Sound to Support Medicine: Designing Hospital Auditory Environments

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Hospital auditory environments are often experienced as stressful and disturbing. Yet, the absence of sound may increase the patients' feeling of being isolated. This article discusses strategies to improve hospital auditory environments by adding sounds, rather than suppressing unwanted sounds exclusively. The central thesis is that narrative, as a temporal design strategy, may help in designing positive hospital auditory environments. The interviews conducted with patients, visitors, and hospital staff suggest that a pleasant, positive hospital auditory environment is one that allows for proactive behaviour and stimulates the attuning of inhabitants to the ambiance of a hospital, i.e. the ongoing and temporal negotiations between the sensing bodies of its inhabitants in relation to others and to the hospital environment. Sonic narratives, considered as sequences of sounds that make sense in time, may be a means to stimulate this attuning and make the passing of time in a hospital more pleasurable.

Keywords: Narrative, Hospital auditory environment, Ambiance, Sound design

1. INTRODUCTION

Narrative may be one of the oldest temporal designs created by humans. Throughout human history, narrative has been used as a means to both make the passing of time more pleasurable and to structure time. One way to get some kind of grasp on events, sonic or otherwise, is to create stories around them [1].

Narrative can be considered the product of a universal human need to communicate with others and to make sense of the world [2]. Stories are important both in grasping the world and in communicating this grasp. Narratives function as accounts with which human subjects can make the events they undergo discursive; in other words, to turn them into experiences.

The main thesis of this paper is that narrative, as a temporal design strategy, may help in creating positive hospital auditory environments, i.e. environments that allow their inhabitants full freedom and control over mind-states and stimulate proactive behaviour [3]. A hospital is supposed to be a place where patients receive treatment and have the opportunity to heal. The success of the healing process is not only determined by the treatment itself, but also by other factors, such as the lighting in the hospital, the way it is decorated, the temperature in the hospital wards, and how the hospital sounds [4, 5, 6]. Sound can have a profound impact on patients, staff, and visitors in hospitals [7]. Often, sounds in hospitals are experienced as stressful and disturbing. On the other hand, many of these disturbing sounds convey meaningful information that is vital to the hospital staff. As a consequence, the experience of an auditory environment, i.e. the

soundscape [8], of a hospital may at times be considered noise by patients, that is, as unwanted sound given one's current needs, goals, and activities [3]. This paper will argue that pleasant, positive hospital auditory environments can be designed by incorporating narrative strategies, resulting in auditory environments that are not confusing to listeners, but are instead interpreted by their inhabitants as soundscapes consisting of sequences of sounds that make sense to them.

First, four concepts that are relevant to this project will be discussed: soundscape, auditory environment, ambiance, and narrative. The first two concepts, soundscape and auditory environment, are closely related. The term "auditory environment" refers to the actual sounds that can be perceived in a space, as well as the manner in which this space transforms, blocks, or amplifies these sounds [9]. "Soundscape," on the other hand, refers to the ways in which an auditory environment is perceived and understood by an individual or by a community [10]. In order to properly investigate hospital sounds and their influence on patients, visitors, and staff, the concepts "auditory environment" and "soundscape" are indispensable.

The concept of ambiance addresses the interrelatedness of environments and the subjects that populate these environments. An ambiance can be defined as a space-time qualified from a sensory perspective, and foregrounds the interaction between the properties of an environment and the lived experience of its inhabitants. It asserts the activity of inhabitants and the role of social practices in the sense people make of the environment [11]. Although an ambiance involves all the senses at once, sound and ambiance are particularly closely related. Both sound and

ambiance question the idea of a clear distinction between the perceiver and the perceived, the subject and the object, the inside and the outside, the individual and the world. Ambiances are ongoing and temporal negotiations between the sensing body in relation to others and the environment [12]. Ambiance therefore is a productive concept in order to analyse the impact of auditory environments in hospitals on its inhabitants.

