static states existing beforehand in a room, but rather an ongoing and temporal negotiation between the sensing body in relation to others and the environment. Therefore, the dynamic unfolding of an atmosphere is a fundamental feature of finding one's place and thereby making sense of a

place over time.

Rhythms - A Dynamic Perspective on Atmospheres

Jean-Paul Thibaud stresses how atmospheres are closely connected to embodied and temporal functions. We do not passively sense an atmosphere; the atmosphere sets the tone of a situation and resonates with the sensing body in constantly shifting consonant and dissonant relationships (Thibaud 2011). In the search for shared words to talk about atmospheres, Thibaud points to metaphors related to sound and music, revealing a common structural relationship to the temporal in both the worlds of sound and atmospheres (Thibaud 2011: 1). Sound and theories of sound and listening could therefore lead to concrete methods of working with the dynamic aspects of investigating and designing atmospheres.

As presented in our article "Designing Dynamic Atmospheres - Highlighting Temporality as Design Concern within Interaction Design" (Højlund and Kinch 2012), the translation of a temporal awareness into concrete parameters operational in a design process presents a challenge, when working with atmospheres, in interaction design. Temporality is often approached either as an unwieldy subcategory of other concepts like space or technology or as something fleeting and outside the body (Højlund and Kinch 2012). Addressing this challenge, we propose an elaborated connectedness of the temporal with the felt body, as atmospheres emerge in resonance with the body. This awareness can help the designer to rethink the temporal as an embodied way of experiencing the production of space and not only consider it as something fleeting outside us.

In his book *Rhythmanalysis – Space, Time and Everyday Life*, Henri Lefebvre uses rhythms as an analytical tool, describing how "everywhere where there is interaction between a place, a time and an expenditure of energy, there is rhythm" (Lefebvre 2004: 69). Presence is therefore innately temporal in character and can only be grasped through the analysis of rhythm. It is important to note that "rhythm" refers not only to traditional concepts of rhythm related to sound and music, but also as constituting a pervasive phenomenon emerging in the ecology between human and surroundings.

The core concept of listening invites us to listen to the body, buildings, the environment, and so forth, in order to make us more sensitive to times than to spaces (Lefebvre 2004: 22), thereby expanding our awareness of phases, periods, shifts and recurrences. By listening to the temporalities and the shifts of a dynamic atmosphere, we can gain an attentive ear,

enabling us to make sense and order of chaos by differentiating the multisensory inputs of the dynamic atmosphere. Attentive listening is obtained through what might be described as a sort of meditational practice, connected to an artistic practice, of engaging with the surrounding rhythms in order to resonate with them in a consonant way. We can only listen to and perceive our surroundings and their rhythms as being fast or slow in relation to other rhythms; and given that we are always in a body, the rhythms of the body are an important reference in our experience of an atmosphere.

This way of understanding rhythm changes the underlying presumption of the perceiver as merely adapting to the tonality of a place, and instead suggests that the atmosphere is not placed either inside or outside, but emerges in the shifting relation between the interconnected rhythms of the self, the other, and the environment. Through maintaining an awareness of these different conceptualisations of rhythms in the design process and by understanding the basic dynamic identity of the atmosphere as being connected to sound as phenomenon, the temporal aspects become parameters accessible in the design process.

Embodied Sound Habituation

I feel that there are two different ways to experience the place [NIA, eds.], because when I have been off for a longer period and come back, the place affects me differently than during everyday work life. After a holiday, I often have this … Gosh, do I really have to go in there? (Nurse at NIA)

Lefebvre's theory on the meditative process of developing an attentive ear by listening to the rhythms of the world as well as those of the body resonates with the concept of habituation. In positioning our understanding of habituation, Immanuel Kant's construction of habit, as "a negative counterpoint to the processes of human self-making" (Bennett, Dodsworth, Noble, Poovey and Watkins 2013: 7), is abandoned. Instead, we follow the trajectory of habit and habituation as presented by Gabriel Tarde, who "accounts the roles of suggestion, imitation and repetition in the constitution of the social" (Bennett et al. 2013: 10). Within psychology, habituation is referred to as a basic psychological learning process wherein there is a decrease in response to a sense stimulus after a subject is repeatedly exposed to it, indicating a loss of interest (Berk 2008: 136). Thus, habituation is a natural process, where focus on particular aspects of the environment thus shift into the background of awareness, leaving room for other aspects to inhabit the foreground of attention. Approaching atmospheric experiences from a habituation perspective points towards the observation that the users form

no socio-culturally "homogeneous audience" (Albertsen 2012), thus it is a way to acknowledge how our own habitual background continuously shapes our individual and contingent experience of the atmospheres.

Moving into the discourse on sonic environments, Barry Truax stresses how our innate ability to shift sounds to the background of awareness depends on habituation, which involves memory and associations. For our perceptual system to be able to shift specific sounds to the background of awareness, they must be habituated, meaning that they are expected and predictable in a certain context (Truax 2001: 21). This type of background listening demands that we are able to easily detect and separate sounds from each other, so we won't have to consciously struggle with the environment in order to make sense of it, which can lead to the feeling of being alienated or separated from the surroundings. It is therefore not only the perception of the specific characteristics of the sound that influences whether they are put in the background of awareness, but also the way in which they are habitually perceived (Truax 2001: 22). It is, however, important to stress here that the auditory system is also our most effective alarm system. As we are continually monitoring the sensory background for changes, a sudden auditory change in the environment will trigger an automatic startle reflex that is most likely to redirect an unexpected stimulus to the foreground of attention, making it impossible to ignore (Horowitz 2013: 111).

Thibaud underlines the importance of reflecting not only on the different categories of listening but also how, and under what conditions, we manage to shift from one type of listening to another (Thibaud 1998: 2). A design that responds to actively changing listening modes requires an alternative sound design strategy, however, not by redesigning the concrete sounds in the environment or by covering them, but instead by altering the attitude of the users towards the existing sonic environment. For the designer to induce such a change, through facilitating user coping with complex and alarming atmospheres, an understanding of how to influence the autonomous and conscious habituation processes for environmental sounds is needed.

By acknowledging habituation's connectedness to rhythms and resonances as a fundamental and dynamic quality inherent in finding one's place, we underline once more that atmospheres emerge as rhythms in-between the body and its surroundings through an ongoing temporal negotiation. Embodied sound habituation as design strategy invites the user to develop an attentive ear through controlling prominent rhythms of the environment in an active and embodied way and becoming capable of synchronising them with her own

bodily rhythms. The users now become co-creators unfolding the atmosphere. The habituation process is actively aided, guided and accelerated by a design artefact. The advantage of designing specifically for this process is that the habituated sounds can move to the background of awareness, leaving perceptual room to what the user wants to take the foreground of attention, here the meeting with the relative.

5. The Design Case Kidkit

Context & Problem

A daughter of a patient with head injury explains how her mother told her that she thought she died several times while slowly waking up from an unconscious state in the hospital. She later explained that this experience was triggered by the alarm sound from another bed in the shared ward. She associated this sound with that of a heart monitor stopping as she remembered it from movies. (Højlund and Kinch, field notes)

Building upon field work and interviews with patients, anthropologist Tom Rice describes the hospital as a holistic entity with an "unusual atmosphere of sensory absences" (Rice 2003: 5) – caused by the lack of tactile, visual and olfactory, among other, stimuli – leading to a sense of alienation and detachment from the surroundings. These sensory absences often cause the soundscape of the hospital to shift to the foreground of attention, making hearing one of the most important senses for understanding and making sense of the environment. This resonates with statements from the nurses at NIA, in which noise is said to be the main stressor. In initial stages of the research, one of the nurses stated that her biggest wish was that someone would design a noise deflector that could create a private atmosphere for the patients and relatives in the shared wards.

The soundscape of this unit, as is often experienced in modern functionalistic hospitals in general (Frandsen et al. 2009: 71), is dominated by a cacophony of alarms and other functional sounds relevant for specific members of the staff. As they are not relevant or functional for the patients, they become unwanted noise for them. Because the alarming sounds are designed to arouse and attract attention, they are difficult to ignore and resist being shifted to background awareness, and thus interfere with patients' attempts to sleep, interact, or relax. Combined with other sounds from, for example, equipment and conversations, they form a complex soundscape with many intrusive sounds, intensified by long reverberation times related to the acoustic properties of hard tiled walls and floors. This

soundscape induces unnecessary anxiety and aroused body states, counteracts healing and sleeping, and augments the feeling of seclusion and alienation from the environment.

After being prepared through a verbal explanation in the waiting room, two brothers, seven and five years old, enter the ward to meet their hospitalised mother for the first time following her accident. The nurse explains that the two kids feel ill at ease when entering the ward and that "both of them are standing at a remarkable distance from the bed. Neither of the boys moves closer when the mother extends her hand". The nurse believes that they are frightened and that this is why they approach their mother as a stranger. Afterwards the nurse says that she believes "that this visit was not, by any means, successful for anyone". (Højlund and Kinch, field notes)

Nurses stress that children brought to the unit must be meticulously prepared in the waiting room for what they are about to experience, in particular concerning the many alarming sounds in the ward. The sudden shift in atmosphere from waiting room to ward often becomes an obstacle for an engaged meeting with the relative. The actual change in atmosphere itself becomes the foreground of attention, even though all parties would prefer this to remain in the background. In such a situation, the rhythms of the alarming atmosphere in the ward affect the bodily rhythms of the child, which leads to a feeling of stress in response to aroused bodily rhythms. Our main design challenge has been to find an adequate response to this invisible obstacle between child and environment.

Form & interaction

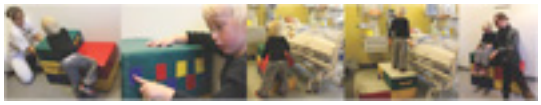

Figure 1: Kidkit in five different stages during a visit at the NIA

Kidkit is flexible interactive furniture, which accompanies the children and nurse throughout a visit: from the waiting room, to the ward, and back again. Its flexibility allows for change in form, and its interaction corresponds to the specific functions it serves during the different stages of the visit. Kidkit is designed with the overall rhythm and structure of the visit in mind: First, Kidkit assists children through the entire visit, becoming a secure anchor that can detract focus from the sudden shifts in atmospheres, thus helping the children become more sensitive to time than to spaces. Second, the temporal design allows for adaption to specific rhythmical functions, appropriate to the different environmental settings. Taking these aspects into account, the bodily rhythms of the children adapt in relation to their habituation process, as

described below. We thus present different design tactics relating to specific stages of the visit:

VideoObject2: Kidkit in use

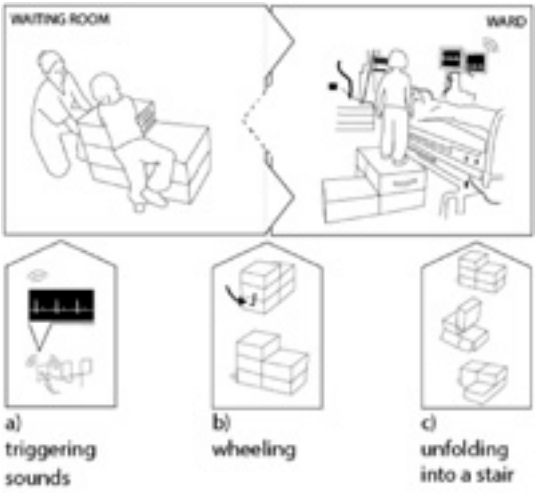

Figure 2: Transformations of Kidkit

a) When Kidkit is introduced to the user in the waiting room for the first time, it is in the form of five upholstered blocks, stacked into two piles, the upper block of each of the two piles being flexible. Kidkit is designed to afford two occupants (child and adult) a surface to sit on, at eye-level with each other, accommodating an intimate atmosphere. A touch interface with eight sound triggers (explained in detail in the next section) is sewn onto the surface of the upper, green, block of Kidkit.

VideoObject3: Kidkit sound triggers

b) When the users are ready to go into the ward, the wheels of Kidkit are revealed by means of a handle, thus making it possible to lift and lower the furniture and wheel it from one space to another. The mobility of Kidkit allows the child to bring something to which she is habituated into the ward, encouraging her to take ownership of Kidkit before, during, and after the visit as a familiar anchor in a confusing and unknown environment.

VideoObject4: Kidkit wheeling

c) The flexibility of the form allows the child to alter the form from that of a seat to a stairway configuration when placed by the bedside in the ward, assisting her to stand, at eye-level, beside the hospitalised relative. The physical, bodily, way of interacting with Kidkit, through

rhythmic folding and unfolding manoeuvres, invites the child to create meaning through embodied interaction.

VideoObject5: Kidkit unfolding

The colours support the various transformations of Kidkit. In the waiting room, where it serves as a tool for playful exploration, Kidkit exhibits strong colours. In the ward, in the stairway configuration, the sound triggers are hidden, and its most visible colours are in the grey scale, so as to attract less visual attention. The simplicity of the quadrangular shapes of the five poufs is similar to building blocks, and the shape of Kidkit, corresponding to the scale of a child's body, allows for flexible play practices. We emphasize that Kidkit is not a handheld device, but furniture that physically relates equally to body and space, affording collective use. In this manner, Kidkit initiates a shared transitional space, for the child, the other relatives, and also for the nurse, assisting them with coordinating the visit (Kinch and Højlund 2013). Furthermore, the size and materiality of Kidkit challenges the child to be physically engaged, moving focus away from the sudden shifts in atmospheres.

Sound Design

Figure 3: A seven-year-old brother visiting his sister at NIA

Magnus, a seven-year-old boy is going to visit his hospitalised sister who has a brain tumour. In the waiting room he meets Kidkit and pushes one button at a time, triggering the sounds. When he asks, "Can these sounds be heard by Julia right now?" the nurse answers, "No, the sounds around Julia are coming from the equipment and the two other patients. The equipment is noisy because it wants the nurse to look at it. It does not make noise because

the patients are in pain". This conversation gives the boy insight into the sounds of the apparatus, and after this conversation, he and the nurse decide to go and see Julia. Upon entering the ward and during the meeting, Magnus is focused on his sister. He appears relaxed and tells stories. Afterwards, when we are in the waiting room, we ask him about the alarming sounds in the ward, but he says that he did not notice them at the time. We then asked him if he thinks he heard any of the sounds from Kidkit introduced earlier in the ward. He answers, "Yes, I heard the funny dododododo sound", and he repeats it in a rhythmic pattern similar to the sound from the Kidkit, which was sampled from one of the alarm sounds in the ward. (Højlund and Kinch, field notes)

Following the specific sound design focus presented in this article, *Épochè* is implemented as a tactic to design for embodied sound habituation in the waiting room. *Épochè* refers to a practice presented by Pierre Schaeffer (reworked by Michel Chion). Adapted from a phenomenological understanding of how the bracketing of a phenomenon can open up a method to examine it aside from one's associated assumptions and beliefs, the concept refers to the process of putting specific sounds in parentheses in order to actively create reduced listening circumstances (Chion 2009: 28). Reduced listening can change listening from serving as a vehicle of meaning concerning the source, asking us, instead, to listen to the sound itself. By isolating or moving the sound from its source and out of the audio-visual complex to which it initially belonged (what Schaeffer calls acousmatic listening) and listening to it repeatedly, one can actively recondition one's habitual listening patterns and references. This will allow "us to clarify many phenomena implicit in our perception" (Chion 2009: 31). Although the most natural mode of listening is to try and understand the sound by identifying its source, this repeated reduced listening can "perhaps 'exhaust' this curiosity and little by little impose '*the sound object as a perception worthy of being listened to for itself*" (Chion 2009: 12).

Épochè, through repeated reduced listening, can set the ground for habituating sounds quickly, thus changing the attitude towards them, e.g. through developing a more musical perception in the waiting room. This tactic is unfolded by presenting the eight sounds separately from each other. One button triggers one sound file as feedback, made with touch sensors and a phidgets board. Hidden beneath the upholstery, a computer and loudspeaker play the sounds that have been sampled directly from the ward. These sounds are based on a one-hour recording made in the ward - where the nurses presented all sounds they found dominating, not only alarm sounds, but also noises made while handling equipment - that were thought to be suitable for sampling. The duration of the different sound files is two

seconds, maximum, and the sounds are categorised into three groups: yellow areas play three different alarm sounds, red areas play two suction sounds from a respirator, and the blue areas play three dominating equipment sounds, e.g. the lid of a bin being shut. The characters of the eight sounds are quite different in pitch, timbre, rhythm, and expression. The feedback is immediate and can be triggered again and again when pushed, and the system can play several sounds on top of each other if more than one trigger is activated. In this way the child is able to create a rhythmic pattern corresponding to well-known beat structure, resembling a drum loop with various drums, and thus conditioning a musical interpretation of the sounds.

The embodied experience of controlling the concrete rhythms of the environment repeatedly in one's own tempo can help children to synchronise the sounds with their own bodily rhythms. In this way, the alarming sounds can be shifted to background awareness upon entering the ward, as they are now habituated as familiar, expected, and predictable in the context rather than frightening and uncontrollable.

Magnus' interaction with Kidkit indicates that he habituated the "dodododododo" alarm sound anew and could separate it from the rest of the sounds in the ward.

The way he repeated the sound, rhythmically and melodically as in the sound sample, and referred to it as funny indicates that the strategy of embodied sound habituation through *Époché* in the waiting room helped him transform his perception of the sound into something primarily musical and not frightening. Furthermore, his statement that during the visit in the ward he did not really notice the sounds indicates that he was able to put the alarming atmosphere in his background awareness, leaving room for the visit to take the foreground of attention.

6. Concluding Remarks

When acknowledging the dynamic habituation process of atmospheres as an essential part of finding one's place and of feeling as an integrated part of an environment, it is important to reflect on how different contexts and different target groups call for different strategies in the search to help this process through design. In calm and familiar surroundings, the rhythms of the body can adapt more easily to the rhythms of the environment (Horowitz 2013: 189), and therefore a more traditional approach to atmosphere design, as in a traditional stage setting, could be effective (e.g. through slowly changing colours, lighting candles, or playing calm background sounds). The claim presented throughout this article is that slow and calming

rhythms presented to visitors in an alarming atmosphere would not be felt to be in coherence with the predictably aroused and tense bodily state and rhythms. Therefore, it would be ineffective in synchronising the rhythms of the environment with the rhythms of the visitor.

Habituation typically happens almost automatically in environments where we spend a lot of time, through a gradual and slow adaption. As a patient in an English hospital puts it: "Well, I guess as with whatever environment you become familiar with, you gradually lose the acute sensation that you first get. I mean, you can really be overwhelmed with the noises … Gradually, that fades, and you can almost not notice it." (Wainwright and Wynne 2007: 14). In the brief time of a short visit to an alarming atmosphere, this process cannot take place. Experiences derived from our case study indicate the positive effects of an active and engaging habituation process, which set the ground for a quicker habituation process. In an environment where sound is one of the main stressors, we therefore suggest a strategy based on embodied sound habituation. The user is given an opportunity to not only listen to differentiated sounds derived from a chaotic soundscape, but also to control them through embodied gestures, to synchronise them with her own rhythm, and be able to shift them to background awareness when faced with more important tasks.

