From Atmosphere to Intervention:
The circular dynamic of installations in hospital waiting areas

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ABSTRACT

This paper is a description of a pilot project conducted at the Hamburg University of Music and Drama (HfMT) during the academic year 2015-16. In this project we have addressed how interventions via interactive, generative music systems (i.e. sound installations) may contribute to the improvement of the atmosphere and thus to the well-being of patients in hospital waiting areas. The project was conducted by both the students of the music therapy and multimedia composition programs and has thus offered rare insights into the dynamic of such undertakings covering both the therapeutic underpinnings, as well as the technical means required to achieve a particular result. DJster, the engine we used for the generative processes is based on Clarence Barlow's probabilistic algorithms. Equipped with the proper periphery (sensors, sound modules and spatializers), we looked at three different scenarios, each requiring specific musical and technological solutions. The pilot was concluded by a symposium in February 2017 and the development of a prototype system. The symposium yielded a diagram detailing the circular dynamic of the factors involved in this particular project, while the prototype was demoed in June 2016 at the HfMT facilities. The system will be installed permanently at the University Medical Center Hamburg-Eppendorf (UKE) in June 2017.

1. INTRODUCTION

The concept of "healing environment for healthcare buildings" has been described as: "… a physical setting and organizational culture that supports patients and families through the stresses imposed by illness, hospitalization, medical visits, the process of healing, and sometimes, bereavement. The concept implies that the physical healthcare environment can make a difference in how quickly the patient recovers from or adapts to specific acute and chronic conditions" [1].

It is not only the room's architecture, materials, colours and light design that affect patients and personnel. Acoustic conditions, the soundscape, are no less influential than these aspects—"soundscape regards the complex sound environment, embracing positive sounds as well as annoyance" [2].

All these varied sensuous influences *tune the atmosphere* of a room, they *modify* the actual psychological state; and vice versa: the inner "framing" (the circumstances and reasons for sitting here) influences the perception of a situation.

Coming from music therapy and from multimedia composition our questions in the pilot project were:

- What are the acoustic and atmospheric conditions both for patients and for staff in three different waiting areas of the UKE?
- Could we modify and improve these conditions by means of an interactive, generative sound installation?

Although music therapists were among the instigators of this project, this kind of sound intervention is not to be called music therapy. Music listening and sound interventions can be part of the practice of music therapy, but there is a consensus that a *therapeutic relationship* is needed to call a musical intervention music therapy. "Music therapy is a reflexive process where the therapist helps the client to optimize the client's health, using various facets of music experience and the relationships formed through them..." [3]. In our case there was no therapist, no therapeutic relationship and no treatment agreement involved. However our interest in observing the everyday soundscape in hospital waiting rooms from the position of therapeutic sensitivity: the soundscape is an important part of the "healing environment"—for patients as well as employees.
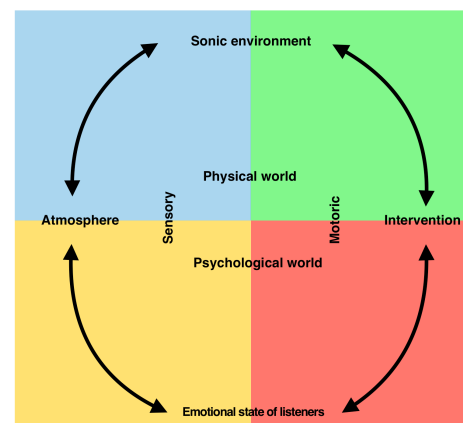

Fig. 1. Circular dynamic of installations in healing environments

2. FROM SONIC ENVIRONMENT TO ATMOSPHERE TO WELL-BEING

Atmosphere, a key concept in the philosophy of Gernot Böhme and other proponents of the New Aesthetics movement, connects the physical and the psychological conditions in their environment: the emotional state of a person in a waiting room and the physical environment of the room both influence the

perceived atmosphere. Böhme places atmosphere within "the relation between environmental qualities and human condition" [4]. So we have an *object-pole* and a *subject-pole* as two sides of the evolving atmosphere in a given situation. The atmosphere is *not* in the room, like a substance; but the specific conditions of the room allows one to perceive atmospheric "tuning" against the background of one's emotional situation. Atmospheres are relational in-between phenomena. Sound interventions modify the acoustic conditions of a room, they influence the atmosphere in a room and thus may modify the mood and increase the well-being of listeners, patients and staff (see Fig. 1).