Narrative, finally, is what makes a temporal phenomenon engaging for its observers. Narrative here is understood as a representation of a temporal development. It is a representation of sequence of logically and chronologically related events [13]. By adopting narrative strategies pleasant, positive hospital auditory environments can be designed, environments that may be interpreted as soundscapes consisting of sequences of sounds that make sense to their inhabitants.

After introducing these concepts, the interviews conducted with patients, visitors, and hospital staff will be discussed, from which the requirements for positive hospital auditory environments will be derived. Next, three designs created using narrative strategies and incorporating the outcomes of the interviews will be evaluated. This paper will end with a discussion of the results.

2. THEORETICAL BACKGROUND

This section provides a literature review of the concepts that are relevant to this project: hospital auditory environments and soundscapes, ambiances, and narrativity. First, research that has been undertaken on hospital sound in general will be discussed. This discussion focuses on the relation between health and sound, in particular. Next, an overview of the manner in which the notions of soundscape and auditory environment are conceptualised will be presented. Also, the notion of ambiance will be addressed and the relation between sound and ambiance explored. Furthermore, it will address the usefulness of this concept as far as the research on hospital sounds is concerned. Finally, the possibilities of narrative as a temporal design strategy will be discussed.

2.1 Hospital Auditory Environments and Soundscapes

A hospital can be a noisy place. An auditory environment of a hospital includes sounds such as air-conditioning systems, medical devices, and occupant sounds such as conversation. Next to these semi-continuous background noises, incidental sounds of short duration, such as doors slamming and alarms, can also be heard. Hospital staff may be exposed to as many as 700 physiologic monitor alarms per patient per day [14].

Noise, considered as unwanted sound given one's current needs, goals, and activities [3], can be detrimental to the health of those exposed to it. Relations have been identified between hospital noise and sleep disturbances, such as reduction of sleep depth, continuity, or duration [15, 16]. Moreover, noise negatively affects wound healing, pain management, and other patient responses [17]. Noise is not only potentially harmful for patients, but for staff and visitors as well. Noise in general has been shown to alter staff stress levels, impact job performance, induce hearing loss at high noise levels, generate annoyance, and cause an increased rate of burnout [17].

Another risk of noise in hospitals is that it may interfere with oral communication between staff members. Often, the staff may need to speak louder in order to be heard and understood. Obviously, speech intelligibility is crucial in order to reduce the possibility for medical errors. At the same time, however, one has to make sure that the privacy of patients is guaranteed and that a patient's diagnosis is not heard by people other than the patient and the staff that is treating this patient [18].

Because of its potential harmful effects hospitals have tried to take measures to reduce noise. One way to accomplish this is to change the room acoustics of a hospital. The most important parameters are sound pressure level and reverberation time. Reducing these parameters affected the psychosocial environment in a positive manner. In this way, intelligibility of speech may be improved and the negative effects associated with noise reduced. Improved acoustic conditions in hospitals thus may reduce stress, risks of conflicts, and errors [19].

Merely reducing noise, however, may not be enough to improve the auditory environment in hospitals. Patients who have to stay in a ward for a prolonged period of time, such as cancer patients, may experience their environment as static and monotonous. Therefore, simply reducing noise may amplify the feeling of being isolated [20]. Moreover, silence may also evoke connotations related to solitude and death, whereas sounds are generally associated with lifeness and human presence [21]. Furthermore, noise, considered as unwanted sound, is a subjective notion, since a sound can be unwanted by one person, but desired by another [22]. Also, the same person may desire a certain sound at a certain moment, but not at another. There is strong evidence that exploring the positive aspect of sound in a hospital context can evoke positive feelings in both patients and nurses. Much of the auditory environment in hospitals comprises information that may potentially be positive for both patients and nurses, depending on the time when this environment is experienced [7]. At a certain point in time, particular sounds might be considered negative noise and at another, they may be

considered positive. Moments, for example, during which the average sound level is excessive, but people perceive it as positive sounds or find it enjoyable nonetheless. Examples of this are the noise made by visitors in a hospital, or the sounds generated by a tea trolley. Also, physical descriptions of auditory environments are insufficient to account for the subjective impression of acoustic phenomena. As a result, a more cognitive approach to environmental sounds as meaningful events that affect people may be necessary. This implies that a shift from noise annoyance studies and decibel reduction to more qualitative evaluations of sound quality in auditory environments is needed [23].