Looking at existing solutions, which can be primarily seen as implementing positive distractions, through the lens of dynamic atmospheres as presented throughout this article, at least two insights are of paramount importance:

- A hospital is not one uniform place with one type of static atmosphere. Calming music, art, and lights are only relevant and useful in specific atmospheres, at specific periods of times, namely the ones where people are capable of taking in calming and gentle impressions.
- Existing solutions mostly aim to improve the well-being of the individual patient through tactics such as diverting focus from certain aspects, those which seem undesirable or unpleasant, of the surrounding atmosphere and bodily presence, with the unfortunate result that communication and interaction with others actually becomes more difficult. By designing solutions aimed at the shared social atmosphere, other groups in addition to the patients are also be considered.

Our contribution, therefore, has been the articulation of a design strategy that does not try to create a temporary distraction, but acknowledges the basic need of the user to feel that she is an integrated part of the environment, resonating with the surroundings in a consonant way.

This strategy might be relevant in other alarming contexts and with other target groups, but this would require more testing and evaluation to insure the durability of the proposed strategy in future work.

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Notes

1 Examples of Danish companies working with healing architecture: Art: Sonovision (http://www.sonovision.dk/); Healing music: Musicure (http://www.musicure.com/); SoundFocus (http://www.soundfocus.dk/index_en.html); Designed light: ChromaViso (http://www.chromaviso.com/uk/); Solutors (http://solutors.com/service-menu/english/).

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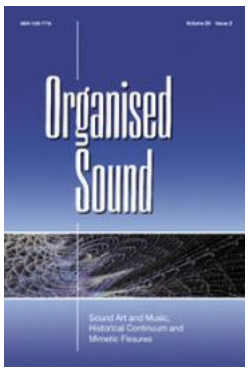

Wavefront Aesthetics: Attuning to a dark ecology

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Wavefront Aesthetics: Attuning to a dark ecology

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In this article, we offer an object-oriented ontological perspective to complement the diversity of sounding ontologies, challenging the human perspective as the only valid perspective and call for the necessity of including perspectives of objects such as a speakers, voices and light sensors. Subscribing to this view also confronts music and sound art as consistent autonomous categories and focuses on how the pieces attune to the environment, emphasising meetings, transformations and translations through and with other objects. These meetings generate an ecological awareness of causal aesthetics where objects *time* and *space* each other. This contrasts with traditional analysis of music and sound art, which is based on the assumption that time and space are containers in which sound and music unfold. We analyse two contemporary pieces by the authors in an attempt to unfold a dark ecological[1] approach to test the implications, limits and potentials for future use and development.

1. INTRODUCTION

Sound art and music have generally been understood as opposing traditions in that sound art often implicated a break with the autonomous view on music. Recent research (Vandsø 2015; Kotz 2001) points towards a new situation in which sound art, through a post-Cagean understanding, has become increasingly normalised, while music simultaneously has become increasingly spatialised. Annette Vandsø therefore suggests that the analytical perspective should seek a middle ground in which phenomenological listening should be incorporated with an intertextual and discursive framing to acknowledge the post-Cagean situation. This article endorses this new starting point, and proceeds by suggesting a break with the human-centred focus of the presented analytical perspectives by subscribing to an object-oriented ontological approach, proposing that the correlational prominence only presents us with insight into human-world relations, and not interobjective attunements. Instead, we propose a perspective in which the wavefront[2] (Khare and Swarup 2009: 153–7) becomes a central term, suggesting a focus on how the materiality behaves, interacts, develops, manifests and translates through other objects (both human and non-human). Thus, using a vinyl record as an example, the specks of dust that gather on the record are as much an artist as the composer of the music that is inscribed as modulated spiral grooves in the rotating polyvinyl chloride.[3]

From this perspective, the analysis of sound art and music should also be a process of tuning into the attunement[4] between the objects involved, thus the analysis of the two pieces presented in this article explore how the contact between human and non-human objects resolves the habitual distinctions between world and self. They do this not by trying to minimise signs of translation, but by taking into account and exploring the inconsistency and fragility of the objects involved, through a conceptualisation that the sounding materiality possesses *thingliness* and at the same time constitutes the illusion of an environment (Morton 2007: 41).

2. OBJECT-ORIENTED ONTOLOGY

The following section briefly introduces central perspectives within object-oriented ontology (OOO), and therefore only scratches the surface of this diverse philosophical field. Although it is by no means exhaustive, pivotal terms and conceptualisations are presented in order to develop a dark ecological approach to sonic analysis.

[1]The term 'dark ecology' was coined by Timothy Morton (Morton 2007), and has recently given its name to a research and commissioning project initiated by the Dutch Sonic Acts (Methi 2014).

[2]A wavefront is a continuous line or surface including all the points in space reached by a wave or vibration at the same instant as it travels through a medium. The movements travel with a velocity that is appropriate for the medium in which the wavefront exists.

[3]Object-oriented ontology (OOO) has already been mapped onto performance and theatre (Shapiro 2013), and art analysis more generally (Jackson 2011).

[4]In the writings of Timothy Morton, attunement has several other names according to the character of the tuning involved. These include translation, mediation, sampling, transducing and rendering.

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2.1. No human superposition

The larger context of OOO originates from the speculative realism of Graham Harman, Ray Brassier, Quentin Meillassoux and Iain Hamilton Grant. A speculative realist wants to break with correlationism – a term used to describe how *being* exists only as a correlate between mind and world, placing humans at the centre (Harman 2010a). As an example, Heidegger claimed that objects can exist outside human consciousness, but their *being* exists only through human understanding (Bogost 2012: 4). Therefore, based on phenomenological thinking, speculative realism breaks with its fundamental focus on human perception and suggests that 'one must abandon the belief that human access sits at the centre of being, organising and regulating it like an ontological watchmaker' (Bogost 2012: 5). In the development of a non-human phenomenology,[5] all things exist equally, which introduces notions of flat or tiny ontology, which collapses the traditional distinctions between subject and object and thus the world as our stage.[6]

2.2. Objects appear and withdraw

Central to OOO thinking is that it is not only humans that objectify other objects. Non-human objects also use other objects, but never exhaust them because objects are also always *withdrawn* (Harman 2002; Morton 2013b). Withdrawal is understood as an unbreakable encryption irreducible to perception or meaning, which makes it impossible for any knowledge to replace the object in question (Morton 2013b: 17–59). All objects are simultaneously fragile and autonomous, as they possess a potentially infinite progress in which they can be unfolded. At the same time, objects contain other objects and are contained in other objects (Morton 2011: 150–151; Morton 2013b: 45). Objects appear but withdraw at the same time – a double-edged quality that constitutes the *objectness* of what an object is; an open secret (Morton 2013b: 202). As objects withdraw, no object or parts of an object can have direct access to any other object (Bryant 2011: 18, 26). This means that the object is not reducible to its parts (undermining), but also implies that an object cannot be reduced to its whole (overmining) (Harman 2011: 7–18; Morton 2011: 150; Morton 2013b: 44). Following this line of thinking, the World (including other holistic concepts such as Nature and the Environment) also ceases to exist as a neutral background or stage for humans to occupy.

2.3. The Rift, causality and the aesthetic dimension

For Timothy Morton,[7] objects are ontologically riven between their withdrawn essence and their appearance for other objects (Morton 2013b: 56). The Rift becomes central to the development of an expanded form of causality, which becomes integrated within a new view on aesthetics, claiming that causality *is* the aesthetic dimension produced by the interaction between objects (Morton 2013b: 64). Within the realm of sound, the Rift can be understood as the medium or mediation between the essence of the sound and its appearance, which is meaningful in relation to how the speed of sound changes depending on what material it is mediated by. This makes it impossible to grasp the essence of a sound without its mediation, suggesting that it is impossible for the sound object to be without its mediation, as it would then be reduced to appearance only. If this mediation is happening in air, making sound acoustically audible to humans, or if movement of the pickup needle on the record player is secondary in this context, the important issue is the awareness regarding this Rift within the sound object (Morton 2013b: 122). The aesthetic experience is then not solely something that occurs within our human mind, but is instead expanded to incorporate all causal events taking place in and between objects (Morton 2013b: 120–1). This leads to a non-human phenomenology in which there is very little difference between how a shadow is perceived by a light sensor and by a human (Morton 2013b: 35).

Causality and the aesthetic dimension does not take place in a space- and time-container that has already been established; instead, it pours or radiates from the tension of the Rift between essence and appearance, establishing the notion of interobjectivity[8] (Harman 2010b: 150; Morton 2013b: 35–66). Thus there is no environment in which objects float; instead, time and space are emergent properties of interacting objects themselves. This understanding resonates with post-Einsteinian physics, in which space-time is the product of objects (Morton 2011: 151); therefore, objects *space* and *time* each other, not unfolding *in* time and residing *in* space.

[5]Ian Bogost developed the term 'alien phenomenology' (Bogost 2012), which is outlined later in this article.

[6]Even though OOO is a research field that has received attention in contemporary philosophy, it has also attracted criticism. In Jonathan Sterne's earlier writings, he clearly distanced himself from the perspective of OOO, claiming that: 'sound is a product of the human senses and not a thing in the world apart from humans' (Sterne 2005: 11). However, Sterne later pointed to the possibility of the validity of studying sound from perspectives other than those of humans (Sterne 2012: 7). OOO has also been critiqued in relation to political issues (or the lack thereof) (Berry 2012; Galloway 2012; Thorne 2012). In Galloway (2010), Cole (2013) and Cesarale (2014), a critical discussion of speculative realism can be found that critiques the speculative anthropomorphism of things through the use of phrases such as 'objects speak, listen, feel'. Cole ultimately claims that OOO outlines a very traditional ontology, which does not acknowledge medieval philosophy and mysticism as having coined post-human thinking.

[7]An ultra-condensed version of Morton's theory of objects can be found in (Morton 2012b).

[8]In OOO terminology, the word 'interobjectivity' replaces 'intersubjectivity' in an extension of the traditional phenomenological vocabulary to include non-human entities.

2.4. A dark ecology of the ambient

Through an OOO line of thinking, art becomes a collaboration between humans and non-humans, and thus an important way to explore the Rift of objects through attunements between objects (Morton 2012a: 138). From this perspective, the aesthetic is not some kind of icing on the cake, but an elementary exploration of causality as the aesthetic dimension, opposing the historical separation of rhetoric from logic and substance from accidents (Morton 2013b: 79). This understanding of the aesthetic and causal dimension permeates traditional distinctions between background/foreground, figure/ground, inside/outside that are often taken to be key analytical concepts in approaching the artwork. Therefore, according to Morton reality is like an illusion, albeit a real illusion, as we often judge something to be an object when it is actually just its appearance, habituated to our own normalisations (Morton 2013b: 143). Morton denotes this illusion as the Ambient, a conceptualisation of a *here* and *now* being evoked and sustained for a while, with cracks and strangeness pouring out, as inconsistent and fragile as the Rift. If art tries to hide the translations taking place in the aesthetic dimension, or claims that they do not exist (e.g. its timing and spacing qualities, but also the medial relations), it is attempting to pretend that there is no Rift. In attempting to create consistency, the in-itself ceases too become a real illusion because they fail to recognise the fragility and inconsistence of the Rift. In Morton's notion of the Ambient, the environment comes forward from the background when art explores the fragile materiality of objects, which subverts the idea of the world as our neutral stage (Morton 2010: 107). Through ambient effects, art makes it appear as if, for a fleeting second, there *is* something in between (Morton 2007: 50), an understanding that challenges the concepts of ambient and atmosphere as something blurry in between, something that just sits there ready for humans to perceive – reducing objects to pure appearances (Morton 2013b: 71).

The role of this ecologically aware art then becomes a way of attuning to the inconsistency of the Ambient as a dark ecology that collapses the subject–object division, giving rise to a sense of coexistence and connection to other objects. An attuning that is slightly out of phase – recognising its inconsistency and fragility and thereby also its own uncanny strangeness (Morton 2013b: 177).

3. A MULTITUDE OF SOUNDING ONTOLOGIES

The contemporary music and sound art scene has exploded, imploded and scattered among an overwhelming number of artistic and academic traditions. It can seem like an impossible task to initiate a discussion concerning how music constitutes itself in relation to sound art, and how sound art relates to music.[9] Does the difference lie unfolded in the relationship between music's and sound's symbolic conceptualisation, as opposed to its physical manifestation (Wishart 1977; Nussbaum 2007)? Is the question of whether something belongs in a musical or sound art tradition more a question of poetics (Gonsales 2011; Kane 2013)? Trying to define both what constitutes music and sound art often takes its starting point in what it is *not*. This point is exemplified in the term 'cochlear music', coined by Seth Kim-Cohen and unfolded through a discussion of intra-musical (sounds in themselves) and extra-musical perspectives relating to the enclosing Western musical traditions (Kim-Cohen 2009). These traditions embrace the premise that it is possible to analyse music that is *in itself* independent of both ambient and temporal translations and also, for example, material manifestations of the symbolic score (e.g. the paper it is printed on). This implies that it would be ideal if we somehow could experience the piece without the instruments, room and recording technology (Morton 2007: 30). An example is Eduard Hanslick's autonomy of music, in which music has one type of content, which is the notes it consists of; music does not only speak through notes, but it also speaks nothing but notes (Benestad 1977: 299). New musicology breaks with this autonomous view of music by highlighting the discursive, social and institutional frameworks 'around' music, often combined with a more traditional structural analysis.

The autonomy of music has also been challenged in cognitive musicology (Zbikowski 2005; Pearce 2006; Dean and Bailes 2010), paired with studies in cognitive perception (Bailes and Dean 2012) and music semiotics (Tarasti 1995), giving the mental representation of music a central role as 'higher-level' phenomena (Clarke 2005: 191). Although sound art and writings on sound art have led musicology to acknowledge the role of the environment, correlationism is still apparent in the perception-based (Wishart and Emmerson 1996) and spectromorphological (Smalley 1986; Thoresen and Hedman 2007) analysis of sonic art. More recent research has started to incorporate sound's enclosing and encapsulating qualities, paired with broader philosophical perspectives of the sonic (Voegelin 2010) and expanding sound and music palette through notions of ambience and affect (Kassabian 2013; Schmidt 2013). Ecological and material approaches to music and sound art break with the idea of a disembodied mental representation in perception (Cox 2011), ordering phenomena hierarchically

[9]There is even a Yahoo Answers page devoted to the question of how sound art defines itself in relation to music (Yahoo 2014).

(Clarke 2005: 15) by emphasising the interrelationship between the sonorities of music and the environment.

Vandsø (2015), among others, proposes that we have moved into a post-Cagean aesthetics, where sound art no longer can be said to be primarily a negation of conventional ideas of the autonomous artwork in music, but a positive expansion into the social situation. She argues that because of the widely acknowledged conceptualisation that sound is inseparable from its context, it requires a different ontological status of the object in question. She proposes an approach that understands the act of perception as something that is always already conditioned by the discursive formations, and as such is in between the two predominant positions in the current field of sound art studies: the one that emphasises the pure phenomenological act of listening and underlines the non-discursiveness of sound as an artistic medium; the other that emphasises the linguistic, symbolic and intertextual dimension of sound art. Due to this relational condition she concludes that there is not only one new ontology of the work of art, but also a multitude of local ontologies in the field. Here she is referring to Georgina Born who calls for a relational musicology that is 'alert to the diversities of the musical ontologies of the world' (Born 2010: 241).

Despite its various theoretical and methodological expansions within the presented fields of analysis, the approaches described above still point towards a widespread correlationism that does not yet embrace a multitude of different ontologies. Even though ecological and material approaches wish to abandon the rigid separation between human and non-human environments (Harley 1996), similar to OOO's break with correlationism, it still takes the human perception as its only valid starting point (Harley 1996: 9; Clarke 2005: 197), which only presents us with insight into human-world relations.

Adhering to the described post-Cagean and ecological positions the following will present the pieces *Lys, Landskab og Stemmer* and *Opaque Sounding*, in order to articulate these with a dark ecological perspective that breaks with the human-centred focus, thereby exploring what an OOO perspective has to contribute to the diversity of sounding ontologies.

4. *LYS, LANDSKAB OG STEMMER [LIGHT, LANDSCAPE AND VOICES]*

Lys, Landskab og Stemmer is a mixed-media piece by Elle-Mie Ejdrup Hansen and Marie Højlund from 2011.[10] Commissioned by the Cultural Circle of East Jutland, Denmark, consisting of six municipalities around Aarhus, this large-scale cultural project took place over a period of two years, with the aim of giving local citizens a possibility to experience and participate in innovative and interactive art outside Aarhus (as the largest city in the area). The project takes its starting point in explorations of relations between a multiplicity of objects in a specific location in each municipality (the six sites) and connecting them to a multiplicity of recordings of voices from the same area, reciting a poem.

To explore what a shift of perspective from the human perspective towards a dark ecological perspective has to offer, the following analysis charts Morton's proposal for an object-oriented rhetorical theory that reverses the implicit order of Aristotle's five parts of rhetoric: 'The five parts are invention (or discovery); ordering (or disposition); style; memory; and delivery' (Morton 2013b: 84). Reversing the order by starting with delivery, or viewing them as simultaneous processes, both in the composing process and in the analysis, serves to short circuit the romantic idea of the genius composer who gets an idea, figures out how to compose it and then performs it (Morton 2013b: 84). On this view, delivery or performance cannot be an invisible medium that delivers the message from the composer's mind; instead, it becomes an attuning object in its own right. The causal relationships between the various objects, voices and landscapes are thus the aesthetic dimension for the artist to explore without any predetermined end point, making the composing process one of listening or tuning into the multiple objects.

4.1. Recording voices of humans and non-humans

In the spring of 2011, a caravan that had been converted into a mobile recording studio (see Figures 1 and 2) travelled the six municipalities, where local people were invited inside one by one to read parts of Inger Christensen's poem *Lys [Light]* (Christensen 1962) aloud. Participants were informed that the recordings would be transformed into an outdoor installation for them to experience some months later at a specific location in their area. In total, 758 voices were recorded.

Participants entered the caravan alone; inside they could only see a microphone and a button on the ground. They were informed that the recording of their voice reciting the poem would start when they stepped on the button. During the reading, the input of the voice transformed large digitised landscape drawings (see Figure 3) of the sites in real time on a semi-transparent screen in the middle of the caravan. During the reading, the voice input made the drawings emerge from nothing, magnifying how the voice vibrates the landscape. Furthermore, a convolution

[10]Assisted by Sune Hede and Søren Lyngsøe Knudsen (for video documentation of the piece, see Højlund 2011b). As this project is diverse and protracted, this analysis focuses on issues related to sound and music.