Our aim to create music or a soundscape which has little performativity and draws little attention, but has an implicit effect in modifying the atmosphere, is rooted in the work of well-known progenitors. When Eric Satie composed his "Musique d'ameublement" in 1920 for a vernissage at an art gallery, he claimed that the music "creates a vibration: it has no other goal; it fills the same role as light, heat— as comfort in all its forms" [5]. Satie compared the compositions to furniture, tapestry and acoustic tiling—and did not even want people to sit and listen attentively to this "background noise".

Since the middle of the 20th century composers like John Cage and Morton Feldman, and later György Ligeti, have been engaged in abstaining from dynamic and dramatic development in their music. When Cage turned his interest to the sounds of the environment within his compositions he wanted to have "music" without the intentions of a composer. Feldman wrote pieces of "silent music" which sometimes never exceeded the dynamic of *piano*—he was "seldom raising his musical voice above a whisper" [6].[1] Or think of Ligeti's *Atmosphères* (1971), where the compositional technique of *micropolyphony* and the absence of hierarchical structures like melody, harmony, and rhythm convey atmospheric impressions of a process of emergence.

Brian Eno composed *ambient music*, which emphasizes atmosphere within space. "An ambience is defined as an atmosphere, or a surrounding influence: a tint. My intention is to produce (...) environmental music suited to a wide variety of moods and atmospheres. (...) Ambient music must be able to accommodate many levels of listening attention without enforcing one in particular; it must be as ignorable as it is interesting"[7], a concept that could also be referred to as "neutral music". In 2013 Brian Eno designed (generative) light and sound installations, called "77 Million Paintings for Montefiore" and "Quiet Room for Montefiore", at Montefiore Hospital, Hove, England for patients, staff and visitors. A spokesperson for Brian Eno, as reported by *The Independent*, said that Eno was directly inspired by Florence Nightingale who wrote in 1859 that "variety of form and brilliancy of colour in the objects presented to patients have a powerful effect and are actual means of recovery." [8].

Our approach differs from Eno's "Quiet Room" in that our audience is, due to how the room is used, forced to participate, and is more alike to "77 Million Paintings" and his airport music. This, to us, poses an ethical dilemma and prompts us to use additional caution when dealing with the sound material and its presentation. As will be shown below in our case studies we opted to use textures characterized by the following qualities:

- Disjunction (harmonic, melodic, timbral and/or spatial)
- Aperiodicity
- Sonic richness ("beauty") of the individual event

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[1] Feldman had a collection of oriental rugs and compared his composing to weaving a rug.

- Slow to medium tempo
- Low to medium dynamics

3. FROM INTERVENTION TO SONIC ENVIRONMENT

Gesture / Motions
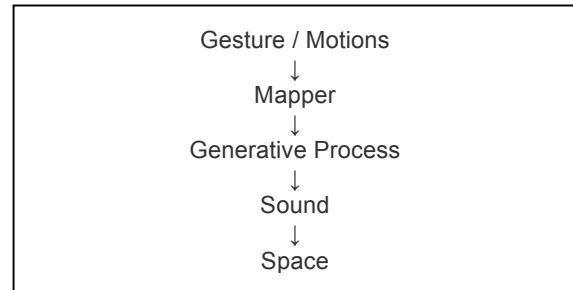↓
Mapper
↓
Generative Process
↓
Sound
↓
Space

Fig. 2. The conceptual stages in the generative processes employed in the hospital waiting room installations

3.1 DJster

For our installations, we chose DJster as an event generator [9]. DJster is based on the probabilistic algorithms Clarence Barlow created in the 1970's and implemented in his program AUTOBUSK. It features a flexible 17-dimensional parameter space in which some of its parameters are linked in clever ways to create a sense of tonality and metricity, or its opposites, atonality and ametricity. In addition, a virtually unlimited number of scales (in any temperament) and meters (in any number of stress patterns) can be chosen as the material basis on which the probabilistic event generator operates on. In contrast to many other generative systems DJster is agnostic towards style and does not define any rules in terms of harmonic progression or voice leading. As style is an emergent property of the parameter space and not a built-in feature as such, DJster lends itself perfectly for mapping environmental and psychophysical data onto musical parameters. DJster is a Max abstraction which exists in several incarnations, an Ableton Live device and a MaxScore plugin among them.