Consequently, hospitals should not aim for silence, but instead try to facilitate perception of quiet and calm by stressing the importance of understanding the individual experience of annoyance. Absence of sound may increase the patients' feeling of being isolated and lacking control, and may be associated with solitude and death. The introduction of wanted sounds over which patients have a degree of control, however, may increase their well-being [22].

The above discussion of hospital sounds indicates that the effects sound can have on listeners is subjective. An auditory environment can be defined as the totality of the actual sounds that can be perceived in a space, as well as the manner in which this space transforms, blocks, or amplifies these sounds [9]. Such an environment may in itself be objective and measurable, but the ways it is experienced by its inhabitants is not. Barry Truax uses the term "soundscape," which he borrowed from R. Murray Schafer, to refer to the experience of an auditory environment. A soundscape can be defined as a relation between individuals and their auditory environment, as an environment of sound with emphasis on the way it is perceived and understood by an individual, or by a society [10]. A soundscape is listener-centred and acknowledges the subjective bonds between listeners and the auditory environment that surrounds them. Consequently, there are as many listeners as there are soundscapes [8].

The term "soundscape" was originally developed within the World Soundscape Project led by Schafer as an analogue to "landscape" to denote the collection of sounds in an environment. Some of these sounds can be considered natural "keynotes," which are sounds that arise from the overall geography of a specific area [24]. In addition, a distinction can be made between "hi-fi" and "lo-fi" soundscapes. Hi-fi soundscapes are those soundscapes that are relatively quiet with a wide amplitude range where it is possible to hear a large amount of detail. Lo-fi soundscapes, on the other hand, are loud and noisy, and generally consist of sounds produced by man-made machinery, masking any sonic detail that may be present as well [24].

In line with Schafer's distinction between hi-fi and lo-fi soundscapes, auditory environments reflecting human activity are generally perceived as more pleasant than environments where mechanical sounds are predominant [23]. Listeners generally consider natural sounds such as birdsong and running water as positive soundscapes, and sounds such as traffic noise or construction sounds as negative or unpleasant [7]. Other experiments corroborate these observations. In these experiments sounds produced by cars, traffic, and construction work were considered unpleasant. Sounds of nature, birds, and "other people," with the exception of angry people, some noises neighbours may make, and cellular phone use, however, were labelled as pleasurable [3].

Certain natural sounds such as the sound of birds may even offer benefits that contribute to a positive feeling, perceived restoration of attention and stress recovery [3]. Partly for this reason, research on healthcare design has identified substantial relationships between physical environmental factors, including sound, and well-being. The physical conditions of a healing environment thus appear to play a significant role in the reduction of pain, anxiety and stress that patients may experience [6]. This suggests that, instead of eliminating unwanted sounds exclusively, it may be more productive to introduce wanted sounds that both mask these unwanted sounds and result in auditory environments that may be interpreted as positive soundscapes by their inhabitants.

2.2 Ambiances

The concept of ambience may be helpful in discussing the relation between the physical conditions of healing environments and their inhabitants. People interpret their environments and add specific meaning to it, turning the "space" into a "place." Individuals become part of the environment and in doing so contribute to defining its identity. In doing so inhabitants of an environment influence the ambiance, which is the atmosphere of an environment experienced by a person [25].

An ambiance can be defined as a space-time qualified from a sensory point of view. It relates to the sensing and feeling of a place [11]. This implies that an ambiance is both subjective and objective, as it involves both the lived experience of people and the built environment of the place. Ambiance is what gives life to an environment. An environment is objective and measurable, whereas ambiance is laden with value [26].