Figure 1. Caravan converted into a mobile recording studio for *Lys, Landskab og Stemmer.*

Figure 2. Caravan converted into a mobile recording studio for *Lys, Landskab og Stemmer.*

reverb made at the same location was added to the voice, and played through speakers in front of the participant, mixed with a non-edited outdoor field recording also from the site of the area.[11]

Starting with the vocal delivery reverses the normal ways of understanding a poem through human interpretation before performing it, as there is no preparation time for the participant. The voice translates the words it speaks, as an improvised evocation of the encrypted heart of objects not via revelation but via obscurity, thus pointing towards an environmental understanding of the poem. The vibrating landscape drawings excited by the voice make the participants aware of the shape and size of the space around them; as to voice is also to room (Morton 2007: 48). Furthermore, to voice is also to time through a rhythmic causality that emerges between voice and the algorithms of the landscape's transformations. A sensual aesthetic appearance of an object to another object emerges, dissolving the landscape as a neutral background for humans to act upon. The inter-objective causality organises space and time in a very literal and visual way in the caravan. We lose the words and hear the room, as voice and room are mutually determining; one does not precede the other.

The convolution reverb, the interactive landscape drawings and the field recording act as ambient effects that have the dual purpose of underlining the

[11]For a video documentation of the interaction between voice and drawings, see Højlund 2011c. The transformations of the drawings and the voice are also recorded in the form of animated videos available from Højlund 2011a.

Figure 3. Voice transforming digital landscape drawings in *Lys, Landskab og Stemmer*.

strangeness of listening and seeing your own voice interact, and also of creating the illusion of a *here* and *now* that emerges from the causal relationship between the objects involved. This ambient illusion demands engagement and, in doing so, motivates participation, as there is no background or foreground defined beforehand, only a coexistence that emerges from the interobjective translations. The choice of introducing these ambient effects as a deliberate overhear in the caravan runs counter to normal recording practices of minimising overhear from other objects as much as possible.[12] It also points to the importance of regarding the aesthetic as something emerging in the causal relationship between objects. Many people feel as though their own voice does not sound like their own. This is underlined by the fact that participants are hearing their voices through speakers, which amplifies the medial translations that wavefronts have for other objects such as skulls, ears, speakers, microphones and walls. This realisation is connected to the withdrawal of the inconsistent object, as the self is also withdrawn (Morton 2010: 87).

4.2. Transforming voices

The transformation of the 758 voices into a site-specific piece for 24 outdoor speakers (see Figures 4 and 5) presents a continuation of the ambient translations in the caravan, as the delivery of the poem is not an envelope that delivers a message of the meaning of the poem *in itself*, rather, the multiplicity of recordings reveals itself as a new withdrawn object. It is only through this repeated delivery that the causal aesthetic of sampling is revealed, as are the similarities of inconsistency shared among strangers. The renderings of the timbral voices through the recordings have a strong ambient effect, pointing to the very medium of the voice itself and the recording as a recording. This undermines the normal distinction between the recording medium as a background and the voice medium as a material physicality in the foreground. In Danish and German, this tuning of the ambient and the voice is present in the word for voice (*stemme*/*Stimme*) and correlates to the word for the atmosphere of a room (*stemning*/*Stimmung*). Both words refer to tuning as the way objects are vibrating each other, as we *are* also environments for other objects. Therefore, the timbre is not changed in post-production with wet effects such as reverb. No faults are corrected or edited out, which makes the voices vibrate as inconsistent 'noisy, messy, fuzzy, grainy, vague and slippery' (Morton 2010: 66) objects. The rendering effect of the anonymous voices resembles that of the disembodied acousmatic wavefronts that emanate from an unrecognised source, provoking uncertainty because of the inherent hesitation between an obscure source and no source at all.

The transformations of the recordings are created through temporal and spatial negotiations between voices and algorithms within Max/MSP. The algorithms translate the recorded files through predefined parameters set by the artist, both in the recordings and in the software, by placing up to 15 cues in all of the voice recordings, according to the same parts in the different readings of the poem, different algorithms can be executed with different patterns. The algorithms execute both spatial patterns in the 24 speakers simulated in the software and a temporal unfolding of the

[12]The pursuit for an unmediated engagement with the sonic material of the voice *in itself* is an expression of the high fidelity paradigm of the recording studio practices (Philpott and Spruce 2012: 128).

voices triggered by the cue numbers.[13] The algorithms build on repetitions and suspensions that play with familiarity and difference. Meeting repetition and rhythms through voices and speakers provides us with an opportunity to face our own artificiality projected onto the outside world; the voices of the anonymous speakers become stranger through repetition and layering. The changing rhythms and repetitions present a kind of moving without moving by being suspended in the framing of an illusionary *here* and *now*. These sampling translations interrupt the flow of a prototypical chronological reciting of a poem from beginning to end, making us aware of the ambience *around* the poem. In this inclusion of unintention, the inclusion of silences, pauses and coughing evokes the illusion that the piece is working by itself.

The voice transformation are accompanied by rhythmically organised sound samples recorded at the sites (e.g. wind in trees, birds singing, planes passing, pebble being stepped on, cars driving on pavement) as well as notes played on an old, out of tune piano prepared with multiple objects from the sites. This accompaniment can be said to express a dark ecological approach in two ways. First, the sounds are not played by traditional music instruments, but by instruments either created by sounds recorded from the sites or prepared by objects from the sites. Furthermore, the inconsistency and fragility of the piano is highlighted through its detuned notes and the awareness of the inner structures and physicality of the strings prepared with objects. Second, it is not intra-musical parameters or harmonic concerns created by the composer that structure how the sequences are developed, but the intonation and rhythms of the voice transformations. Thus, the rhythmic patterns are not set as a fixed tempo or time signature beforehand, but emerge in the interplay between the rhythms of the voices and the rhythms of the sound samples.[14] Likewise, arpeggios played on the sampled, prepared piano are structured through listening to the intonations in the cacophony of voices without a pre-prepared melodic and harmonic progression or based on a fixed key signature.

The 24 speakers were designed and built for the project in conjunction with Dynaudio.[15] When the speaker is activated, a circle of LED lights illuminates the opening from which the voices are heard. The speakers are designed in such a way that they come forward from the background as *speakers* – that is, objects with their own physicality and translations – and thus become sculptures that co-define the presentation sites. Therefore, the general observation that familiar objects tend to fall into the habituated background is challenged by the unfamiliar design of the speakers, provoking an awareness of the speaker as both object and environment.

4.3. Ambient voices

The presentation of *Lys, Landskab og Stemmer* consists of six different parts, each six hours long, at each of the six sites, consisting of the voices from that specific area and chorus parts with voices from all the areas. The presentations unfolded over six evenings in September 2011, starting at 6 p.m. and ending at midnight, accompanied by a green laser beam (see Figures 6–8). The length of the pieces attunes to temporalities in the landscapes, weather and circadian rhythms different from normal concert practices. During the evening, the sites transformed into an uncanny darkness, covering rather than discovering the poem and the voices. This covering was also represented in the voices changing over the evening, from high-pitched children in the beginning to grown women's voices at dusk, to deeper male voices in the dark, pulsating the voice-activated light of the speakers. One visitor described the site as having transformed into a kind of burial mound,

Figure 4. Outdoor speakers designed for *Lys, Landskab og Stemmer* together with Dynaudio.

[13]Listen to stereo renderings of algorithms executing voices in different temporal and spatial configuration (Højlund 2014a, 2014b, 2014c).
[14]Resembling the transcriptional technique used in Steve Reich's *Different Trains*.
[15]Dynaudio is a Danish loudspeaker manufacturer: www.dynaudio.com.

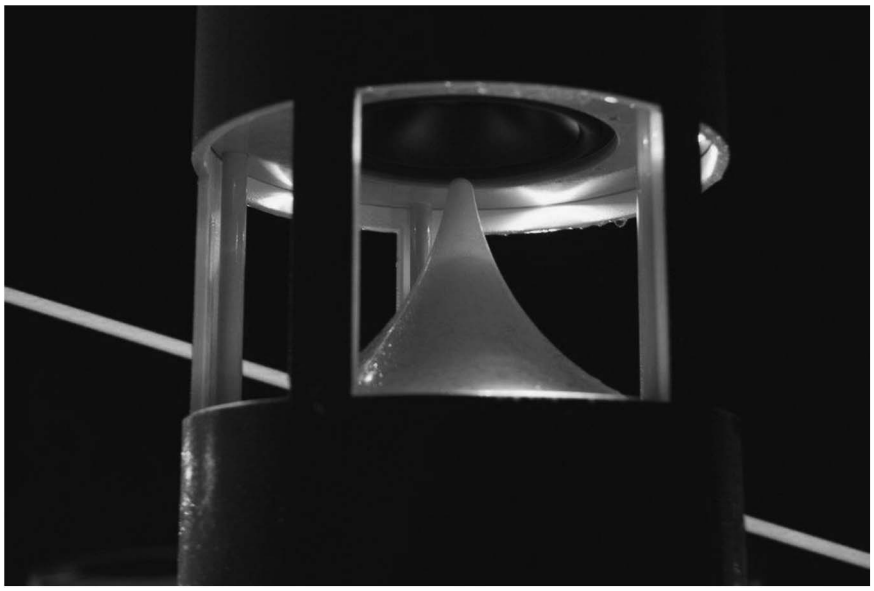

Figure 5. Outdoor speakers designed for *Lys, Landskab og Stemmer* together with Dynaudio.

Figure 6. Issehoved, Samsø: one of the six sites of *Lys, Landskab og Stemmer.*

coming to life with the voices of the strangers. By presenting the anonymous voices that originated from and reconnected to the specific area, the local not only becomes the familiar, but also the familiar becomes strange. The voices through the translations of the recording, the algorithms, and the speakers spread out over a large area combined to make it difficult to maintain the aesthetic distance to the landscape as a background. This challenges the dividing lines that we normally draw between nature, subject and objects. Approximately 5,000–6,000 people visited the sites over the six evenings, making their own compositions while walking around, sitting or lying down, thereby defying the idea of a perfect sweet spot created for the listener. The piece is not primarily about human internal interpretation of the meaning of the poem (discovery) but about creating a 'musical-social space for a while (hours and days) in which the project of attunement to the nonhuman is performed' (Morton 2013a).

5. OPAQUE SOUNDING

Opaque Sounding[16] is a piece written, built and attuned by Morten Riis in 2014 by commission of SPOR Festival (Spor 2014) and ACTS Festival (Acts 2014). The piece consists of four *Aldisette* vintage slide projectors that project light onto a mirror ball placed at the centre of a completely darkened room filled with smoke (see Figures 9 and 11). Each projector has been modified by replacing the original slide system with a perforated paper strip that runs through the projector operated by a specially designed mechanism, built in Meccano and driven by a small 12v DC engine (see Figure 10). The perforated paper strip now forms a loop around the slide projector, controlling how much light is projected onto the mirror ball.

[16]For a video documentation of the piece, see Riis 2014.

Figure 7. The Beach, Grenaa: one of the six sites of the *Lys, Landskab og Stemmer.*

Figure 8. Tre Høje, Mols Bjerge: one of the six sites of *Lys, Landskab og Stemmer.*

An LDR (light-dependent resistor) is mounted on the lens of each of the four projectors to measure the light intensity from the apparatus. Through a specially designed circuit, the resistor values are transformed into control voltage that drives four separate voltage-controlled amplifiers. The outputs of these amplifiers are connected to a transducer mounted on the body of each of the *Aldisette* projectors, transforming the metal structure of the projector into a speaker. The audio that is fed to the amplifiers consists of pitched noise, sine and square waves generated from a modular synthesiser, all of which are tuned to the resonating frequencies of each projector. Additionally, a four-track cassette recorder is used to play back pre-recorded sine waves consisting of simple fifth and fourth intervals in different transpositions on each projector. The performance is structured in five sections, each of which focuses on explorations of noise, square or sine waves, or simple combinations of the mentioned sound sources.

5.1. Alien listening

The transducer mounted on *Aldisette* projector number 1 begins to vibrate. This vibration excites the metal structure of the projection apparatus, which starts to propagate the floor with the vibrational energy of pitched noise that flows through the copper wires that connect the output of VCA-1 (voltage controlled amplifier) in the modular synthesiser to the input of power amp-1 that drives transducer-1. The pitched noise is generated by a white noise generator connected to a notch filter, tuned to the resonating frequency of the metal structure in the projector; this now functions as the audio input of the VCA-1. The control input of VCA-1 is derived

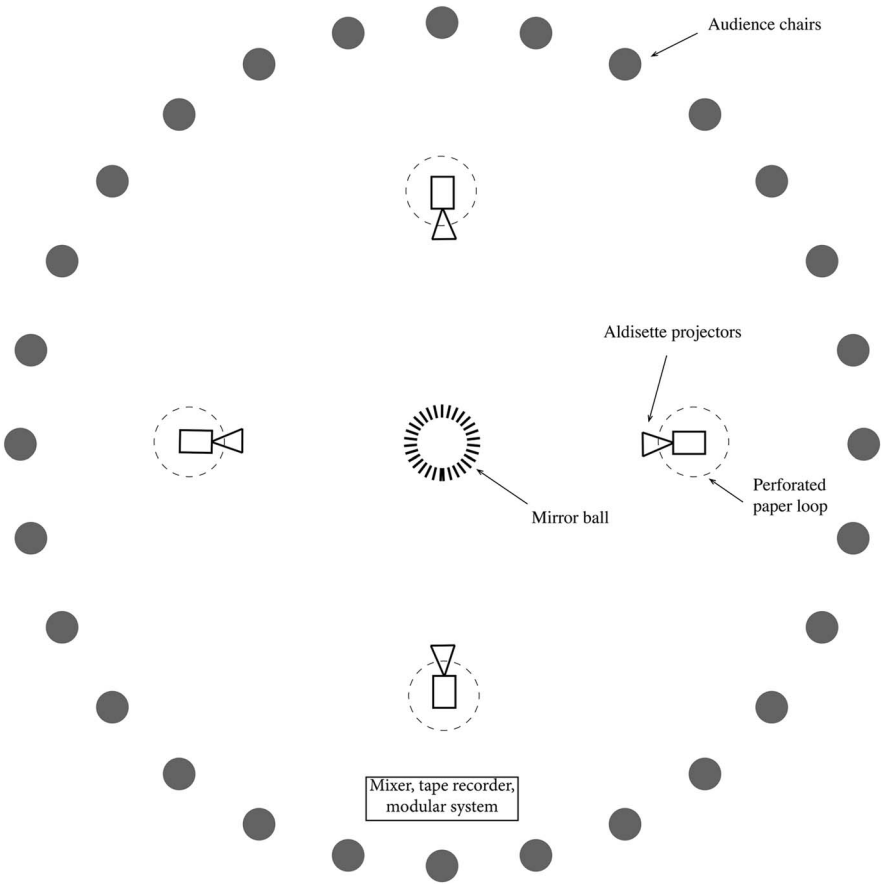

Figure 9. Diagram of *Opaque Sounding* by Morten Riis.

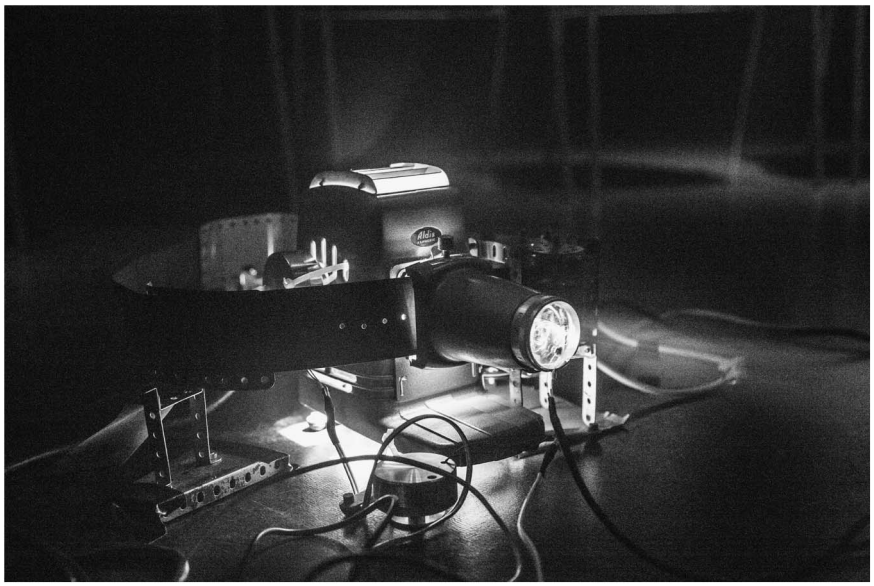

Figure 10. Close-up of one of the projectors used in *Opaque Sounding* by Morten Riis (photo by Kasper Hemme) showing the perforated paper strip that controls the intensity of light. This figure also shows two transducers (one on the floor in front, and one on mounted on the projector) that are used to excite the metal structure and wooden floor.

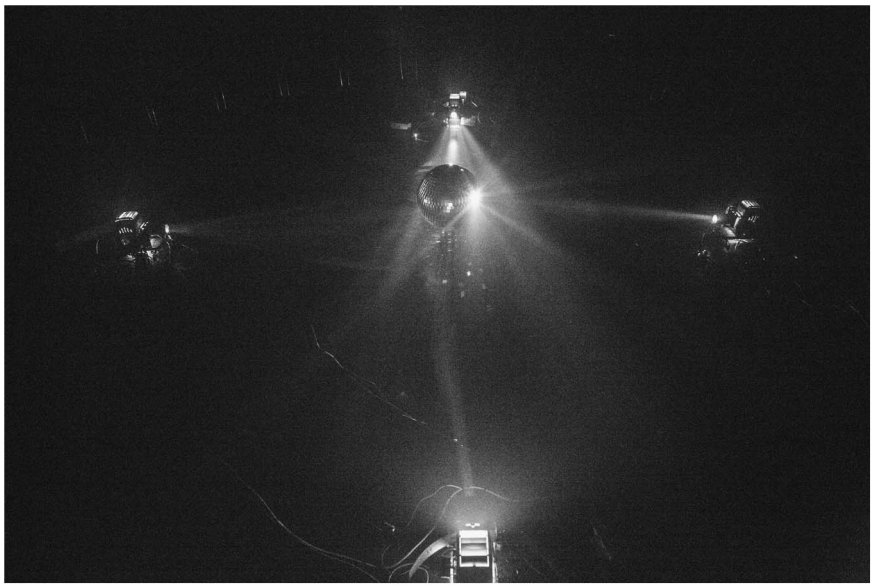

Figure 11. Overview of *Opaque Sounding* by Morten Riis (photo by Kasper Hemme) showing the four *Aldisette* projectors projecting light onto the central mirror ball.

from the LDR mounted on the projector measuring the intensity of light that is mechanically operated by the rotating perforated paper strip. The light intensity captured by the LDR is outputted as a resistor value going through a circuit designed to convert resistance to control voltage. This operates the amplitude of the VCA-1 based on the amount of light particles hitting the surface of the LDR.