Fig. 3. The DJster GUI in its incarnation for Ableton Live

For our installations, it was embedded into a patcher receiving its data from sensors on its periphery and sending them through a complex mapping process (see 3.2) to adjust them to the appropriate value ranges.
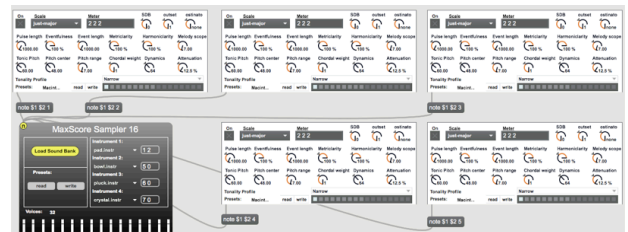
**Fig. 4. Five instances of DJster driving the sound generation process.**

Several instances of DJster can be employed independently, each representing a player communicating with a sound engine—a multitimbral and microtonal sampler originally created for the networked multimedia performance environment Quintet.net and now part of the DJster package (see Fig. 4). It also features a multi-channel version capable of sending its audio output to 16 different outputs which can in turn be spatialized independently from one another. In our preliminary experiments, we used both VBAP and Ambisonics for spatialization [10][11].

3.2 Mapping Strategies

In algorithmic composition, the mapping of gestures to sounds may be considered the composition itself [12].

As described in section 5, the three rooms due to their specificities require considerable tweaking of the system. Two of the rooms (NOT and PRIV) require constant capturing of the environment in terms of visual brightness, loudness, amount of motion, etc. while the third one (PACU) may just rely on the time of day and average sound pressure level. We needed a flexible environment capable of dealing with the many mapping scenarios we might be facing (few-to-many, many-to-few and everything in between) [13]. We are therefore developing a mapper abstraction in Max called PatMap which uses its own patching paradigm on top of Max. Just as Max possesses a large number of objects, which can be connected by patch cords, PatMap basically uses its GUI to script the instantiation of abstractions and establish the dataflow between them. These abstractions are built with standard Max objects as well as third-party objects implementing the whole range from simple scaling to machine learning, such as backpropagation neural networks. Neural network simulations prove to be particularly effective when dealing with the high-dimensional parameter space offered by DJster. Much effort from the side of the music therapy and multimedia students has gone and will still go into creating seamless calibrations between sensory input and sonic output, whose effectiveness in creating a particular atmosphere or emotion will be gauged by patients and volunteers providing information which will be fed back into the calibration process.
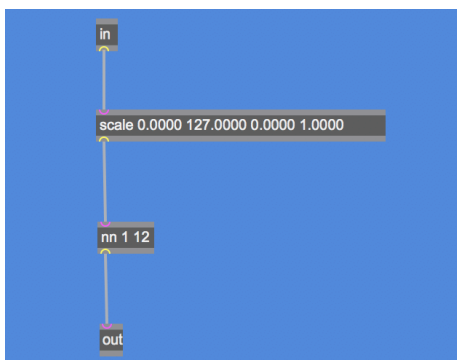
Fig. 5. The PatMap GUI built on top of Max's own patching mechanism, built to facilitate an intuitive mapping strategy.
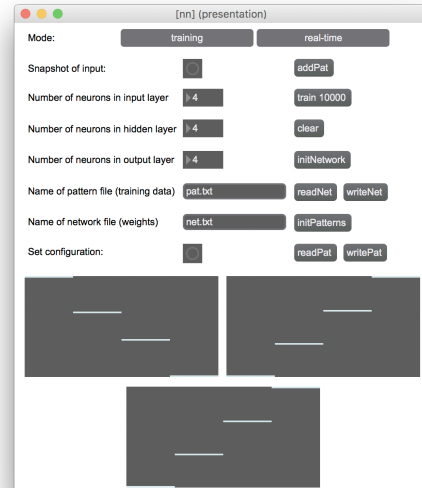
Fig. 6. Inspector for PatMap's nn (neural network simulation) abstraction.

4. FROM EMOTION TO INTERVENTION

Since we decided to focus on creating an algorithmically driven, quasi-therapeutic sound installation we looked for examples of similar endeavors when preparing the next phase of the project. What we found was that our case is unique in that we wished to generate the music algorithmically via modulation of discrete high-level parameters, namely those within the DJster parameter space. Linking research methods from the field of music therapy to this compositional approach presents some challenges, since we collected qualitative data about the environments, which cannot be easily translated into compositional instructions without a composer reworking and reviewing material. Dealing with a kind of music that seeks to function within an already established health context, we looked into existing health-focused design concepts to influence the design of our own system. Agency and situatedness are key notions which helped us to understand the implications of such a design.