Sound is crucial for an ambiance as well. Inhabitants of an environment are surrounded by sounds that propagate all around and come from everywhere at once. Sound thus literally places them in the midst of a world. Moreover, sound and ambiance are

so closely related because they both question the idea of a clear distinction between the perceiver and the perceived, the subject and the object, the inside and the outside, the individual and the world. In this view, sensing subjects are nothing but resonant bodies that get in sync with their environment by attuning to an ambiance [11]. Ambiances are ongoing and temporal negotiations between the sensing body in relation to others and the environment [12]. For this reason, the foundation of a supportive hospital environment starts with establishing the feeling that its inhabitants are an integral part of the hospital environment. This implies enabling patients, visitors, and staff to attune to the ambiance of the hospital environment, to be able to engage in temporal negotiations between the inhabitants and the environment [22].

Sounds influence the ways in which inhabitants attune to an ambiance, as positive sounds can stimulate and noises can frustrate proactive behaviour [3]. This implies that positive hospital auditory environments can stimulate the attuning to the ambiance of a hospital, with being able to attune to the ambiance considered as a form of proactive behaviour. A pleasant, positive hospital auditory environment is one that is not confusing to listeners and that allows its inhabitants full freedom and control over mind-states. Moreover, a positive hospital auditory environment stimulates proactive behaviour in order to enable the attuning to the hospital ambiance. Such environments are interpreted by their inhabitants as soundscapes consisting of sequences of sounds that make sense to them in time and therefore enable attuning to this environment.

2.3 Narrative as Temporal Design

The process of attuning to an ambiance is a temporal negotiation, one that may be stimulated through temporal design. Temporal design may be defined as the creation of alternative temporalities and more nuanced expressions of time [27]. Narrative, then, can be considered as an example of temporal design that sets out to create such alternative temporalities.

As indicated in Section 1, narrative here is understood as a representation of a temporal development. It is a representation of sequence of logically and chronologically related events [13]. The construction of a house, say, can be regarded as a sequence of events, but it is not in itself a narrative. Rather, it is a process on a different experiential level from the process of narrative. As soon as this process is recorded on video, for instance, that recording can be regarded as a narrative. After all, we now have a representation, in the shape of a video recording, of a temporal development, that is, the construction of a house. This does not imply, however, that a narrative has to represent these sequences of events in a chronological order. Many, if not most, narratives do not, for that generally would result in a rather uninteresting story.

The above definition of narrative implies that causality, or at least the suggestion of causality, is very important in narrative understanding. A narrative can be understood because the events it represents can be interpreted as being related in a causal manner, regardless of whether this relation is a reality or a projection of an apprehending subject. Objects that can be interpreted as containing events that are somehow – metaphorically or otherwise – causally related might be more easily grasped in a narrative manner. Because narrative, ultimately, is nothing more than a basic pattern-forming cognitive system bearing on sequences experienced through time [28], humans try to structure these sequences in the most straightforward way possible, which is in a linear fashion. If possible, they interpret succeeding events as the former being the cause of the appearance of the next. Thus, causal relation is one of the most important kinds of structuring relations within a narrative. But again, this does not imply that the causing event and its effect are necessarily always represented in a chronological order.

A sonic narrative, then, may be considered as consisting of sequences of sounds that make sense to them in time because listeners interpret these sounds as being causally related. Because these sequences of sounds make sense to them, it is expected that auditory environments that include sonic narratives are interpreted as positive soundscapes that stimulate proactive behavior and therefore enable positive attuning to this environment.

3. METHODS AND RESULTS

This section starts with a review of the analysis of the semi-structured interviews that were conducted for this exploratory study, followed by a discussion of how these findings may contribute to the development of designs for positive hospital auditory environments. Next, three designs for positive hospital auditory environments that were made for this project will be evaluated. The requirements for the designs are summarised, followed by an outline of the method that was used to evaluate the designs and a discussion of the results of the evaluation.