In a dark ecological perspective, the described fifth and fourth intervals played back from the cassette tape recorder can be seen as raising the awareness of how humans throughout history have forced the temperament of, for example, the piano. In this light the well-tempered scale proposes a structure that seems to be consistent and solid (making it possible to play in every key for instance), but this stable structure is founded on an even distribution of errors and incompleteness that internally breaks with its own consistency. To be able to stage this inconsistency and fragility within the well-tempered scale would be to acknowledge the Rift between essence and appearance, as for example in La Monte Young's explorations of equal temperament in his *The Well-Tuned Piano* (Young 1987). A piece that proposes an alternative form of tuning that stages the inconsistency of the well-tempered piano through a reflexive liberation of the piano from human slavery (Morton 2013a: 166). By subscribing to this perspective, the reductionist understanding of intervals that reduce sonic objects and events to be describable within the proposed consistency of the well-tempered scale, dissolves itself. Instead, OOO proposes an investigation into the inconsistency within the piece from the perspective of the objects involved.

When the human audience in the concert hall hears the sound of the transducer exciting and vibrating the metal structure of the projectors and the wooden floor, what are they listening to? The sound of the floor? The sound of metal? The sound of transducers? The ears of the audience members are hearing wavefronts in the vibrating metal and wood through their human ears. The transducer hears the electrical signals flowing through the copper wires in a transducer-morphising manner, translating it into transducer-ish. Through this perspective, it becomes hearing-as and sounding to something else unfolded in a relational framing. A notion that resembles Morton's description of how matter always is relational too: its matter-for something, not matter in itself as a closed entity (Morton 2013b: 82).

It may seem counterintuitive to propose that non-human objects listen. However, this anthropomorphism must be contextualised through Ian Bogost's concept of *Alien Phenomenology*,[17] in which he investigates the question of what it is like to be a thing, and outlines a conceptualisation in which computers '*do* entail human experience and perception' (Bogost 2012: 9). This conceptualisation takes its starting point in Harman's vicarious causation (Harman 2012), a construct in which things never truly interact with each other, but interact through an

[17]The alien in Bogost's *Alien Phenomenology* refer to both the alienating principles lying within the conceptualisation that objects can experience the world and that their experiences of and appearances to each other also are incomprehensible and alien to us. Here including a reference to Thomas Nagal's conceptualisation of the bat's phenomenological experience of the world being alien to humans.

unknown fuse not really fusing the objects in question. Thus, it becomes the philosopher's job to write the speculative fiction of non-human objects through the practice of alien phenomenology (Bogost 2012: 34). Bogost's phenomenology of things is greatly influenced by Thomas Nagel's objective phenomenology, which aims to describe 'the subjective character of experiences in a form comprehensible to beings incapable of having those experiences' (Nagel 1974: 449). However, where Nagel calls for an 'objective phenomenology' that avoids the anthropomorphising and mediating tendencies of figurative language, Bogost's alien phenomenology deliberately embraces it. 'In a literal sense', writes Bogost, 'the only way to perform alien phenomenology is by analogy' (Bogost 2012: 64). In this context, Jane Bennet also points out that anthropomorphism can be used to remind us that we are no longer 'above or outside a nonhuman environment' (Bennett 2010: 120). This stresses the importance of an analytic perspective that turns attention towards the ears of the objects in question, unfolding a speculative anthropomorphic listening of objects.

The transducers mounted on the metal structure of the slide projectors are of the moving-coil actuator type – a device that transforms one kind of energy (electrical current) into another (physical movement via electromagnetic induction). The coil listens to the electrical current flowing through the copper wires connecting the output of the amplifier to the transducer. It pays special attention to the way in which current flows through the coil around the iron core, creating a magnetic field that works against and with the permanent magnets (Campbell 1994: 180–3; Sinclair 2001: 135). The moving coil itself tries to position itself according to the flowing current that enters its sensory apparatus, and tries to balance itself between the strength of the magnetic field and the torsional force in the spring that facilitate its movement. The coil's ears are tuned to a variety of different signal types. It is trying its best to keep up with the seemingly endless stream of electrons hitting its metal and copper eardrums, as it reacts to even the tiniest almost inaudible changes of electrical current. The coil rapidly digests its auditive impressions, and begins to give voice to its own version of the current. A voice that is based on and inspired by the electrons' movement within the copper wire, but the coil somehow makes it its own song, not like a cheap cover version, but rather a version that expresses the coil's deepest and most grounding feelings of what it is like to be a moving coil.

The proposed alien listening perspective of the moving coil presents us with an expanded perspective of what agencies are at stake within the objects that together constitute what we normally denote as listening situations. Alien listening offers a step further into a phenomenology of objects than for instance proposed by a technical mapping, or the ontography of Bogost (2012: 38) – the mapping of objects, their differences and their relations to one another. In this manner alien listening becomes a way to expose how causality can be denoted as belonging to the aesthetic dimension, a turn that emphasises that aesthetic experiences are not limited to interactions between humans or between humans and objects (Morton 2013b: 19–20). Through the figurative and anthropomorphising language we have the possibility to unfold this new perspective on causal aesthetics and investigate how art directly works with causes and effects (Morton 2012c: 205–6). The transducer is a good example of aesthetics as causality – what Harman calls vicarious causation – because we never hear the transducer itself – neither do the humans ears, the projector's metal structure nor the wooden floor grasp the essence of the sounding transducer. But instead we – and the other objects involved – translate the effect of the transducer as it creates and build space, understood as interobjective *timing* and *spacing* (Morton 2012c: 214; Harman 2011: 99–102).

6. CONCLUDING REMARKS

Eric Clarke has observed that the relationship between analysis and a newly applied theory can imply a danger of being temporarily impressed by a substitution of terminology, or a reframing of some kind or other, only to discover that nothing has really changed. According to this view, applying a new theory to analysis has a potential circularity risk (Clarke 2005: 201). Therefore, Clarke argues that it is worth considering what such a reframing might be able to achieve, regarding the revealing of relationships and perspectives that were previously hidden and even unsuspected, and help to explain phenomena that remained inexplicable by presenting them within a different conceptual framework (Clarke 2005: 202).

As the above-mentioned critique of OOO indicates, an OOO perspective is often accused of being inhuman. However, advocates of OOO claim that it is necessary to break with the superposition of the human perceiver in order to return to the human position through a new flat and dark perspective that includes other objects and non-humans on the same level. This enables a new sort of humanism that is liberated from the correlational system (Bogost 2012) and can help us break from the autonomous and consistent view of music and sound art. We recognise the potential pitfalls in, for example, proposing an alien listening, even though it is described by a human, but find that a dark ecological perspective can serve an intermediate function in broadening our insight into the sounding objects that constitute our present auditory reality, by recognising that they are *not* consistent

entities exhaustible within a single ontological conceptualisation.

We end this article by considering the key aspects of what the attempt to take a dark ecological perspective might contribute to the diversity of sounding ontologies. These are as follows:

- The focus on the voice as not just a representation of the human, but as something that emerges in interobjective translations between multitudes of different objects.
- The acknowledgement of the mediating mechanisms – such as computers, transducers, and projection devices – having a role as artists and not just as transparent, ubiquitous devices ready to serve human artistic goals.
- The break with traditional dichotomies such as human/nature and figure/ground, instead emphasising the interobjective spacing and timing between objects.
- The proposal of an alternative paradigm of listening, in which not only humans but also objects listen or attune to one another, enabling speculative and anthropomorphic modes of listening, in which the causal belongs to the aesthetic dimension.

Morton argues that in the age of the anthropocene (Morton 2011: 154; Whitehead 2014), the dark ecological perspective is not only important within analysis, but also in the creation of sounding pieces. This is because art is forced to relate to the current state of affairs concerning the human-made ecological crisis (Morton 2013b: 20, 22). Connecting the aesthetic to the causal dimension through dark ecological art forces us to coexist with a vast plenum of non-human objects and must help us explore our own fragility and Rift within ourselves. Doing so collapses the belief that we can distance ourselves from the world; consequently, art and music cannot separate themselves from the world either.

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[P4]

Chapter 18
Audio Satellites: Overhearing Everyday Life

Morten Breinbjerg, Marie Koldkjær Højlund, Morten Riis, Jonas Fritsch, and Jonas R. Kirkegaard

Abstract The project "Audio Satellites – overhearing everyday life" consists of a number of mobile listening devices (audio satellites) from which sound is distributed in real time to a server and made available for listening and mixing through a web interface. The audio satellites can either be carried around or displaced arbitrarily in a given landscape. In the web interface, the different sound streams from the individual satellites can be mixed together to form a cooperative soundscape. The project thus allows people to tune into and explore the overheard soundscape of everyday life in a collaborative and creative process of active listening.

18.1 Introduction and Motivation

In this paper we present "Audio Satellites – overhearing everyday life", a cooperative system that allows people to actively listen to their everyday soundscape by mixing together streams of auditory data recorded at different physical locations. Hereby, people can curate a mediated soundscape that expresses an individual or collective perspective on the everyday. The idea of listening to a soundscape normally relates to a passive situation, where people listen to a pre-recorded soundscape or participate in a sound walk in which they are encouraged to listen to e.g. a city soundscape following a predetermined route. In our project, we want

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instead to encourage people to be active listeners in the following two ways. First, the audio satellites can be displaced at free will as long as there is access to a WiFi-network that allows for live streaming of sound from the built in microphones. Second, the different sound streams can be mixed together in real time and listened to by a person through a custom designed web interface. The people setting up the audio satellites and mixing together the audio streams can be the same, or they can have decided to work together, but will most likely be unknown to each other.

The project builds on an ongoing exploration of the collaborative potential in using interactive sound to engage people in living cultural heritage and collective storytelling as a form of community engagement [1, 5]. The research agenda pursued in "Audio Satellites – overhearing everyday life" is to create a more agile system, with mobile listening devices that can be distributed freely indoor and outdoor, and further to add the real time mixing as a collaborative ingredient to facilitate a participatory and active listening experience

In this article we first outline a conceptual framework for how listening through technology can be used as a strategy to engage people in an exploration of their everyday lives. We build on this to introduce the concept of "overhearing" as a central concept for exploring the aesthetics of listening. We then present the Audio Satellites system and related work. Finally, we reflect on the way in which the system can be understood as a cooperative system that allows people to attune to their everyday environments in novel ways through collaborative making and active listening.

18.2 Listening Through Technology

Often soundscape recordings are seen as ways to represent or draw attention to the structure or the constituent elements of a given place, but as Murray Schafer noticed any recording is technologically mediated and as such the role of technology and the question of what it means to listen through technology should be considered [8]. As a consideration, we wish to avoid what Yolande Harris calls sonic colonialism, as any de-contextualization of a soundscape from its environment forces us to listen as outsiders, inevitably biasing our understanding, often leading to a pseudo-understanding of a distant location. Harris stresses the importance of considering our relationship to the recorded sounds: the context in which they originate, the place in which we hear them and how our experience is mediated by technology [4]. So how, then, can we make the acute awareness of embodied location present? By playing with ways of listening, e.g. by encouraging listeners to be aware of the displacement in interplay with their immediate surroundings and technology.

Harris suggests the term techno-intuition to encompass the practice of using technology to establish and enhance our relationship to the environment through sound and listening in action [11]. With the aid of sonic technologies and awareness

enhancing practices, we can re-experience environments we know and access others beyond our physiological abilities. So rather than considering technology as the antithetical to the environment it becomes a way to provoke a sense of direct involvement and entanglement with it. When we are physically involved in movement and action it provokes an attitude of openness challenging us to expand beyond ourselves as consistent, closed entities. In this way active listening through technology provokes an open attitude that form new sonic relationships with the environments around us, than through passive listening.

18.3 Overhearing: The Aesthetics of Listening

Brandon Labelle, echoing Michel Serres, introduces the concept of the overhear as a generative potential forming an essential part of our experience of everyday environments. The overhear is not to be considered as the neutral backdrop (as suggested in the common term background noise/noise pollution), but a necessary ground on which the signal is heard, and therefore a part of the relation and a productive component of all information transmission. The overhear is the horizon that all sounds relate to, in the open space, as there is always sound outside the frame of a specific listening and therefore these multiple perspectives become part of the experience with a promise of the outside. The overheard registers and underlines our spatial surroundings by explicitly connecting us deeper than through what we see and consciously listen to. In this sense, the overhear expands our space or freedom to act [7]. With the concept of overhearing we wish to call attention to the kind of listening strategies that the Audio Satellites system supports. In Danish, the word "overhear" has two meanings. The traditional understanding of the word refers to the situation where we do not hear something that we were supposed to hear due to e.g. distraction. The second and recent understanding refers to the situation in which we hear something that was not meant for us to hear in the first place. In this context, we play on both meanings of the concept in the sense that the system allows people to attune to sounds we normally do not pay attention to e.g. noises or background sounds, to penetrate what Luc Ferrari has called the "domain of secrecy" [3] i.e. tapping into sounds that was not deliberately directed to our attention. In the latter case, issues around intimacy, surveillance and telepresence come forward. As such the system allows, in the terms of Susan Sontag, for both a hermeneutic and an erotic way of listening [9]. In the hermeneutic way, the soundscape becomes "readable". We hear the different sound streams as representations of specific events and places and use them to make sense of what we are listening to. In the erotic approach, the purpose is not to map and identify space and to seek an overview but to affectively sense the sounds heard in all their detail and material diversity and to follow imaginary paths that echo the unruly and "ghostly" nature of sound [2, 10].

18.4 The Audio Satellites Concept and Related Work

The project "Audio Satellites – overhearing everyday life" consists of a number of mobile listening devices (Audio Satellites) from which sound is distributed in real time to a server and made available for listening through a web interface – the overHEARD online soundscape mixer. The Audio Satellites can either be carried around or displaced arbitrarily in a given setting. Through a web interface, the different sound streams coming from the individual satellites can be mixed together to form a cooperative soundscape. The soundscape can only be heard in real time, and is not recorded. The proposed soundscape mixer is compatible with current digital devices such as smartphones, tablets and computers.

The Audio Satellite technical platform is based on the Raspberry Pi 2 equipped with WIFI/3G modem and a high quality audio interface. Streaming is done using Darkice and Icecast with a 3G modem. Besides a Linux OS, the Raspberry Pi runs the Jack Audio Server, Pure Data (pd-extended) and Darkice. Dynamic directional microphones are placed at carefully selected places at the site, all connected to a rack mount digital mixing console with DSP capabilities. Via Ethernet based OSC (Open Sound Control) it is possible to control parameters such as level, pan, equalization and dynamic processing (compression/limiting). The output from the mixer is then connected to an audio interface. From the audio interface the audio is sent to Pure Data. From here it is routed via Jack to Darkice that encodes the audio stream to mp3-format and streams it to the Icecast server. The web interface where users can mix the soundscapes contains a player that receives the Icecast streams from the different satellites. The different Audio Satellites are physically constructed for outdoor use and designed to be as maintenance free as possible. The enclosure ensures a moist free environment so the electronics will not corrode or short-circuit. They do not need Internet cable connection as they stream via a 3G modem. However, they do need power. The Audio Satellite status can be monitored and reset via the Internet connection and calibration/adjustment to the audio signal can be done here as well.

The Audio Satellite system continues a line of inquiry opened by the possibility of bridging different geographical locations through sound in real time arising as early as with the invention of telephone and radio broadcasting, understood as forms of listening through technology. With these technologies, the ghostly nature of sound, which allows for "the presence of what is absent" [10], like the voice of a person transmitted from the far end of the world, is accentuated. Today, many projects presenting the soundscape of places around the world can be heard on the Internet based on uploaded sound recordings or live streaming of sound. In the *London Sound Survey* initiated by Ian M. Rawes in 2008, sounds of everyday public life throughout London is collected in order to document the soundscape of London city and how the sound environment changes (http://www.soundsurvey.org.uk). Similarly *radio aporee*, an open and collaborative platform for research on sound founded by Udo Noll, allows people to upload sound recordings as long as they subscribe to a few guidelines (http://aporee.org/maps/). In the *orca-live.net*

project, building on the research of Paul Spong, underwater sound is streamed live through a network of hydrophones allowing for e.g. the detection and experience of whale/orca songs. The project relates to the concept of the Nature Network: stations set up in Nature in order to transmit live images and sound to people around the world. All these projects differ from each other by being either curated or collaborative/open and by being archival or live/in real time.

A more explicitly socially oriented project is *Peccioli Radioscape*, which formed part of the Presence Project led by Anthony Dunne and William Gaver, and explored how radio could be used to amplify the sociability of the small rural village of Peccioli. The elderly people of the village were enabled to overhear the social life taking place in the streets, at the market or in cafe's from within their private homes. By placing transmitters with built-in microphones in the landscape, people could tune into the sounds of other people talking and discussing or into the sounds of the rural landscape like bird songs or the sound of splashing water from near by streams.

In "Audio satellites – overhearing everyday life" we share the common ideas of presenting different everyday soundscapes to people using different listening technologies. We wish further to expand the idea by developing an aesthetics of listening based on active overhearing, having listeners mix different sound inputs from their everyday environments. The ambition is to qualify the way people can overhear and attune to everyday soundscapes through technology as active listening.

18.5 Conclusion

The aim of the project "Audio Satellites – overhearing everyday life" is to allow people to tune into the everyday soundscape and evoke an active listening approach through a process of participation. The active listening process is facilitated by either controlling both the position and placing of the individual Audio Satellites or by mixing the individual audio streams into a personalized soundscape through the web interface. Active listening as overhearing is to be understood as a process of bodily action, interaction and intentionality. As such, people participate in a creative process of collaborative making that is both situated and embodied, formatted through a complex relation of technological and human agency. This creative process arises within a field of force and flow of material, as suggested by Tim Ingold, where the active listening process represents a form of improvisation with technology, flows and rhythms of sound and spatiotemporal conditions [6]. Hereby, overhearing becomes a process of active involvement, participation and exploration that counters the normal comprehension of overhearing as a passive and unconscious modus.

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Beyond insulation and isolation

– Towards an attuning approach to noise in hospitals

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Abstract

Most research on the acoustic environment in the modern Western hospital identifies raised noise levels as the main causal explanation for ranking noise as a critical stressor for patients, relatives and staff. Therefore, the most widely used strategies to tackle the problem in practice are insulation and isolation strategies to reduce measurable and perceptual noise levels. However, these strategies do not actively support the need to feel like an integral part of the shared hospital environment, which is a key element in creating healing environments, according to the paradigm of Evidence-Based Design and Healing Architecture. This article suggests that the gap in contemporary research is intimately linked to a reductionist framework underlying the field, which is incapable of accommodating the multisensory and atmospheric conditions amplifying the experience of noise. This article argues that an attuning approach should be included in the field to help bridge the gap by offering active ways of attuning to the shared environment.