One suggestion from within the group was that we use descriptors that can be translated into sonic results, via an evidence-based design (EBD) influenced approach [14]. EBD focuses on implementing credible evidence in design practice, and usually expresses itself via architecture and interior design. Aspects of this approach which could be relevant to our scenarios are the use of positive distractions (attention modulation) and incorporating nature themes in various ways. Attention fatigue and the dangers of using overly abstract art in a healing context have also been noted [15]. This brought about the understanding that we needed to design a system capable of modulating between the states of musical silence and activity and strengthened our idea that "neutral" music would give the best results. During our review of the existing literature, we realized that the musical terms used in medical journals are not always clearly defined to the extent we would like them to be for our purposes. Key questions that arose in discussions on this issue were: how can we overcome such subjectivity? And should we in fact embrace it? The problem remains that the next incarnation of the installation needs to be of a generally agreeable nature musically (in terms of its disruption to the environment). Despite evidence existing that music that has

been selected by an individual for their own listening having benefits in health settings [16], the aspect of control (i.e. personal light switches, privacy given to patients in their rooms, controls for adjusting their beds) is not possible here to the same degree since these are all shared spaces. In our case, the individuals passing through these areas are fairly diverse as the local population come from an array of cultural backgrounds. Making general predictions about their harmonic, rhythmic or stylistic preferences as a group would not immediately be possible and the music would have to be evolved dynamically based on feedback from the users of the spaces. One proposal was to implement an evaluation terminal for feedback at the end of their time in the space. By presenting a range of emoticons to users this system could offer both an aspect of control (affecting the patients' experience of the system) and give us the ability to assess the effectiveness of the system as a controller for musical applications. Pictograms in the form of emoticons represent an ideal feedback/control mechanism, due to the ease and speed of their usage, and the universally understandable character to which they aspire [17]. We are currently in the process of researching various levels of emoticon complexity and arousal/valence models, but in the next phase of our project will start with the basic triad of satisfied-neutral-unsatisfied emoticons. In order to automate the process we are considering using a backpropagation neural network with said emoticons as an evaluation function for the training of the network. It has however been noted that if the patient is not made fully aware of the ways the music functions therapeutically they might form preference rather than a response [18].
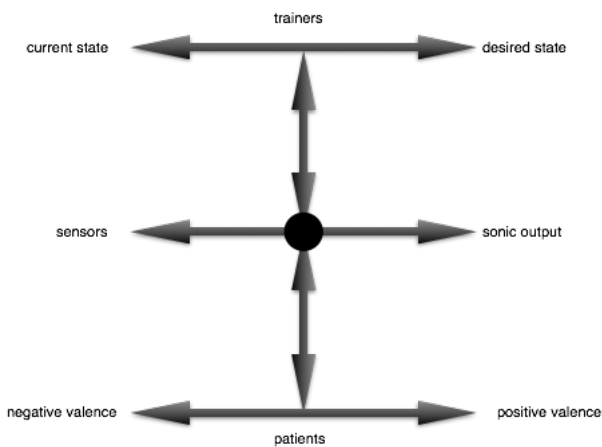

Fig. 7. Tuning of the mapping process

5. CASE STUDY: THE THREE SCENARIOS

The three rooms we will be placing our sound installations in are the peri-anesthesia care unit (PACU), private waiting room (PRIV) and emergency waiting room (NOT) all located in the main building of the UKE [19]. Each possesses a specific and distinct ambience and poses a different set of challenges. Students participating in the project were asked to spend 20 minutes in each of the rooms and fill out two questionnaires in order to assess the qualities of the rooms. These questionnaires were dubbed "Description of Soundscape" and, "Atmospheric Assessment of Rooms" and were created by Katharina Nowack and Eckhard Weymann respectively (see Appendix). A brief description of the rooms follows:

5.1 PACU

Peri-anesthesia care unit (PACU)—this room hosts the patients going under or coming out of anesthesia. It is a large hall (200+ m^2) with beds separated by thin, movable walls, filled with subtle noises of medical instruments and voices of medical personnel. The general feel of the room, as described by students, is one of anonymity, sterility and isolation. One of the biggest challenges in working with this space is reducing its "artificiality", and doing so without disrupting the sonic feedback which the medical personnel is getting from the medical monitoring equipment. Most of the important sonic information lies above 250 Hz, so we are considering using only frequencies below this threshold for our installation, so as not to interfere with the sonic feedback. Another way to avoid interference is using distinctly different timbres. Alternatively, a pair of speakers could be installed for each bed, thus localizing the sound and preventing interference. Due to the size of the room and the fact that the patients are unable to move, we will be using a simple data feed to control our algorithmic composition (see section 3.2).