3.1 Requirements Gathering

For this exploratory study, semi-structured, individual interviews were conducted with hospital staff, patients, survivors, and patients' relatives. The interviewees were a nurse in their forties, a teenage patient, a parent, in their fifties, of another patient, and

two survivors – people who suffered from cancer as a child and survived – one in their twenties, and one in their thirties. The interviews were recorded, and full transcriptions were made. Through open and axial coding relevant themes pertaining to the experience of hospital auditory environments were derived.

The aim of the interviews was to investigate how patients, survivors, visitors, and staff experience hospital auditory environments, as well as to collect suggestions as to how to improve the hospital auditory environment. The intention was to interview at least one person from each category, in order to make sure that the perspective of each category of people who frequent hospital environments was represented. The projected length of each interview was thirty minutes. No questions were given to the participants before the interview, so as to ensure that their responses would be as spontaneous and as little biased as possible. The questions included asking them what they first listen to when entering a hospital environment and the preferences they have for a particular hospital environment as far as sound is concerned, what they consider noise in a hospital environment, and how they deal with noise. In addition, they were asked to come up with suggestions how to improve the hospital auditory environment for patients, visitors, and staff.

The interviews suggest that sound does contribute in a significant manner to the way patients, visitors, and staff experience hospital environments. From the analysis of the interviews it can be concluded that the two main categories of hospital sounds are man-made and medical machine-generated sounds, and that the sounds belonging to either category can be intrusive. Apart from their intrusive character, sounds patients and visitors hear in the hospital can also evoke negative associations, because it may trigger memories of unpleasant hospital experiences.

Furthermore, sound is a major source of information for the hospital staff. Not only because much of the communication between staff and patients is verbal, but also because the hospital devices emit alarms and status signals. As a hospital generally is a noisy environment, it is sometimes difficult to discern these sounds.

Conversely, sound can be used to mask other sounds, and create a sense of privacy. Privacy is very important for patients, and giving them a degree of control over their environment may contribute to this. This control may include the ability to block unwanted sounds in order to create a peaceful and calm environment, but complete silence is generally not favoured by patients, visitors and staff. Patients, in particular, have very limited opportunities to entertain themselves, either because the lack the energy or as a result of their being restricted to their rooms. Music and other sounds may be a way to make their stay

more comfortable. Being confined to their rooms may also lead to a feeling of isolation. Enabling them to listen to sound from home and everyday life, selected and controlled by the patients themselves, may alleviate this feeling.

The analysis of the interviews furthermore indicates that patients, visitors, and staff members need to deal with the intrusive character that many of the hospital sounds have, as well as with the negative associations that they may carry. They need to attune to the hospital ambiance, which is the atmosphere for the hospital environment as experienced by its inhabitants, in order to fit in the hospital environment and to adjust to it. Also, they may develop strategies to modify this environment in order to make it fit their needs, for instance by introducing other sounds that they enjoy listening to, such as music. Attuning to an ambiance in the manner outlined here includes the manipulation of meanings of hospital sounds through engaging with these sounds and by bringing in new sounds.

The hospital environment may thus be improved for patients by exposing them to sounds that are pleasant to them, and/or by masking unwanted sounds. Furthermore, this may be established by introducing an auditory environment that consists of calming sounds -- such as sounds that refer to nature, that are not very loud, and evolve gradually rather than abruptly -- to create a sense of privacy, and/or to make their environment less monotonous. Finally, the feeling of isolation experienced by patients may be minimised by optimising the familiarity of the auditory environment through the introduction of sounds from home and everyday life that are selected by the patients themselves.

Care need to be taken, however, to make sure that hospital staff will experience these auditory environments as positive soundscapes as well. The auditory environments should ideally not be too hectic or chaotic, as this would result in a less comfortable working environment. Also, personnel need to be able to communicate and hear the alarms and status signals of the medical devices. Sounds that are too loud, for instance, may prevent staff members from hearing alarms and other sounds that are relevant to them. Since the direction of where the status and alarm sounds come from is an important source of information for the hospital staff, the designs for positive hospital auditory environments need to focus on spatiality, too. Staff members indicated that they prefer to be able to hear sounds like alarms, sounds that are generally unwanted from the perspective of the patients and visitors. As a consequence, the spatial location of sounds is crucial, as this may enable the masking of sounds such as alarms from the listening perspective of patients and visitors, while still being audible to staff members, and thus be less invasive. Finally, the auditory environments should ideally avoid

repetition as much as possible and allow for variation, as hearing the same sequences of sounds at the same moments each day may become quite annoying for the people who work in these environments.