> 'In short, in normal everyday life, when I perceive, I am always perceiving from somewhere, exposed to my surroundings and in the process of doing something. Far from being simply epiphenomena, these contextual dimensions are an integral part of perceptual activity'. (Thibaud, 2011, p. 205)

Introduction

During the 2010s the Danish regions are building new hospitals to improve healthcare by putting patients first as part of a larger paradigm shift in healthcare over the last 30 years – from focussing purely on curing disease to including concerns about how to support the healing process. To improve healthcare settings these visions are to be unfolded through the creation of healing environments, guided by research done in the field of Evidence-Based Design (EBD). A healing environment should be designed by reducing stressors and shielding the patient from a hectic environment, on the one hand, and by creating stimulating surroundings that can support the equally vital need to feel like an active and integral part of the environment, on the other.

In this context the acoustic environment has become a central concern, as research has shown that noise levels in the modern Western hospital exceed recommendations, and at the same time noise is consistently mentioned as a critical stressor for patients, staff and relatives (Busch-Vishniac et al., 2005). The research constituting the knowledge base for EBD recommendations on the noise problem has been dominated by two main approaches. The first of these is a noise reduction approach[1] rooted in natural science and acoustics, which aims to achieve a

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measurable reduction of the overall sound level by the implementation of various insulation strategies in order to eliminate noise as effectively as possible, mainly by installing soundproofing material.

Based on data that questions the adequacy of the noise reduction approach, a second approach has emerged in the last decade advocating for a human-centred approach, rooted in interdisciplinary collaboration between natural, human and social sciences, focussing on the subjective experience of noise. According to this approach, focussing purely on reducing sound levels simplifies the complexity of the noise problem, and must be supplemented by an ongoing and multifaceted effort to chart a course for quiet or calm for patients. Therefore, this approach recommends isolation strategies to reduce the experience of annoying sounds (e.g. by reducing reverberation times), and by adding positive sounds (e.g. by the use of healing music in headphones) offering the individual patient a momentary island of rest from the hectic environment. The combination of the noise reduction approach and the human-centred approach fits well within the EBD recommendations to both reduce stressors and provide positive stimulation, thereby holding out a promise of support in creating a healing environment. However, an analysis of the strategies of these two approaches reveals a gap in terms of adequately meeting the need to feel like an active and integral part of the environment in situations where it is not favourable to be insulated or isolated from the shared environment.

This article argues that the shared reductionist framework underlying the existing approaches implies a radical split between subjects and objects and a passive perception model rooted in sensory atomism that prevents taking the appropriate steps to close the gap, as it is unsuitable to accommodate the complex multisensory and atmospheric conditions that are central parts of the noise problem in shared hospital spaces. The main contribution of this article is therefore to argue for the importance of including a third attuning approach in the field, based on a foundational framework capable of addressing the gap. The article consequently outlines an attuning approach based on a non-representational framework in which *attunement* refers to a capacity to actively sense, amplify and attend to difference shaped by the atmosphere, all of which contribute to and condition *what* and *how* something appears in the world (Ash & Gallacher, 2015, p. 70). This framework allows research that addresses the gap, but does not fit within the reductionist framework, to be unfolded. Research that identifies non-acoustical and contextual factors as central parts of the noise problem in hospitals. Furthermore, it illuminates valid reasons for the gap identified in the field of EBD, because the noise reduction approach and the human-centred approach focus on diagnosing *what* constitutes noise or quietness, thereby failing to consider *how* the patients' appraisal of sounds also depends on the possibilities of acting in and responding to the environment. Including the attuning approach in the field can therefore help specify the main concerns when

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designing attuning strategies to facilitate ways to feel like an integral part of the environment, ways which are currently missing in the field.

The article ends by discussing the advantages of adopting Reflexive Epistemological Diversity (David, 2005, p. 22) in EBD, which would allow the inclusion of alternative research that builds on different foundational frameworks. This expansion would help strengthen the explanatory validity in the field, which is needed to create healing environments in the complex Danish hospital environments in the future.

Addressing noise in hospitals

From 2010 to 2020 a number of super hospitals are being built in Denmark with the explicit aim of improving healthcare through patient-centred care. To unfold the visions, key themes guide the process, including how the environment impacts on patients and staff, and how design and architecture can contribute to the healing process.[2] There is a growing demand for basing such decisions on scientifically based knowledge, which has partly been met in publications such as *Hospitals of the Senses* (*Sansernes Hospital* [Dirckinck-Holmfeld et al., 2007]) and *Healing Architecture* (*Helende Arkitektur* [Frandsen et al., 2009]). This literature gives design recommendations on how to create healing environments, based on research done in the area of EBD, which has become an international trend in healthcare design. To meet the evidence-based criteria of research validity, EBD recommendations are derived from literature reviews of credible research in the field of hospital noise, which are regarded as the primary source of knowledge when approaching the problem in connection with the construction of the new hospitals (Frandsen et al., 2009, p. 79).

'Unnecessary noise, then, is the most cruel absence of care which can be inflicted either on sick or well' (Nightingale, 1946, p. 27). This quote recurs frequently in both public and academic presentations on the growing noise problem in the modern Western hospital. The quote is taken from the book *Notes on Nursing: What It Is, and What It Is Not* from 1859 by Florence Nightingale, the founder of modern nursing. Throughout the article different interpretations of the quote will serve as an illustrative framework for mapping the main approaches in the field, as well as other research that is not yet included in the field.

The quote is mostly used as above, without an intratextual context. The word *then* is ignored, after which the word *unnecessary* is taken to support the argument that the reduction of noise levels is *the* paramount concern in fighting the noise problem in hospitals (Busch-Vishniac et al., 2005, p. 3629; Call, 2007, p. 2).[3] This interpretation reflects an acoustic noise concept in which loud sound has negative physical and psychological effects, and therefore the goal is to lower noise levels. To achieve this goal the noise reduction approach therefore recommends a range of insula-

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tion strategies such as installing insulation material and sound-absorbing panelling, eliminating excess overhead paging and culling extraneous alarms (Joseph & Ulrich, 2007).

An alternative interpretation of the quote, taking the context of the chapter where the quote appears into consideration, will serve as an illustration of a second approach, which has come to dominate the field throughout the last decade. The quote appears in the middle of the fourth chapter 'Noise', which begins: 'Unnecessary noise, or noise that creates an expectation in the mind, is that which hurts a patient. It is rarely the loudness of the noise, the effect upon the organ of the ear itself, which appears to affect the sick' (Nightingale, 1946, p. 25). In this first sentence of the chapter *unnecessary* is defined as having nothing in particular to do with the loudness of the noises, an interpretation that is underlined in the following sentence: 'Unnecessary (although slight) noise injures a sick person much more than necessary noise (of a much greater amount)' (Nightingale, 1946, p. 27). Following this interpretation of Nightingale, the noise reduction approach has become increasingly contested as inadequate by a human-centred approach. This approach has argued for a shift towards a subjective noise concept defined as *unwanted sound*, not chasing silence, but facilitating perception of *quiet* and *calm* by stressing the importance of understanding the individual experience of annoyance (Johansson et al., 2012; Topf, 2000). This shift is supported by data collected in hospitals tackling the noise problem solely through insulation strategies, concluding that noise reduction as a cure and silence as a goal are not adequate (Wolf & Madaras, 2012). The human-centred approach seeks to address perceived noise annoyance through detailed acoustic measurements combined with qualitative studies (Okcu et al., 2011, p. 1349) based on interdisciplinary collaborations (Ryherd et al., 2008, p. 23). The strategies proposed by this approach include creating positive environmental adjustments by reducing reverberation time, isolating the patients in single bedrooms, providing positive distractions through music intervention and adding continuous background sound called masking noise (Dirckinck-Holmfeld et al., 2007; Frandsen et al., 2009). Other strategies address cultural and behavioural patterns through alignment of people with continuous noise awareness and effort, for example through carving out blocks of daily 'quiet time' (Wolf & Madaras, 2012). Taken together, the strategies strive to recognise the subjective and thus divergent experience and therefore target individual patients through isolation strategies that help them find islands of rest shielded from the hectic hospital environment.

Due to the emergence of the human-centred approach, the noise problem is increasingly approached as a complicated and ongoing problem with no easy solution, highlighting the importance of not only considering negative aspects, but also including qualitative features (Mackrill et al., 2013, p. 1). This direction reflects a

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general paradigm shift in research on complex and public sonic environments from no sound to quality sound, an approach that has been emerging in several disciplines. This work, termed 'soundscape research' (Kang et al., 2013), has disputed the idea that sound, unless organised in accepted musical structures, is always unnecessary and undesired by proving that the quality of life is not improved by removing sound, but rather by shaping its aspects, as 'fighting against noise pollution may not be the same as fighting for silence' (Thibaud & Amphoux, 2013, p. 64). In other words, the univalent focus on noise understood purely as a nuisance is problematic when addressing complex sonic environments, and therefore issues of noise must be supplanted by reflections on aural comfort.

According to EBD, a healing environment is characterised by the fact that it meets the need to feel both protected from the hectic healthcare environment and to feel like an integral part of this environment, by empowering the patient to be able to actively choose privacy or engage in the environment at different times (Frandsen et al., 2009). These two vital needs are supported by research in the field of noise in hospitals (Mackrill et al., 2013, p. 5; Shattell et al., 2005, p. 168). Designing to achieve a healing environment therefore simultaneously reduces stressors and positively stimulates the senses through the interplay of art and architecture. A combination of the two main approaches seems to match these ideas, and may therefore prove capable of adequately addressing the noise problem. However, considering the individual shielding character of these strategies reveals that they are unsuitable in situations where insulation and isolation are not the most effective or feasible ways to meet the need to feel like an integral part of the environment. Therefore, the second part of this article will analyse the shared foundational framework underlying the existing approaches in order to expose possible reasons for these shortcomings.

Reductionist framework

The two approaches are based on the understanding that noise and not-noise are consistent concepts that can be fixed in various representational and dichotomous frameworks as noise versus not-noise or unwanted versus wanted sound. Both approaches suggest that there is something that can be separated and conceptualised in itself and thereby removed and/or described independently: The noise reduction approach because its quantitative premise is that noise can be objectified, measured and thus removed, and the human-centred approach because its qualitative premise is that it can comprehend and deal with noise in all its complexity by establishing a comprehensive general taxonomy to distinguish between the *unwanted* and *wanted*.

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Following the object-oriented philosophy of Graham Harman, this article argues that both approaches share an underlying reductionist framework based on 'undermining' and 'overmining' tactics (Harman, 2013, p. 43). Both approaches seek to handle complexity by capturing the essence of things (noise) either through 'undermining' by reducing things downwards to their smallest components, as when the noise reduction approach assumes a correspondence between observation and real world, or through 'overmining' by reducing things upwards into broad dichotomous concepts, as seen in the human-centred approach, which regards noise as nothing more than the effect on the individual subject. When both approaches are included in EBD, the result is 'duomining', where the field not only depends on defining measurable criteria for noise, but is also commensurable with human understandings of general categories such as noise. 'Duomining' ignores the fact that both the instruments for measuring and the categories to describe noise constitute the object under study, by both reducing and amplifying certain aspects of it. In this way, 'duomining' demands exaggeration as a primary tool, as expressed in the Cartesian reductionist framework, which presupposes a dichotomous divide between the experiencing subject and the object (noise).

According to Martin Heidegger, taking such a subject/object dichotomy as a point of departure will lead us to fundamentally mischaracterise the prevalent engagement in the everyday world in which we are usually unreflectively immersed. He diagnoses this as being the result of a prevalent modern worldview, attempting to establish mastery and control over an unruly world (Thomson, 2011). As a consequence of this radical split the human is considered a passive receptor of raw sensory data, who fills in the gaps through accumulation of knowledge in a chaotic environment where structure is imposed on the world by building an internal model (Clarke, 2005, p. 22; Ingold, 2011, p. 282). Furthermore, it presumes a division of the senses as different channels that can be individually addressed as discrete faculties, and thus encourages research to start in 'sensory atomism' (Ihde, 2007, p. 43). This can be observed when sound and noise and hearing are understood as a passive sense, cut off from the other senses and their bodily interplay. In this view, the overload of sound (raw sensory data) bombarding the passive receiver makes noise an unhealthy, contaminating stressor that causes disease (Biddle, 2009). Therefore, the noisy acoustic environment in hospitals creates a tension amplified by the cultural understanding that quietness is the most appropriate environment for healing (Rice, 2013, p. 29).

Dividing the subject from objects and other subjects forms the groundwork for what Heidegger terms 'subjectivism'. This is a perspective in which an objective realm is separated from isolated subjects and so needs to be mastered by the normative and practical activities of these subjects, as reflected in the existing strategies. The attempt to skip the integral and practical entwinement of self and world

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will lead to 'enframing', when the failed attempt to control the world turns on itself, with the result that the subject is increasingly transformed into just another object to be controlled. This tendency can be traced in the attempt of isolation strategies to control subject behaviour through, for example, 'quiet time' and urging individuals to seek harmony elsewhere, for instance by withdrawing into headspace through the use of healing music, which is believed to 'work' as a kind of medicine controlling the patient's mind (Lind, 2007, p. 211). 'Aesthetics becomes a psychology that proceeds in the manner of the natural sciences; that is, states of feeling become self-evident facts to be subjected to experiments, observation, and measurement' (Heidegger in Thomson, 2011, p. 59). Together the insulation and isolation strategies represent efforts to resist and prevent what Erving Goffman identified as 'contaminative exposure' (Rice, 2013, p. 44). This worldview assumes that there is a quiet and balanced world somewhere, and that our job therefore is to restore the balance by removing noise through protective regulatory measures until the problem has been solved. Research on noise has therefore been focussed on explaining how people get stressed and fall ill owing to noise pollution, and the strategies aim at removing noise as much as possible to create a healthy and healing environment.

However, the emerging human-centred approach has increasingly revealed that the current gap in the field is related to the limitations of such a reductionist framework. For instance, Dirckinck-Holmfeld et al. state that the sensory atomism in the field represents a serious limitation, as research consequently has to guess what role the multisensory and atmospheric intertwinement plays. They call for future research to give name to the ineffable, which would demand another framework able to accommodate 'what we cannot know' (Dirckinck-Holmfeld et al., 2007, p. 196, my translation) in the *EBD* domain. Based on the analysis presented in this part of the article, these issues will thus remain ineffable if the field continues to be based solely on a reductionist framework that is incapable of reflecting the complexity of the problem being approached (Annerstedt, 2012). Consequently, the next part of the article will outline a third attuning approach, based on a framework which is capable of accommodating the multisensory and contextual aspects with a view to revealing the potential of this approach for outlining a way to bridge the gap in contemporary research.

Towards an attuning approach

Research outside the field of EBD focussing on listening in hospitals has investigated the obstructive as well as encouraging factors when it comes to feeling like a part of the hospital environment. These studies have been conducted using different qualitative methods, including ethnographical and phenomenological methods, and stress the need to address the noise problem with a focus on how the

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situational multisensory, corporeal and affective context mediates and facilitates listening as a primary sensory mode. Therefore, they point to the need for comprehensive assessment with a view to placing noise in relation to other non-acoustical aspects (Mackrill et al., 2013, p. 6). According to anthropologist Tom Rice, who spent a year in an English hospital focussing on the listening experience of the patients, the hospital environment has an 'unusual atmosphere of sensory absences' (Rice, 2003, p. 5), encouraging the development of an intense sonic sensitivity. This is due to a general impoverishment of non-auditory stimuli, leading to a sense of stasis, which is amplified by corporal confinement in bed (Johansson et al., 2012, p. 113; Radley & Taylor, 2003). The experience of noise is therefore intimately connected to and cannot be demarcated from contextual conditions, jointly creating a feeling of being disconnected, isolated, exposed and disorientated (Shattell et al., 2005, p. 168). Rather than producing affectively numbed or desensitised bodies, this atmosphere gives rise to a heightened sensibility in the auditive area by actively sensitising listening. The complex and ambiguous relationship between the acoustic environment and listening therefore takes on a central, disturbing and reassuring role in navigating and negotiating the role of being in hospitals to both orient and connect, but also shield and restore (Johansson et al., 2012, p. 112; Shattell et al., 2005, p. 161).

However, the acoustic environment in hospitals is distinctly different from other domestic and public spaces, because the sounds of other sick people, medical practices and equipment define the overall hospital atmosphere as a medical space. Moreover, it is dominated by many affective intrusive and sudden sounds, amplified by the fact that they often cannot be confirmed and prepared for in visual or other sensory modalities or balanced with other non-medical sounds. Therefore, the soundscape contributes to a feeling of being in the middle of something uncontrollable. Furthermore, the many alarms that make the body acoustically present create what Rice describes as a feeling of 'sonic incontinence' (Rice, 2013, p. 180), amplified by the experience of a subdued environment and a lack of dynamic non-medical background sounds (Johansson et al., 2012, p. 113), forming a system of control which the institution enforces. Understanding the ongoing annoyance and appraisal of different sounds in this perspective, noise might as well consist of small, quiet and muted sounds that reinforce the feeling of being present in a system of control without being *in* control.

The combination of the intense sonic sensibility and the uncontrollable soundscape calls upon specific attentive listening modes such as 'monitory listening' (is something wrong?) and 'diagnostic listening' (what is wrong?) (Rice, 2013, p. 181). Following Andringa and Lanser (2013), directed attentional modes demand a lot of energy to distinguish between important and unimportant sounds, which can lead to directed attentional fatigue and exhaustion, if they are not complemented by

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other less demanding modes of perception. Less focussed and vague modes of hearing or overhearing are not directed towards diagnosing specific sounds, and therefore do not make great demands on directed attention. Such restorative modes therefore provide time to restore the capacity for direct attention and reduce arousal (Andringa & Lanser, 2013, p. 1445). Facilitating these modes of hearing can therefore take on a key role for establishing audible safety and thus enhancing the feeling of being in control of the situation.

As the hospital environment with its general lack of dynamic background sounds often does not facilitate these modes of listening, patients spend energy trying to counterbalance demanding listening modes by turning a deaf ear to feel shielded and thus restore listening attention. The patients' ability to successfully cope therefore depends on their ability to successfully habituate the sounds in order to overhear them, which is made difficult by their affective character and the patients' inability to control them. In other words, as patients are left without possibilities or skills to actively habituate and overhear, the role of the acoustic environment as reassuring and restorative is obstructed and transformed into an urgent need for zones of privacy (Wiese, 2010, p. 100). This strand of research thus points towards the need to facilitate less attentive hearing modes as a fruitful way to restore attention and cope effectively, providing both the needed indicators of safety in the unsafe and demanding sonic environment and active possibilities to actively attune to the patterns and rhythms of hospital life.