5.2 PRIV

Private waiting room (PRIV) - the room is dedicated to a smaller number of patients, mostly suffering from vascular conditions. The room is small (some 20 m^2) and furnished to resemble a living room. The room is acoustically dry and even the slightest sounds are clearly perceivable. The general feel is that of a small space. Sitting on a comfortable sofa was assessed to induce sleepiness and passivity. In order to increase the alertness of the occupants, we are planning to use Microsoft Kinect cameras to drive the algorithmically generated music and its spatialization. This way, we hope to provide the patients with active controls over the sound output.[2] An array of speakers will spatialize the sound. Of all the three rooms, this one allows the composers the greatest freedom of expression.

5.3 NOT

Emergency waiting room (NOT) - this middle sized room (ca. 60 m^2) is well lit and noisy. The main acoustic feature is a vending machine—every 5 to 10 minutes it produces a noise with a peak frequency around 709 Hz. As a background to it there is a constant drone of air conditioning, quiet voices, coughing, sneezing and movement outside. Unrest, petulance, nervousness and tension are the words our students used to describe this room. An approach we decided to take in dealing with this situation is "masking" the vending machine noise by incorporating its sound into the soundscape. The 709 Hz is a F5 tone 26 cents sharp and was used as the tonic of a just intonation scale. Apart from time/date/day of the week (measured by in-built computer clock), light intensity (measured by light sensors connected to the Arduino board) and the average room loudness (measured by microphones), we are considering also measuring the airflow and CO_2 levels. Due to the current limitations on the range of Kinect cameras, at this point we are opting out of using them in this setting.

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[2] The sound materials we were planning to use are samples of wind noises, rushing water, air noise of the accordion, processed accordion sounds, gongs, wind bells, harps, celestas etc.

6. CONCLUSION

After approaching this project from a dual perspective formed by two groups differentiated by their backgrounds (music therapy and multimedia composition students and educators), we were succesful in creating a prototype design for our installations. Some of the intial explorations into the philosophy of the atmospheres produced an impetus to seek interdisciplinary solutions to a complex and highly situational range of ethical, philosophical, musical and technical challenges. After explicating the circular nature of healing environments, we identified a number of poles governing its dynamic (see Fig. 1). The descision to pursue an ideal of "neutral" music was realized after the analysis of the first sound designs and their execution with DJster. This project has a wide scope for further development, where we hope to incorporate an evidence-based design approach.

Moving forward, we wish to continue work with complex mapping strategies, including machine learning to assist with the "tuning" of future incarnations of our systems. This would expand the range of possibilities available to us when wishing to assess the effectiveness of our approach.

7. ACKNOWLEDGMENTS

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9. Appendix: Questionnaires used for the assessment of the hospital waiting areas

Course: Healing Environment (Prof. Dr. Hajdu, Prof. Dr. Weymann, Prof. Dr. Sonntag)

The analysis of the atmosphere in rooms - in 3 steps

0

Before you enter the room, focus on your personal perception of this "transition".

1

Find a place in the room where you can remain undisturbed.
Sit still for a few minutes, peaceful and attentive, concentrate fully on your senses.

How do you experience the room, how do you experience yourself in it? How does the room resonate with you? What do you feel here, does the environment invite you to act in a certain way (bodily sensations, need to move etc.)?

2

Direct your attention to the environment, the room. What do you notice? Observe the items in the room, the layout, the furnishings, colours, movements, smells, sounds...

3

With which words can you describe your observations? Take some time to formulate your impressions! At the end write *a summary in one sentence*.

Room: Date, time: Observer:

Observations:

Summary in one sentence:

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Template for the description of soundscapes

Katharina NOWACK (based on SCHAFER 2010)

S = speech, **M =** music, **G =** noise, **m =** man-made,
n = natural, **t =** technical
Dynamics = musical indications, e.g. p (piano), f (forte)
Time = E: single occurrence, W: repetitions,
approximate duration

Observer:
Room: Date:

Time									
Loudness - average									
Loudness - minimum									
Loudness - maximum									
Type of sound									
S, M (m/t), G (m/n/t)									
Dynamics									
Sound progression									
Time									
Type of sound									
S, M (m/t), G (m/n/t)									
Dynamics									
Sound progression									
Time									
Type of sound									
S, M (m/t), G (m/n/t)									
Dynamics									
Sound progression									
Time									

Note: please mark down the three most prominent sounds every 5 minutes

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