3.2 Evaluation of Designs

Based upon the results of interviews discussed in Section 3.1, patients, survivors, and visitors generally favour three kinds of auditory environments. They indicated that they prefer environments that contain sounds from the outside world, a world that can be seen from inside a hospital but not heard, environments consisting of domestic sounds, and environments made up of calming sounds. The staff members that were interviewed mentioned that they favoured calming environments as well, but did not indicate any other preferences.

The conclusions of Section 3.1 also confirm that positive hospital auditory environments need to meet the following requirements. First, they need to be able to mask unwanted sounds from the perspective of patients and visitors. Yet, the environments should ideally be as non-invasive as possible from the perspective of the hospital staff. Staff members need to hear medical alarms whenever they sound, as well as other sounds that are important for the hospital staff to be able to properly do their job. Also, auditory environments are ideally supposed to be pleasant, as long as they are non-invasive. They are not supposed to interfere with the sounds that staff members need to hear. Next, positive hospital auditory environments should ideally improve the privacy for patients, but again, only if this is possible in a non-invasive manner. Finally, the environments should avoid repetition as much as possible.

The primary aim of sound designs that are intended to improve hospital auditory environments thus is to mask unwanted sounds, that is, unwanted from the perspective of the patient, while remaining pleasant where possible. Masking takes place by addressing the areas of frequency spectrum, onset and duration, spatiality, and dynamics. Care needs to be taken that the level of sound is just enough to mask unwanted sounds, but not too loud. Sounds that are too loud may be interpreted as intrusive and considered unpleasant. The spatial position of sounds in the designs should selected in such a way so as to mask unwanted sounds as effectively as possible, while keeping the volume of the sounds as comfortable as possible. At the same time the spatial position of sounds may help to improve the privacy for patients by acoustically shielding them off from other patients.

As the designs should ideally minimise repetition, surprise and variation need to be built into the designs as well. The designs thus are not a mere concatenation of sounds. Instead, the sounds in the designs are processed and mixed as sonic narratives, which means that they need to be processed and mixed as representations of a temporal development. Such developments consist of a succession of moments of relative tension and rest, with moments of tension "leading to" moments of rest, and is responsible for evoking the impression that the sounds are telling a story. A sense of causality is suggested by tension and resolution, and, as explained in Section 2.3, a sense of causality is crucial for narrative. Put differently: a sequence of sounds can be considered narrative if it represents a temporal development by the interplay of tension and resolution through the manipulation of sonic parameters such as dynamics and rhythm. Following these guidelines, three auditory environments have been designed: one consisting of positive domestic sounds, one consisting of calming sounds, and one consisting of sounds from the outside world. In addition, a simulation of a hospital auditory environment was created, and each design was played together with the simulation. In this way, the contribution of the designs to the experience of the auditory environment as a supportive soundscape by patients, visitors, and staff could be evaluated. The simulation and the designs all had a length of two minutes and 33 seconds. This length allowed for a proper evolution of sound events, while still being short enough to make sure participants would remain focused on the recordings throughout the entire session.

The participants were a nurse in their thirties, a survivor in their twenties, and a parent, in their forties, of a patient. All participants indicated that they had normal hearing for their age. They were asked to listen, on headphones, to four recordings of auditory environments. The recordings included the simulation of a hospital auditory environment without any added sounds, and three auditory environments consisting of the simulation of the hospital environment mixed with one of the designs. The recordings were played in a random order and were level-matched. After the playback of each recording, semi-structured interviews were conducted with the participants about their impressions regarding what they had just been listening to. The questions included asking them to describe the auditory environment they were listening to, the effect the design had on them, and which sounds they liked and disliked. Finally, the results of the interviews were analysed in order to evaluate the designs.