Taking these insights into consideration calls for a third interpretation of Nightingale that is outlined in the rest of the chapter on noise and the overall message of the book, with a view to addressing the complexity of the noise problem adequately. Throughout the first pages of the chapter on noise Nightingale unfolds the argument that sound only becomes noise and thus *unnecessary* when it appears to be unresolved and meaningless, but demands an unfair amount of attention. She uses the startling effect of sudden sounds in relation to a quiet background and the unresolved effect of overhearing fragmental conversations and acousmatic sounds[4] while confined in bed as illustrative examples. This state of affairs gives rise to a frightening feeling of confusion which counteracts the healing process. The word *then* in the famous quote mentioned above thus takes on an important role as a reference to these pages on the meaning of the word *unnecessary*. The chapter on noise is consistent with the main argument of the book that the overall environment for healing has a huge impact on the sick (Nightingale, 1946, p. 5). The noise problem should therefore be considered in interplay with the general lack of positive multisensory stimulations and possibilities to actively cope, which together facilitate attentive listening modes foregrounding noise as a main stressor. This third interpretation fits Hillel Schwartz's conclusion that 'Nightingale's sense of noise-

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lessness was ecological, aristocratic, and metaphysical: a permeating "atmosphere"' (Schwartz, 2013, p. 274).

On this basis the article argues that there is an urgent need for EBD to be able to adequately respond to the third interpretation of Nightingale, emphasising how negatively the inability to actively exert control over a stressor influences sound-related annoyance (Topf, 2000, p. 521). This perspective suggests that the experience of wanted or unwanted sound also depends on the possibilities of acting and responding to the environment, calling for strategies that offer a diversity of acoustic situations to be actively chosen and co-created as active coping strategies to feel like an integral part of the shared hospital environment. Therefore, the article suggests an attuning approach to operationalise this perspective in the field through a non-representational framework that develops a vocabulary for understanding the multiple and shifting relations between humans and their environment. Whereas representational theories study the mind and its operations as preconditions for action, non-representational theory is an umbrella term for diverse work that seeks to cope better with our complex multisensory worlds by taking as its starting point unreflexive, preobjective and habitual interactions and analysing affective resonances of that which is unsaid or barely sayable (Vannini, 2015, p. 8). Ash and Gallacher propose attunement as a way to engage in this non-representational background, as it constitutes a basic capacity to sense, amplify and attend to difference shaped by the atmosphere, which together act as 'the conditions of possibility for what and how something appears in the world, before it is organized through internal self-narration, the representational logics of language or a theoretical account of the senses as a series of discrete faculties' (Ash & Gallacher, 2015, p. 70). An attuning approach seeks to acknowledge how backgrounds that often fall out of common awareness and habitual dispositions both shape our capacity for action and constitute a basis on which particular things show up and take on significance, for example noise. The previously ineffable opens up as a space of possibilities for intervention and innovation as well as domination and control.

On this account the intense sonic sensibility in hospitals promoting attentive listening modes is a consequence of an environment that obstructs attuning by promoting a significant subject/object division through confinement in bed, lack of control and an atmosphere of absence. Heidegger suggests that such atmospheres of *Ungestimmtheit* are the most powerful, as they are easily overlooked because they appear empty, though at the same time create a feeling of being alienated, standing outside or against the environment (Flatley, 2008, p. 22). Therefore, the existing insulation and isolation strategies unintentionally reinforce this feeling of standing outside the environment, unable to act, as they gesture towards silence. According to Don Ihde, 'Gesturing toward silence enhances listening' (Ihde, 2007, p. 222), as the focus on trying to exclude other sounds negates itself and produces the con-

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trary effect of increased vulnerability. The more we gesture towards silence, the more radical the intrusions of formerly unobtrusive disturbances become. Eric Clarke compares this type of listening to certain forms of musical listening, where we listen *as if* the music was autonomous and outside the environment. This listening mode is different from everyday listening, because it encourages the listener to turn away from the wider environment in searching for meaning, as it affords internalised contemplation (Clarke, 2005, p. 138). The hospital environment affords this kind of detached and attentive listening, limiting the perceivers' capacity to intervene in or act upon the immediate environment through less attentive listening modes that would allow active coping strategies.

Therefore, the foundation for feeling like an integral part of the hospital environment must be established before such detached and attentive listening modes become dominant, and this is done by acknowledging that the attuning relationships between the self and the world involve a two-way process and are mutually constituting. Jean-Paul Thibaud suggests that we do not perceive atmospheres as such; instead we perceive *on the basis of* atmospheres (Thibaud, 2011, p. 212). Hence, atmospheres are intermediary phenomena occurring between people and space as a sensory background that specifies the conditions under which phenomena emerge and appear. Following this line of thinking, the attuning approach addresses the atmospheric and multisensory conditions *on the basis of which* our perception depends, consisting of a reciprocal and shifting relationship that conditions us, but is also conditioned by us. This will offer a way to operationalise the concept of atmospheres in praxis and point to the importance of strategies to consider the fragile and changing temporal and spatial relations. Leaving static concepts such as noise/quiet behind reveals how rhythmic attunement to a familiar place may be confounded when the body is *out of place*, as in hospitals. But it also reveals how the environment can facilitate spatiotemporal patterns or 'reconfigure presence' to help us to integrate anew 'in a changed or unfamiliar space in order to regain ontological security' (Edensor, 2010, p. 5). As atmospheres are always in the process of emerging and transforming, attuning to the temporal aspect and habituation through repetitive actions inevitably has a neutralising effect on the affective impact (Højlund & Kinch, 2014). So offering concrete ways to actively structure space and time could be a way to rethink the relationship between us and the environment through 'sensibilising practices' (Thibaud, 2014, p. 4), or what this article terms attuning strategies. Perception is thus connected to action, as it is through perceptual learning that we can designate a new way – active adaptive attunement – for listeners to optimise their resonance with environment. Adopting this viewpoint, the sense of control should be established in the attuning relationship between the person and the environment and not *in* the person (isolation strategies) or in the environment (insulation strategies).

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According to the ecological understanding of listening, as further developed by Clarke, this is how we normally navigate through sounds in the context of other sounds and situations, where ecological or overhearing listening modes lead to action and action modifies perception by exploring the source of the sound and, consequently, changing the way we perceive them (Clarke, 2005, p. 137). As different listening modes provide both distal and proximal situational awareness, the background *attuned* by overhearing can create a continual sense of place without requiring conscious attention and can still provide a safe feeling through offering 'ample opportunities for restoration' (Andringa et al., 2013, p. 15). In normal everyday environments we thus actively design our environment to afford inattentive listening modes to create reassuring atmospheres with, for instance, furniture, radios and hi-fi equipment, in order to thus mask unwanted sound and create a sonic climate that is perceived as pleasant (Hellström, 2003, p. 78). The ubiquitous use of music technologies today is regarded as a particularly effective device to which we turn in order to regulate ourselves as agents structuring materials of subjectivity (DeNora, 1999, p. 45). According to Annahid Kassabian, such musical practices facilitate inattentive listening or 'ubiquitous listening', which plays a key role in conditioning 'distributed subjectivity' – a condition that is non-individual and that renders identity as an emergent node in a constantly shifting field of sound, atmosphere and affect open to a network of listeners – to feel like part of a shared environment (Kassabian, 2013, p. 10). However, in the hospitals we are often not able to engage in 'ubiquitous listening' as a way to gain a sense of control and connection to the environment.

Discussion

EBD recommends that a healing environment in the hospital should meet the need both to feel protected from the hectic hospital environment and to feel like an integral part of it. However, the two dominant approaches in the auditory area (the noise reduction approach and the human-centred approach) share a reductionist framework which is incapable of addressing the complex multisensory and atmospheric conditions which play important roles in obstructing or facilitating the feeling of being an active and integral part of the environment. To bridge this gap the article has argued for the inclusion of a third attuning approach based on a non-representational framework, allowing research that addresses the gap, but does not fit within the reductionist framework to be unfolded. This research reveals how the combination of the general atmosphere of absence, confinement in bed and lack of control creates an intense form of sonic sensibility in which the dynamic relationship between the patient and the acoustic environment plays a key role in creating or obstructing a healing environment. However, the nature of the acoustic environment creates an affective state of passive vulnerability that calls for attentive

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listening modes dominating the organisation of the experience of being a patient, while less attentive hearing modes that could allow for active attuning strategies for successful coping are obstructed. Including these insights in the field highlights that non-acoustic and contextual factors are central parts of the noise problem in hospitals. Introducing the attuning approach into the field can therefore help specify the main concerns when designing attuning strategies to facilitate ways of feeling like an integral part of the environment, which are currently missing in the field. Attuning strategies should thus be concerned with promoting a sense of control by facilitating and offering a diverse range of possibilities to engage in inattentive listening modes, thereby enabling patients and other groups to feel empowered to actively *attune* different situations and environments in hospitals. Recently in Denmark a few examples of initiatives aimed at offering the hospital patient some control over the acoustic environment can be found in the fields of music therapy and music medicine. First, patients at Aalborg Psychiatric Hospital are offered the choice between five different music genre-specific programmes in the form of a sound pillow (Bonde, 2011, p. 130). Second, an integrative sensory delivery room for Nordsjællands Hospital with dynamic light and audiovisual stimulation is currently being tested and evaluated, including interactive breathing exercises with waves to help women entrain their breathing to stimulate rhythms during labour. Third, at Herning Hospital a similar delivery room project is under evaluation, though the focus here is on offering patients the possibility of creating different zones and giving the users control of the character of the atmosphere.[5]

However, the accordance between the reductionist framework in the field and the EBD criteria for validity presents an obstacle for the inclusion of an attuning approach in the field.

The framework characterising the existing field of noise in hospitals is consistent with the cognitive traditions and laboratory methods prevalent in EBD, based on the evidence-based criteria for research validity. However, Stankos and Schwarz (2007) argue that if EBD is to remain relevant as a paradigm for the future, it must be able to address the messy complexity in the everyday context. This critique has compelled a general shift in the EBD literature from evidence-based to research-based (Frandsen et al., 2009, p. 3) through the inclusion of alternative qualitative methods, as seen in the human-centred approach. However, the process of including such new criteria of validity poses problems for EBD, as the increasingly diverse interdisciplinary theory and methodology puts pressure on the comparability of EBD to evidence-based medicine, which has been an important part of its legitimisation in the healthcare industry. Therefore, previously the consequence has mainly been that research based on alternative methods and criteria of validity other than the ones accepted in EBD is either not included in the field or translated into the existing framework, supporting its presuppositions. This is not a viable

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solution, as research should be guided by a foundational framework that reflects the complexity of the problem being approached (Becker et al., 2011, p. 128), whereas the process of translation includes a risk of reducing and thus missing the potential of relevant research for helping to bridge the gap in the field. However, as health research often considers methods to be tools with no direct relation to the ontological and epistemological foundations, this problem is not easily spotted. The obvious answer would therefore be that EBD should rethink the theoretical and philosophical frameworks used to structure the research process, if these alternative methods are to be relevant alternatives to the existing methods. However, as Becker et al. and others argue, the EBD paradigm has a hard time rethinking baseline assumptions (Becker et al., 2011, p. 128). Therefore, the suggestion put forth in this article is that instead of opting for an either/or solution, a fruitful alternative is to consider how the field can embrace both/and, allowing more than one foundational framework to coexist within EBD through Reflexive Epistemological Diversity (RED).

Within the sociology of science and technology, Matthew David has proposed that the entrenchment within forms of reductionist and relativist epistemology can and should be overcome by adopting RED (David, 2005, p. 22). RED recognises the value of many forms of explanations, promoting interaction between different explanations, at different levels of causation and across the divide between different sciences. The prevalent view that insights from other epistemological traditions will result in confirming the falseness of any one tradition is to be replaced by a willingness to accept and open up to different causal explanations, as the complexity of the world is best approached in different ways on a number of levels. However, epistemological diversity does not mean that all explanations are valid, but that causation occurs at many levels and that specific events are caused by a complex set of factors. Instead of aiming to find *the* evidence to solve *the* problem, RED aims to gain a higher explanatory validity which recognises that the significance of different contributions to an overall account forces us to reflect upon the limitations of each individual explanatory approach, as the differences encourage reflexivity if they are actively engaged with. In this way, RED offers a means of balancing the need to question all taken-for-granted assumptions with the need to respect a range of explanations. This is in contrast to non-reflexive epistemological diversity, which is often seen in interdisciplinary work and is based upon stacking up the results of insular research traditions confined within specific and self-referential disciplinary fields. Adopting RED in the field of EBD would allow alternative frameworks to fruitfully co-exist alongside the existing approaches, enabling the inclusion of research insights that address the ineffable and thus achieve a higher explanatory validity, without which the situation will remain unclear and it will be difficult to intervene in the practical field with the necessary attuning strategies.

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Conclusion

There is not *one* noise problem in hospitals that can be *solved*, but there are different noise problems that can be *managed* adequately if approached differently. Two interpretations of Nightingale's famous quote served as a framework for mapping the two existing approaches to tackling the noise problem in hospitals today. The first interpretation takes the quote to be a simple expression of the need to lower measurable noise levels in hospitals (the noise reduction approach), whereas the second interpretation includes considerations on the subjective experience (the human-centred approach). Although the two main approaches are important steps towards the creation of a better acoustic environment in hospitals, a third interpretation should be included that highlights the impact of the multisensory and contextual conditions on the experience of noise. Therefore, the proposed attuning approach addresses how the ambiguous auditory experience in hospitals, as a dynamic interplay between the atmospheric hospital environment and the active coping and habituation strategies, develops and forms our relationship to the overall hospital environment. In order to adequately address the noise problem in hospitals in the future, all three approaches must be able to co-exist, develop and ideally work together.

This argument finds support in Pascal Amphoux's three different operative attitudes, which he proposes should all be equally engaged with when managing complex acoustic environments in urban space (Hellström, 2003, p. 169). The noise reduction approach fits the first attitude, termed 'Diagnosis of the Environment', which focusses on protection from noise pollution. The human-centred approach fits the second attitude, termed 'Managing the Milieu', which focusses on offensive strategies to manage conflicts, regulate social interaction and equip people with the instruments needed to control a private sonic milieu. And the attuning approach fits the third operative attitude, termed 'Creation of the Landscape', which focusses on creative operations to stimulate consciousness of the acoustic space through sonic design. In this view, the absence of a plan for the third operative attitude in hospitals today calls for a sonic designer that can address both technical aspects towards dealing with architectural, social, cultural and perceptual criteria as well as handling experiential qualities with regard to the actual listening situation. With a focus on the relation between listener and environment and on how listening perception operates when acting in a built environment, such work should concentrate on how the environment activates us and on how we activate the environment through listening (Hellström, 2003, p. 37).

The challenge for future work is therefore to develop strategies that provide a broad diversity of opportunities for individuals to exercise personal control as a way of coping, including a variety of quiet and lively atmospheres over a more

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uniform set of acoustic environments that comply with noise limits (Andringa & Lanser, 2013, p. 1457). Attuning strategies should move beyond reception-based sound design towards *doing with sound*, through enactive sonic design that offers possibilities through affordances in the environment to satisfy the shifting needs. This could be developed through the use of interactive sound technologies that have the potential to increase the malleability of sound and consequently enhance the active engagement of users with sound and listening, which is often perceived as ephemeral and uncontrollable (Franinović & Salter, 2013, p. 43). While this study does not offer a conclusive answer to the question of how to unfold attuning strategies in practice, it appeals to EBD to stretch its methodological and disciplinary boundaries to acknowledge 'what we're doing when we're listening, whenever and wherever that listening happens' (Kassabian, 2013, p. 117) as a first step towards bridging the current gap in the field.[6]

The attuning approach connects to recent developments in the field of music therapy under the name of Health Musicing (Bonde, 2011, p. 121), which is defined as the common core of any use of music experiences to regulate emotional or relational states or to promote well-being, be it therapeutic or not, professionally assisted or self-made. In this way, Health Musicing can be observed in any social or individual practice where people use music experiences to create meaning and coherence in states and times of adversity. In this context the attuning approach could be seen as a fruitful expansion from music experiences to include sound design, sound art and enactive sound design through technology.

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Notes

1 The names of approaches and strategies are termed by the author.

2 See: http://www.godtsygehusbyggeri.dk/Maal%20og%20styring/~/media/Files/Maal%20og%20styring/Vision/Sygehusbyggeri%20med%20patienten%20i%20centrum.ashx

3 Another use of the quote as an argument for noise reduction can be found in a TED talk by Julian Treasure from 2014: http://tedmed.com/talks/show?id=293030

4 Acousmatic sounds refer to sounds that have no immediate identifiable causes.

5 See: https://www.nordsjaellandshospital.dk/afdelinger-og-klinikker/graviditet-og-foedsel/foedslen/Sider/Sansefoedestuer.aspx & http://www.wavecare.com/sensory-delivery-rooms2.html

6 I have developed a case study together with architect Sofie Kinch to experiment with how to apply and implement the attuning approach in practice. We developed the interactive furniture *KidKit* for the

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Neuro-Intensive Care Unit at Aarhus University Hospital to prepare children for the alarming atmosphere they will enter when visiting a hospitalised relative. *KidKit* invites children to become accustomed to the alarming sounds sampled from the ward while they are waiting in the waiting room. By actively triggering the sounds built into *KidKit* the child can habituate them through a process of synchronising them with their own bodily rhythms. Hereby the child can establish, in advance, a familiar relationship with the alarming sounds in the ward, enabling them to focus more on the visit with the relative (Højlund & Kinch, 2014).

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QUADRATURA

Skrifter i dansk kunsthistorie
Writings in Danish art history

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Inconsistent Transduction

Not-knowing Through Sounding Art in Artistic Research

Marie Højlund & Morten Riis

DANSKKUNST
HISTORIKERFORENING

When you make or study art you are not exploring some kind of candy on the surface of a machine. You are making or studying causality. The aesthetic dimension is the causal dimension. (Morton 2013, 20)

The growing integration of sounding art[1] as research practice in academia is a part of the "practice turn" (Borgdorff 2010, 51) in humanities and social sciences, where artistic practices and artefacts themselves become a form of academic inquiry.[2] As the process of creating art represents a valid research method for gaining new knowledge, sounding art pieces thus become more than mere objects for analysis: because the research unfolds in and through the acts of creating and performing art, practice is not only a methodological vehicle but also a site of knowledge production (Borgdorff 2010, 46). Over the last two decades concepts such as knowledge production and the division of theory and practice have been constantly discussed in the emerging field of artistic research in a process of becoming integrated into the knowledge economy of the academy (Borgdorff and Schwab 2014, 9; Borgdorff 2010, 44; Holert 2009, 1). Scholars in this new strand of literature argue that, to manifest the conditions hidden in knowledge and the unconscious transferences that accompany the need to be scientific, one must be critical of traditional understandings of knowledge production (Busch 2009, 4). Therefore, it is crucial to explore understandings of knowledge production that are directed at "not-knowing" or "not-yet-knowing" within artistic research (Borgdorff 2010, 61), thereby inviting and leading to "unfinished thinking" (Borgdorff 2010, 4) or "wild knowledge" (Busch 2009, 6) encompassing the unexpected, the spontaneous and involuntary.

However, we argue that the implicit human-centred perspective present in these alternative understandings of knowledge production in artistic research prevents us from fully engaging with the objects in question on their own premises. Therefore, tuning into the "not-knowing" requires expanding the perspective to encompass non-human forms of knowledge incorporated through an object-oriented ontological line of thinking. By switching the focus from the human perspective to that of the objects themselves we suggest that knowledge production through practice and theory is substituted with causality exploration (tuning) through "carpentry", this being the practice of asking and exploring philosophical questions through artistic practice and performance. Through this lens art and other objects that we judge as belonging to the aesthetic dimension, offer a glimpse into the ways in which causality operates. This world of objects makes clear that any exhaustive knowledge about the world and the things or human beings that occupy it is an illusion that simply offers a focus on how the materiality behaves, interacts, develops, manifests and translates through other objects (both human and non-human). This perspective points towards the challenge faced by existing understandings of knowledge production in artistic research to recognize the importance of the inconsistency and fragility of translations within and between objects. As a consequence, the aesthetic dimension and the knowledge derived from artistic research struggle to position themselves as more than candy on the surface of the scientific field unless considered within alternative knowledge paradigms that acknowledge the conceptualization invested in exploring these inconsistent tuning relationships.

Kevin Logan argues that sound has the potential to be a form of thinking and as a practice a kind of "doing-thinking" (Logan 2016, 121). Following this line of thinking we could ask what we hear when we listen to the wind in the trees? Do we hear the wind or the trees? And furthermore what do we hear when we listen to a recording of our voice on tape? Do we hear the voice or the tape? Questions that have engaged sounding artists over the last fifty to seventy years.[3] Furthermore, these very basic questions exemplify why sound is such a productive way of exploring the nonhuman perspectives of artistic research and knowledge production, because in both cases we are hearing two or more objects as they relate to one another, a modulation of wind through the leaves, a modulation of voice through tape. Thus, sound needs a medium in order to be propagated: it could be air, water, wood, stone or electrical circuits. Through this mediation, sound becomes vibration in matter, whether it is mechanical, acoustic or electrical—and this matter naturally has a great impact on the sound itself, potentially altering its basic vibrational structure to extreme degrees. Much research has been done to optimize and refine this process through the development of recording and reproduction technologies, always with the final evaluation of the human ear as the endpoint: From when the sound/vibrations leave the speakers and meet the ear, and the acoustic experience emerges for our sensory apparatus. The tape machine does not, however, care about acoustics, and it is not interested in the coupling of electrical signals to vibrating sound waves in air. It cares about the magnetic coating on the polyester tape, the speed of the capstan drive, Dolby and DBX filter curves, and Resistor-Capacitor time constants. A line of thinking that can be used to broaden the

palette of artistic research, into the realm of the sounding art. We, as practitioners working with sounding art, are constantly faced with the traces and sounds of these material translations between the different media. This experience uncovers the paradox that the sounding materiality possesses both thingness, and at the same time constitutes an ambient and inconsistent "here and now". The constant tuning processes when working with sound offer a powerful and concrete manifestation of how we will never be able to unravel the essence of sound, but instead we argue that practice-based research should not be concerned with reducing phenomenon and objects to consistent knowledge formations, but should turn to the inconsistency within and between the objects in question.

In conclusion the paper presents "transduction" as a philosophical lab equipment, a research method, similar to "carpentry" as outlined by Ian Bogost (2012). Carpentry is thus transferred to the sounding arts, through the conceptualization of transduction, evolving into a special branch of carpentry that offers both a physical and philosophical framework that can incorporate the translational, relative and fragile workings of sound. As such the thinking-doing mode of transduction that we present becomes important to understand both the artistic (both human and nonhuman) processes within sounding art, but moreover also as an initial contribution to the overall field of artistic research, because the framing that we propose in this paper exemplifies and develops concrete implementations of how artistic research offers alternative forms of knowledge production.

Artistic Research and Knowledge Production

Practice-based research through sounding art belongs to the emerging field of artistic research, that in a Danish context has not until recently been a part of academia. However, over the last two decades the relationship between art and research has been discussed and unfolded in the field of artistic research abroad (Borgdorff and Schwab 2014, 9; Borgdorff 2010, 44). Art is thus said to contribute to academic knowledge and conversely academia offers knowledge that interferes with art practices creating new areas of knowledge production. As stated by key figures in the field, artistic research needs to critically respond and reflect on the existing knowledge imperative so it does not *just* make art in order to produce knowledge or blindly apply theory as canonistic knowledge for research driven art practice (Busch 2009, 1). Therefore, it is suggested that the division of art (practice) and writing (theory) is abandoned (Borgdorff and Schwab 2014, 12) if artistic research is to be more than an application of theory and theory more than mere reflections of practice (Busch 2009, 1). In this understanding art and theory are "nothing more than two different forms of practice interrelated through a system of interaction and transferences" (Busch 2009, 1). As such the work *is* the research, as a site of knowledge production where science and art are intertwined (Borgdorff 2010, 46). Overall these positions point to the need for critical reflexivity towards knowledge production within artistic research (Busch 2009, 4).

"Art as research" or better the "hybridization of art and research" (Busch 2009, 5) differs from *just* art, as art as research intends to carry out an original study about new things to enhance and contribute to what we know and understand. (Borgdorff 2010, 54). Thus artistic forms of knowledge do not restrict themselves to contributing knowledge to art practice, but rather begin to develop into hybrid formations of knowledge, or intervene and impact theoretical discourses, contributing to theory construction (Busch 2009, 5). But what are hybrid formations of knowledge and what kind of knowledge needs to be recognized in academia (Holert 2009, 1) when "thinking in, through and with art" (Borgdorff 2010, 42)?

Henk Borgdorff describes how this type of knowledge differs from other types of knowledge as for example "propositional knowledge" (facts) or "knowledge on skills" (how to make) as it is dealing with the articulation of the pre-reflective, non-conceptual content of art, as explored in phenomenology (Borgdorff 2010, 59). Therefore, it is better considered not as knowledge production but rather as "not-knowing" or "not-yet-knowing", or the idea that all things could be different (Borgdorff 2010, 61) thereby inviting and leading to "unfinished thinking" (Borgdorff 2010, 4). To Kathrin Busch this type of thinking is coined "wild knowledge" (Busch 2009, 6). This concept encompasses the unexpected, spontaneous and involuntary. Artistic research is thus characterized by the fact that the actual object of research is still undetermined, and therefore "the knowledge of certain facts not being yet reduced into concepts" (Busch 2009, 6). Busch quotes Michel Foucault when explaining how art is valid as a different form of knowledge not "showing the invisible, but rather showing the extent to which the invisibility of the visible is invisible" (Foucault quoted in Busch 2009, 4). In this way artistic research could enable us to refer to that which cannot be articulated within the respective fields of knowledge.

In the next section we wish to expand on these ideas of how artistic research can help us tune into the hidden, by ex-

panding the perspective on encompassing non-human forms of knowledge incorporated through an object-oriented ontological line of thinking.

Object-Oriented Ontology and Causal Aesthetics

The larger context of object-oriented ontology (OOO) originates from the speculative realism[4] of Graham Harman, Ray Brassier, Quentin Meillassoux and Iain Hamilton Grant. A speculative realist wants to break with correlationism—a term used to describe how *being* exists only as a correlate between mind and world, placing humans at the centre (Harman 2010a). As an example, Martin Heidegger claimed that objects can exist outside human consciousness, but their *being* exists only through human understanding (Bogost 2012, 4). Therefore, based on phenomenological thinking, speculative realism breaks with the fundamental focus on human perception and suggests that "one must abandon the belief that human access sits at the centre of being, organising and regulating it like an ontological watchmaker" (Bogost 2012, 5). In the development of a non-human phenomenology, all things exist equally, which introduces notions of a flat or tiny ontology, which collapses the traditional distinctions between subject and object.

The philosophical perspectives within OOO can be situated within a larger frame of non-representational theory. According to Hayden Lorimer, non-representational theory is "an umbrella term for diverse work that seeks to better cope with our self-evidently more-than-human, more-than-textual, multi-sensual worlds" (Lorimer quoted in Vannini 2015, 2–3) emerging from the post-Cartesian turn and distinct from cognition, symbolic meaning and textuality in postmodern theory. This emerging field has its roots in the field of human geography and the work of Nigel Thrift in particular, but is connected also to arts, cultural studies, the humanities and social sciences and attempts to synthesize diverse, but interrelated theoretical perspectives such as actor-network theory (ANT),[5] post-phenomenology and pragmatism from multiple fields, including material culture studies, science and technology studies, contemporary continental philosophy and anthropology of the senses. It must build on a principle of relationality, in that it seeks to give the same conceptual and empirical weight to object-human relations as human-human relations, and thus considers a concept such as "material" as wrong, as it implies that objects are consistent entities and not fragile materials entangled with other materials in use, as argued by Tim Ingold (Vannini 2015, 5). Thus, non-representational research privileges the study of relations and affective resonances, as life is believed to arise from the entanglement of actors. It stresses the importance of relations felt in bodies, such as affects and moods, building a new ethics on craftsmanship of everyday life. It puts the unnoticed and contextual that often fall out of common awareness into the centre of attention as backgrounds against which particular things show up and take on significance. These backgrounds, or zones of stabilization, thus become important zones of inquiry open to intervention, manipulation and innovation as well as colonization, domination and control (Anderson and Harris in Vannini 2015, 9).

According to Timothy Morton, objects are ontologically riven between their withdrawn essence and their appearance for other objects (Morton 2013, 56). Withdrawal is understood as an unbreakable encryption irreducible to perception or meaning, which makes it impossible for any knowledge to replace the object in question (Morton 2013, 17–59). All objects are simultaneously fragile and autonomous, as they possess a potentially infinite progress in which they can be unfolded. As objects withdraw, no object or parts of an object can have direct access to any other object (Bryant 2011, 18, 26). This is because objects are deeper than their appearance to the human mind, but also deeper than their relations to other objects. If it is impossible to gain any knowledge about the real objects how do we proceed? If knowledge about reality is inaccessible in our knowledge society, how can we then justify what we as academics are doing? We start by examining the object that we engage with, and thus the "Rift"[6] becomes central to the development of an expanded form of causality, which becomes integrated within a new view on aesthetics, claiming that causality *is* the aesthetic dimension produced by the interaction between objects (Morton 2013, 64). Within the realm of sound, the Rift can be understood as the medium or mediation between the essence of the sound and its appearance, which is meaningful in relation to how the speed of sound changes depending on what material it is mediated by. This makes it impossible to grasp the essence of a sound without its mediation, suggesting that it is impossible for the sound object to be without its mediation, as it would then be reduced to appearance only. If this mediation is happening in air, making sound acoustically audible to humans, or in the flux lines' strength within the tape recorder is secondary in this context, the important issue is the awareness regarding this Rift within the sound object (Morton 2013, 122). The aesthetic experience is then not solely something that occurs within our human mind, but is instead expanded

to incorporate all causal events taking place in and between objects (Morton 2013, 120–21).

Causality and the aesthetic dimension does not take place in a space- and time-container that has already been established beforehand; instead it pours or radiates from the tensions of the Rifts between essence and appearance, establishing the notion of inter-objectivity (Harman 2010b, 150; Morton 2013, 35–66). There is no space or time (or environment as background) in which objects float; instead, they are emergent properties of objects themselves. This understanding resonates with post-Einsteinian physics, in which space-time is the product of objects (Morton 2011, 151); therefore, objects *space* and *time* each other (verbs), rather than unfold *in* time and reside *in* space.

Through this line of thinking, art becomes collaboration between humans and non-humans, and thus an important way to explore the Rifts and attunements between objects (Morton 2012, 138). The aesthetic is not some kind of icing on the cake, but an elementary exploration of causality as the aesthetic dimension (Morton 2013, 79). In Morton's notion of the "Ambient" the environment comes forward from the background when art explores the fragile materiality of objects in this aesthetic dimension (Morton 2010, 107). Through ambient effects, art makes it appear as if, for a fleeting second, there *is* something in between (Morton 2007, 50), an understanding that challenges the concepts of ambient and atmosphere as something blurry in between, something that just sits there ready for humans to perceive—reducing objects to pure appearances (Morton 2013, 71). Morton denotes the Ambient as a *here and now* being evoked and sustained for a while, with cracks and strangeness pour out and permeate traditional distinctions between background/foreground, figure/ground, inside/outside.

From Insight and Comprehension Towards Tuning and Carpentry

The developed perspective on causal aesthetics implies that it is impossible to observe the aesthetic effect from an outside position, a conceptualization that calls for a fruitful way of engaging with art practice. An engagement that tunes into the various objects involved which leads to investigation of them through a specific practical engagement. This type of investigation could be unfolded through Borgdorff's conceptualization of how "knowledge" and "understanding" in artistic research need to be expanded in order to incorporate the "wild knowledge" of practice-based research. He proposes the terms "insight" and "comprehension" as replacements (Borgdorff 2010, 50), but these notions imply a correlationist understanding of the world, as it is insight and comprehension from a human perspective. The promise of artistic research is to unravel both our intimate and distant relations to the world, proposing how the unpredictable, non-representational, sensual and concealed can supplement traditional scientific types of propositional knowledge. Yet, as long as the artistic engagement is still reflected in a correlationist framework this paper claims that a hybridization of art and research is difficult to achieve. Consequently, we propose a non-correlationist understanding of causal aesthetics, which makes it possible to approach the invisibility of the visible through non-human objects. If we accept the premise that the aesthetic is the causal, then the practice of art becomes not just the candy on the surface of the world, but engaged with a perspective that does not exhaust or condense the objects involved, which makes it possible for artistic research to fulfil Borgdorff's claim that artistic research "enhances our awareness of the pre-reflective nearness of things as well as our epistemological distance from them" (Borgdorff 2010, 45). Therefore we propose an engagement conceptualized through both Morton's notion of "tuning" and Ian Bogost construction of "carpentry".

The notion of "carpentry", as conceptualized by Ian Bogost, is described as the philosophical practice of making things. As a philosophical lab equipment (Bogost 2012, 100) carpentry becomes a perspective on creative work that poses philosophical questions, as when matter is being used especially for philosophical use, executing what could be denoted as applied ontology. This happens because writing is dangerous for philosophy because writing is only one form of being, a comment on the assumption that we relate to the world only through language (Bogost 2012, 90). At the core of carpentry lies the understanding that philosophy is practice just as much as it is theory, the practice of constructing artefacts as a philosophical practice (Bogost 2012, 92). The practice that Bogost here mentions as being central for his applied ontology is a specific type of practice—a practice closely related to Timothy Morton's notion of tuning. "Attunement" (Morton 2013, 22) is described as the possibility to explore causality by creating or studying objects. According to Morton, tuning must be considered as more than just a way to standardize musical intervals; tuning is a methodology for approaching the very essence of causality and acting out phenomenology. Tuning in an object-oriented perspective becomes a way of demonstrating how all objects, (human and non-human) can affect each other in different situations. This understand-

ing references the basic acoustical understanding of tuning as the interference occurring when two frequencies collide. Through this perspective tuning becomes not an aim for a higher ideal, but rather a methodological approach for understanding the causal relationship between objects.

Carpentry and tuning can thus be used to tell us something about art practice's epistemic character, because it foregrounds that "Knowing is not about seeing from above or outside . . . Knowing is a matter of intra-acting . . . Knowing is not a bounded or closed practice but an ongoing performance of the world" (Barad 2007, 149). Thus the role of the practice outlined here then becomes a way of attuning to the inconsistency of the Ambient as a tuning relationship that challenges the traditional subject-object division, giving rise to a sense of coexistence and connection to other objects. An attuning that is slightly out of phase—recognizing its inconsistency and fragility and thereby also its own uncanny strangeness (Morton 2013, 177).

In line with OOO's rejection of correlationism, Tim Ingold argues how contemporary discussions of art and technology continue to work on the assumption that the artistic process entails the imposition of form upon the material world, by a human agent with a design in mind. He coins this a "hylomorphic model" of creation, referring to Aristotle's division of matter as passive and inert compared to form imposed on matter by an agent. Instead he argues for a model based on the "textility of making", where the agent follows the materials so that the forms of things arise within fields of force and flows of the materials in play in an "ongoing generative movement that is at once itinerant, improvisatory and rhythmic," comparable to carpentry and drawing (Ingold, 2010, 91). This alternative model highlights the process of making as improvisation or a thinking through making—intrinsically dynamic and temporal. A conceptualization that resembles composer and pianist David Tudor's iconic statement: "I try to find out what's there—not to make it do what I want, but to release what's there. The object should teach you what it wants to hear" (Collins 2004, 1). This understanding foregrounds the dialectic relationship between the artist and materials, in that the electronic circuit becomes the score.

However, Ingold distances himself from both ANT's and OOO's attempt to move beyond the polarization of subjects and objects to rebalance the hylomorphic model through assigning agency to the objects. He argues that these accounts are still trapped in the same model, where life and action is now intended not only by humans, but also by objects on something else. In his view this model can only accommodate action in the traditional view of causation where a subject or an object through intention, cause an effect on the world. Instead he suggests that things, both human and non-human, do not possess agency and intention, but that all things are caught up and possessed by the action of the generative currents of the world. From this perspective there are no subjects or objects already present in the world that then interact with each other, but instead there are "things" that respond to one another in either counterpoint or as melody and refrain, constantly becoming in a "hive of activity" or "a place where several goings on become entwined" (Ingold 2010, 94–97)

Adhering to Ingold's critique, we would however argue that both Morton's idea of tuning and Bogost's concept of carpentry are very much in line with Ingold's "textility of making" when approached from the perspective of artistic practice in sounding art. Neither tuning nor carpentry focus on the agency of objects, but on the aesthetic and causal flux as the hive where things become. However, we argue that Morton's emphasis on how objects *time* and *space* each other appears more useful because it both incorporates sound's relational qualities, and at the same time reflects how sound is not just vibrations unfolding in space and time. In this sense it provides us with a conceptual framework that actively acknowledges the dynamic character of sound that we, the au-

Hylomorphic model of creation	
Knowledge	Understanding
Insight	Comprehension
Non-representational model of creation	
Tuning (Morton)	Carpentry (Bogost)
Textility of making (Ingold)	Thinking through making/Improvisation (Ingold)

thors, as artists are constantly engaged in. As sounding artists we work in the realm of the Rift, and our practice is concerned with showcasing how fragility and instability pours out of our endeavours when trying to control sound.