The outcomes of the evaluation of these sound designs by the participants suggest that it is possible to mask unwanted sounds with other sounds. The louder and denser a sound is, the more effective it is in masking other sounds. At the same time however, louder and denser sounds are more invasive.

The degree of pleasantness of sounds is also determined by their character. The outcomes of the evaluation indicate that sounds that are more prominent and/or surprising may be more eventful, but this also increases their intrusive character. As a result, prominent and/or surprising sounds were not always considered more pleasurable. At the same time, repetitive and/or continuous sounds may be regarded less intrusive, but because of their lack of eventfulness these sounds were not universally interpreted as pleasurable, either. Continuous natural sounds such as birds singing were considered uneventful and uninteresting by some participants, too, despite the fact that natural sounds are generally regarded by listeners as calming and pleasurable [3]. A possible explanation for this is that the participants were primarily focused on the sounds, without any other distractions, visual or otherwise. In those circumstances the sounds may have been too uneventful to keep them fully interested. When the continuous natural sounds were mixed and processed to create a sonic narrative, as an evolving soundscape consisting of sounds that may be interpreted as being causally related, which was done by crossfading between different sounds, dynamic and spatial changes, and dynamic equalisation, these sequences of sounds were considered as more eventful and pleasurable.

Even though continuous sounds were not always regarded as pleasurable, participants agreed that this kind of sounds may improve privacy. Continuous sounds can be used to create an acoustic screen that shield patients from their environment, just as it prevents sounds produced by patients from being overheard by others. For this reason, it may be preferable to incorporate continuous sounds in the design for supportive hospital auditory environments, despite their generally less eventful character.

One category of sounds that appeared to be rather problematic was that of positive domestic sounds. The sounds that were used in this design were not always recognised as positive domestic sounds, which may be an indication of the subjective nature of this category of sounds. The sounds that were selected for this environment made little sense to them, which led to a feeling of uneasiness and confusion. Because of this, they were unable to attune to the sonic environment, to experience it as an ambiance that reminded them of home. Participants suggested that it might be preferable to be able to select sounds from home and everyday life for themselves, as it became evident that deciding which sounds can be regarded as convincingly representing home and everyday life is a highly personal choice.

4. DISCUSSION

In this article, strategies to improve hospital auditory environments by adding sounds, rather than suppressing unwanted sounds exclusively, were discussed. The literature review and the interviews conducted with patients, visitors, and hospital staff suggested that a pleasant, positive hospital auditory environment is one that allows for proactive behaviour and stimulates the attuning of inhabitants to the ambiance of a hospital, i.e. the ongoing and temporal negotiations between the sensing bodies of its inhabitants in relation to others and to the hospital environment. Such environments are interpreted by their inhabitants as soundscapes consisting of sequences of sounds that make sense to them in time and therefore enable attuning to this environment.

Narrative, as a temporal design strategy, may help in designing positive hospital auditory environments. Hospital auditory environments that are designed as sonic narratives, i.e. considered as sequences of sounds that make sense in time, may be a means to improve the temporal negotiations between hospital ambiances and their inhabitants, thus to stimulate the attuning of patients, visitors, and staff to their hospital environments and make the passing of time in a hospital more pleasurable. The incorporation of music, as a sequence of sounds that in many cases can be interpreted as narrative [29], in auditory hospital environments may contribute to their narrative nature, but since musical taste is subjective, this may result in environments that may not be equally appreciated by all inhabitants.

The results of this exploratory study indicate that auditory environments that are interpreted as narrative soundscapes are indeed considered positive. As the scope of this study was far too small to formulate definitive conclusions, more research is needed in order to fully explore the potentialities of narrative strategies in the design of hospital auditory environments. Also, as the present study only used short fragments, future research is needed to determine whether exposure to longer narrative auditory environments will also have positive effects on their inhabitants.

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