The Inconsistent Attunements of the Transducer

The transducer is a speaker without a membrane—it is an electromechanical device that transforms electrical energy into physical movement. As such it can be placed on any surface, thus transforming this surface into a speaker. In his chapter on "Transduction" in the book *Keywords in Sound,* Stefan Helmreich (2015) refers to Jonathan Sterne's recognition of transduction as both a set of physical principles and a cultural artefact. Helmreich thus argues that this duality lays the basis for transduction as a fruitful concept to think with in sound studies, as it joins the mutual interest in the material in both science and technology studies (STS) and cultural studies. On one hand transduction is an inevitable part of a physical sound transmission, as it is always translated, converted, modulated, transformed and transduced through different media be it a microphone, an ear or a loudspeaker. On the other hand, transduction can offer a powerful way to think about the infrastructures through which the vibrating world is apprehended. In this way transduction can help when thinking through the temporality of sound in a techno-scientific infrastructural context. As an example Helmreich refers to how his own field work on submarines has shown how the feeling of being underwater heavily relies on a transduction chain of sounds from outside to the inside sound world. This experience points to how transduction as a technical operation summons up experiential realness or a sense of being in an unmediated presence of a sensation or feeling. Based on this work he previously argued for a "transductive anthropology" that listens closely for "telltale distortions and resistances, turbulence that might reveal the conditions beneath any self-evident 'presence'"[7] (Helmreich 2015, 225). However, he notes that the common use of transduction usually builds on a metaphor of the travelling of sound that does not correspond with the materiality of sound. He flags how waves might travel, but sounds do not—they become present at reception. Referring to Casey O'Callaghan he therefore argues that we have to think not *with* transduction but *across it*.

We therefore argue that doing-thinking across "transduction" can open up the processes of carpentry and tuning in sound, and exemplify how the act of making art also becomes a philosophical practice. In this way the transducer can be seen as an object of carpentry, as a philosophical tool and a research method that can be used to investigate causality. In our artistic practice the transducer is a very important device, used in a multitude of pieces developed over the last five years.[8] When placing a transducer on different surfaces and materials questions present themselves. Questions regarding where and what we are listening to. When the transducer excites and vibrates for instance a metal structure placed on a wooden floor, what are we listening to? The sound of the floor? The sound of metal? The sound of transducers? What we are hearing is hearing-as, referring to Heidegger's *As-structure* contextualized through the writings of Graham Harman (Morton 2013, 120). We are hearing wavefronts in the vibrating metal and wood through our human ears. The transducer hears the electrical signals flowing through the copper wires in a transducer-morphising manner, translating it into transducer-*ish*. Through this perspective, it becomes hearing-as and sounding to something else unfolded in a relational framing. A notion that resembles Morton's description of how matter is always relational: it is matter-for something, not matter in itself as a closed entity (Morton 2013, 82). The transducer is an interesting object for exploring aesthetics as causality—what Harman calls vicarious causation—because we never hear the transducer itself—neither do the human ears, the metallic structure nor the wooden floor ever grasp the essence of the sounding transducer. Through this line of thinking the transducer is not a transparent medium that smoothly communicates semantic meaning to nearby objects—but instead something that translates, alters, devours, converts, demolishes, reworks and consumes reductionist knowledge in the process of creating space and time. Staging the transducers as objects in a performance can in this way show us how spaces are not containers that the objects exist in, rather, a realm of gaps between objects that are introduced when one object puts its footprint into another one by translating it, through interobjective transduction.

Transduction as Philosophical Lab Equipment in Sounding Art

Even though OOO is a research field that has received attention in contemporary philosophy, it has also attracted substantial criticism. In Jonathan Sterne's earlier writings, he clearly distanced himself from the perspective of OOO, claiming that "sound is a product of the human senses and not a thing in the world apart from humans" (Sterne 2005, 11). However, Sterne later pointed to the possibility of the validity of studying sound from perspectives other than those of humans (Sterne 2012, 7), and elsewhere he states that our

present psychoacoustic construct of hearing in-it-self always is a product of the interaction between ears and sound technology (Sterne 2015, 69). OOO has also been critiqued in relation to political issues (or the lack thereof) (Galloway 2012; Thorne 2012). In Galloway (2010) and Cole (2013), a critical discussion of speculative realism can be found that critiques the speculative anthropomorphism of things through the use of phrases such as "objects speak, listen, feel" Cole ultimately claims that OOO outlines a very traditional ontology, which does not acknowledge how medieval philosophy and mysticism already have implemented the non-human perspective. As the above-mentioned critique of OOO indicates, an OOO perspective is often accused of being inhuman. However, advocates of OOO claim that it is necessary to break with the superposition of the human perceiver in order to return to the human position through a new flat and dark perspective that includes other objects and non-humans on the same level. This enables a new sort of humanism that is liberated from the correlational system (Bogost 2012) and can help us break from the autonomous and consistent view of for example art.

When working with sound and sounding pieces of art we are constantly presented and bombarded with the fragile relation between the real withdrawn sound object and its appearance. If it is as artist collaborating with different materials in the construction of sonic art, or in the reception of sounding art pieces, we are constantly reminded of the inconsistency within and between the endless chains of relations sound undergoes. As Brandon Labelle describes it "Sound art as a practice harnesses, describes, analyzes, performs, and interrogates the condition of sound and the processes by which it operates" (LaBelle 2006, ix).

To think across "transduction" gives us a construction that on one side provides us with a theoretical framework in which the network and its relations becomes very central, but on the other side always are negotiable. For example, time and space are constantly changing in relation to the medium through which sound travels. A perspective that can serve an intermediate function in broadening our insight into the sounding objects that constitute our present auditory reality, by recognizing that they are not consistent entities exhaustible through human knowledge.

In the present discussion about knowledge production in artistic research the proposed perspective in this paper forces us to coexist with a vast plenum of non-human objects. By taking this position we abandon the belief that we can distance ourselves from the world; and consequently our engagement with objects becomes not a matter of producing knowledge about the world, but instead an ongoing process of not-knowing or listening.

Notes

1 For an elaborated discussion of the term "sound art" see Højlund and Riis 2015. In the introduction to the newly published book *The Routledge Companion to Sounding Art* the editors present the term "sounding art" as alternative to sound art. They argue that using sounding art emphasises its movement, fluidity, energy, vibrancy, participation and confusion within a larger complex network and thus gets away from "a rigid and perhaps even old-fashioned materialism" of "sounds-in-themselves" (Cobussen, Meelberg and Truax 2016, 2).

2 See e.g. the conference "Sound Art Matters" (2016) at Aarhus University, Denmark, "ISSTA16" (2016) conference on Temporary Autonomous Zones in Derry, Ireland, "International Conference on Artistic Research" 2016 with a track on Writing Sound Art/Music, and the research centre of the University of the Arts London "Creative Research into Sound Arts Practice" (CRiSAP) and the research group at Goldsmiths University of London "Sound Practice Research Group" (SPR).

3 Examples of these practices could be found in the following pieces: John Cage, *4'33"* (1952), Alvin Lucier, *I Am Sitting In A Room* (1969), Rubin/Hansen, *Listening Post* (2001), Christina Kubisch, *Electrical Walks* (2004).

4 For a discussion of different positions in speculative realism and OOO see chapter 4 in Steven Shaviro's book *The Universe of Things: On Speculative Realism* (2014).

5 A remark should be made regarding OOO and ANT (Latour 2005). From an outside perspective both theoretical stances seem to share many resemblances, e.g. both traditions subscribe to alternative forms of non-written knowledge generation, something that becomes evident in Bruno Latour's claim that knowledge does not exist, but it is instead craft that holds the key to knowledge (Latour 1993, 218–19). ANT also recognizes the agency of non-humans, and even argues for an "irreductionism" in which all entities are equally real (though not equally strong) insofar as they act on other entities (Bryant et al. 2011, 5). Where the two research traditions differ is in the status of the relations (Vannini 2015) within the network. As Graham Harman notes (Harman 2013) then the whole of the object is not described by its relations, there will always be some kind of surplus, something withdrawn from its relations. This means that even though OOO and ANT analysis of a given phenomenon may at first seem both to

be concerned with unravelling a network of relations, OOO does not stop at these relations, but always reflects these according to the Rift between essence and appearance.

6 Morton capitalizes the Rift and Ambient to emphasize their status as concepts.

7 A perspective that greatly resembles the media archaeological method as developed by Wolfgang Ernst, Jussi Parikka and Erkki Huhtamo (Ernst 2013; Parikka 2010; Huhtamo 2013) which develops a mode of reverse engineering of normative understandings, a transformation of what has already been written, and thereby counter-history. Media archaeology builds upon these principles to assert that the material-technological dimension is not sufficiently developed in terms of accounting for the way that media produces knowledge and experience. These perspectives are significant as they shift attention to the ability of nonhuman entities to generate alternative forms of knowledge that are not easily perceptible to humans.

8 Morten Riis and Marie Højlund, *Inconsistent transduction.* Live recording (2016): https://soundcloud.com/thelakeradio/sets/lydhor-pa-en-sondag (accessed 22 November 2016). Morten Riis, *Opaque Sounding* (2014): https://www.youtube.com/watch?v=nzybYC5nqJM (accessed 22 November 2016).

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SUMMARY

OVERHEARING - An *Attuning Approach* to Noise in Danish Hospitals

Denmark is currently building a number of new and improved *super hospitals*, based on a vision of improving overall quality by switching the focus from hospitals for treatment to hospitals for healing. To unfold this new paradigm in practice, all decision-making must be guided by the patient's needs and wishes, based on research in the field of *evidence-based design* and *healing architecture*. Patients, relatives and staff say that noise is one of the main stressors in hospitals, and research has discovered that noise levels in hospitals continue to rise. Noise has therefore become a central point of concern in publications on how to unfold the new patient-centered paradigm in practice, recommending strategies to reduce measurable and perceived noise levels. However, these strategies do not support the need to feel like an integral part of the shared hospital environment, which is also a key element in creating healing environments.

The starting point for this dissertation is the conviction that this insufficiency is intimately linked to a reductionist framework underlying the field. This framework regards broad concepts such as *noise* and *silence* as objects with quantifiable properties, and assumes that these properties can be understood independently of the perceiver as a bodily and situated subject. The aim of this dissertation is accordingly to develop an alternative framework capable of accommodating the multi-sensory, affective and atmospheric conditions that influence the experience of noise, with a view to complementing the existing approaches in the field.

The dissertation takes an experimental practice-based approach and comprises six peer-reviewed papers (Part IV), framed by a general overview article (Parts I-III) that develops the theoretical and methodological foundation for the papers, and provides a synthesis and discussion of their main findings. In addition to the papers, which are contributions in their own right, the overview article makes three main contributions:

The first contribution is an overview of the field of noise in hospitals identifying two main approaches: the *noise-reduction approach* and the *human-centered approach* respectively. This contribution establishes that the existing approaches assume that listening can be considered independently of the other senses and as a primarily passive and cognitive process. By taking other research that addresses complex environments from a listening perspective into consideration, it is possible to highlight the importance of addressing not only the physical and perceptual aspects of listening but also the affective aspect of listening. This strand of research stresses the important role of atmospheric, multisensory and embodied conditions in the organization of the subjective experience, suggesting that the experience of noise in hospitals is not only related to acoustic aspects,

but also closely connected to 1) an atmosphere of absence, 2) an alarming sonic sensibility, and 3) a lack of coping skills and active coping possibilities.

Consequently, the second contribution argues for the relevance of a non-representational and ecological framework capable of accommodating these issues, established by viewing sound and listening through the lens of atmospheres. This contribution develops an *attuning approach* that highlights the reciprocal relationship between the way in which atmospheres condition *shared rhythms* that shape us, but also the way in which we can *tune* them in different ways. Attunement skills can be actively developed through *affective attunement* as a way to transform habitual activities and habits. In the context of sound and listening, this creates the potential of *ecological overhearing* as an atmospheric mode of listening which is capable of reconfiguring habitual background and foregrounding relationships. *Attuning strategies* should thus provide opportunities for diverse acoustic situations and possibilities for active choice-making to meet different and shifting needs through an enactive approach in order to enhance empowerment and *ecological overhearing*. Embedding diverse enactive sound installations and interactive sound technology in hospitals can facilitate such *zones of overhearing.* These zones become places for ruptures that strengthen the possibilities for engaging in *counter-attunements* of existing negative atmospheres. In this way, *zones of overhearing* not only provide continual sense of presence without demanding full attention, but also create ample opportunities for the restoration of attention.

The third contribution relates to the practice-based research approach. It is evident that addressing situations *in situ* demands a bottom-up approach, cross-pollinating theory with practice-based work to secure a higher ecological validity. This contribution thus challenges the existing evidence-based criteria for validity in the field, by arguing that when there is a need to rethink the foundational premises of a field it is crucial that other criteria and methods are included that combine scientific knowledge with, for example, artistic and design knowledge. The practice-based work is founded on a range of experiments, but focuses on two main experiments: *Light, Landscape & Voices* and *KidKit,* and the way in which they elicit sensitivities within the topic of investigation. This contribution also concerns the concrete development of installations through the experiments. These installations are in themselves manifestations of and challenges to hypotheses about the topic I aim to address.

The research is an outcome of the doctoral project conducted at *Audio Design, School of Communication and Culture*, *Aarhus University,* Denmark, partly funded by *IT Vest.*

RESUMÉ

OVERHØRE– En *afstemmende tilgang* til støj i Danske supersygehuse

Danmark er ved at bygge nye supersygehuse baseret på en vision om at forbedre den overordnede kvalitet ved at skifte fokus fra behandlingshospitaler til helbredelseshospitaler. For at udfolde dette nye paradigme i praksis må patientens behov og ønsker være styrende for beslutningsprocesser baseret på forskning inden for *evidensbaseret design* og *helende arkitektur.* Patienter, pårørende og personale nævner i brugerundersøgelser støj som en af de vigtigste stressfaktorer, og forskning har konstateret, at støjniveauet på hospitaler fortsætter med at stige. I publikationer om, hvordan man kan udfolde det nye patientcentrerede paradigme i praksis, er støj derfor blevet en central problemstilling og strategier til at reducere målbare og perceptuelle støjniveauer anbefales. Men strategierne understøtter *ikke* behovet for, at patienter og pårørende oplever at være en integreret del af hospitalsmiljøet, hvilket også er et centralt element i at skabe helende omgivelser.

Udgangspunktet for denne afhandling er en antagelse af, at denne utilstrækkelighed er tæt forbundet med, at forskningsfeltet er bygget på et reduktionistisk *framework,* der anser brede begreber som støj og stilhed som objekter med kvantificerbare egenskaber, og at disse egenskaber kan forstås uafhængigt af subjektet som kropslig og situeret. Formålet med denne afhandling er derfor at udvikle et alternativt *framework,* som er i stand til at rumme de multi-sensoriske, affektive og atmosfæriske forhold, der påvirker oplevelsen af støj, som et supplement til de eksisterende tilgange på området.

Afhandlingen har en eksperimentel praksis-baseret tilgang og består af seks fagfællebedømte publikationer (PART IV) indrammet af en oversigtsartikel (PART I-III), der udvikler det teoretiske og metodiske grundlag for publikationerne og giver en syntese og diskussion af de vigtigste resultater i dem. Bortset fra de inkluderede publikationer, som er selvstændige bidrag, tilbyder oversigtsartiklen tre vigtige bidrag:

Det første bidrag er en oversigt over forskningsfeltet vedrørende støj på hospitaler, hvor der identificeres to tilgange henholdsvis en støjreducerende tilgang og en tilgang, der fokuserer på den subjektive oplevelse af lyd. Bidraget fastslår, at de eksisterende tilgange antager, at lytning kan betragtes uafhængigt af de andre sanser og som en primær passiv og kognitiv proces. Tager man anden forskning, der adresserer komplekse miljøer fra et lytterperspektiv i betragtning, fremhæver disse betydningen af ikke kun den fysiske og perceptuelle del af at lytte, men også den affektive. Denne del af forskningen understreger vigtigheden af de atmosfæriske, multisensoriske og kropslige betingelser for organiseringen af den subjektive oplevelse af støj. Hermed peger denne forskning på, at oplevelsen af støj på sygehuse ikke kun er relateret til akustiske aspekter, men også tæt forbundet med 1) en atmosfære af fravær, 2) en alarmerende lydsensibilitet og 3) en mangel på

mestringsstrategier og aktive mestringsmuligheder.

Følgeligt argumenterer sidstnævnte bidrag for relevansen af et non-repræsentationelt og økologisk *framework,* der er i stand til at rumme disse hensyn, ved at betragte lyd og lytning på baggrund af atmosfæreteori. Derfor udvikler dette bidrag en *afstemmende tilgang,* der fremhæver det gensidige forhold mellem, hvordan atmosfærer konditionerer *delte rytmer* som former os, men også hvordan vi kan *stemme* dem på forskellige måder. Afstemnings-færdigheder kan aktivt udvikles gennem *affektiv afstemning,* som en måde at omdanne rutiner og vaner. I forbindelse med lyd og lytning skaber dette potentialet for *økologisk overhør* som en atmosfærisk lyttemåde, der kan omkonfigurere vanemæssige baggrunds- og forgrunds-relationer. *Afstemningsstrategier* skal således give patienter og pårørende mulighed for at opsøge forskelligartede akustiske muligheder og tage aktive valg, der opfylder forskellige og skiftende behov gennem at *gøre med lyd* for at styrke mestring og *økologisk overhør*. Sådanne *overhørings-zoner* kan integreres på sygehusene ved hjælp af responsive lydinstallationer og interaktiv lydteknologi. Zonerne kunne derfor tilbyde brudzoner, som udvider mulighederne for at engagere sig i *mod-stemning* af eksisterende problematiske atmosfærer. På denne måde kan *overhørings-zoner* give både en kontinuerlig følelse af tilstedeværelse uden at kræve fuld opmærksomhed og samtidig skabe gode muligheder for restaurering af opmærksomhed.

Den tredje bidrag vedrører den praksisbaserede forskningstilgang. Det er åbenlyst, at når man adresserer *in-situ* situationer, kræves en bottom-up-tilgang, hvor teorien kombineres med og udfordres af det praksisbaserede arbejde for at kunne sikre en højere økologisk validitet. Dette bidrag udfordrer dermed de eksisterende evidensbaserede kriterier for validitet i feltet ved at argumentere for, at når der er behov for at gentænke fundamentale præmisser i et felt, er det afgørende, at der inkluderes andre kriterier og fremgangsmåder, som kombinerer traditionel videnskabelig viden med en kunstnerisk- og design-baseret viden. Det praksisbaserede arbejde er baseret på en række eksperimenter, men er centreret om to eksperimenter *Lys, Landskab og Stemmer* og *KidKit* og om hvordan de producerer design-sensibiliteter inden for emnet for undersøgelsen. Dette bidrag vedrører også praktisk udvikling af installationer gennem eksperimenter. Disse installationer er i sig selv et udtryk for og udfordring af hypoteserne om det emne, jeg sigter mod at adressere.

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