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The role of noise in clinical environments with particular reference to mental health care: A narrative review

Abstract

Background

There is a large literature suggesting that noise can be detrimental to health and numerous policy documents have promoted noise abatement in clinical settings.

Objectives

This paper documents the role of noise in clinical environments and its deleterious effects with a particular focus on mental health care. Our intention however, is to go beyond the notion that noise is simply undesirable and examine the extent to which researchers have explored the meaning of sound in hospital settings and identify new opportunities for research and practice.

Data sources and review methods

This is a narrative review which has grouped the literature and issues in the field into themes concerning the general issues of noise in health care; sleep noise and hospital environments; noise in intensive care units; implications for service users and staff; and suggestions for new ways of conceptualising and researching clinical soundscapes. Data sources comprised relevant UK policy documents and the results of a literature search of Pubmed, Scopus and Web of Knowledge using terms such as noise, health, hospital, soundscape and relevant additional terms derived from the papers retrieved. In addition the references of retrieved articles were scanned for additional relevant material and historical items significant in shaping the field.

Results

Excess unwanted noise can clearly be detrimental to health and impede recovery, and this is clearly recognised by policymakers especially in the UK context. We use the literature surveyed to argue that it is important also to see the noise in clinical environments in terms of the meaning it conveys and rather than merely containing unwanted sound, clinical environments have a 'soundscape'. This comprises noises which convey meaning, for example about the activities of other people, the rhythms of the day and the nature of the auditory community of the hospital. Unwanted sound may have unwanted effects, especially on those who are most vulnerable, yet this does not necessarily mean that silence is the better option.

Therefore it is our contention that it is important to begin thinking about the social functions of sound in the mental health environment.

Conclusions

Whilst it can be stressful, sound can also be soothing, reassuring and a rich source of information about the environment as well. It may be used to secure a degree of privacy for oneself, to exclude others or as a source of solidarity among friends and colleagues. The challenge then is to understand the work that sound does in its ecological context in health care settings.

The role of noise in clinical environments with particular reference to mental health care: A narrative review

Introduction and background

In this paper we will explore an important yet frequently neglected aspect of the health care environment. We have termed this the soundscape of health care, a term we have adopted because it connotes more than merely 'noise' but which enables us to consider how the distinctive sounds of health care may not only cause annoyance but also contribute to the social meaning, pattern of life and structures of authority found in health care settings. In other words, the noise, as we shall see, is often patterned and meaningful.

Our particular interest is in mental health care, though in exploring the literature we have drawn on different disciplines such as psychology, built environment studies and sociology as well as nursing. The issue of noise in health care settings has been raised in a variety of settings including intensive care and neonatal care as well as in psychiatry and all these diverse literatures will be drawn upon in the current article.

The situation is particularly in need of attention because hospitals may be getting noisier. For example, West and Busch-Vishniac (2005) report that where hospital noise has been studied, since 1960 the average noise levels in hospitals has increased an average of 0.38 dB per year during daytime hours and 0.42 dB during the night.

In *Healthcare Environment* the Department of Health (2007a: 33) states: 'Noise can increase heart rate, blood pressure, respiration rate and even blood cholesterol levels. It can reduce weight gain, disturb sleep patterns and negatively affect hormonal balances…Wounds take longer to heal when patients are exposed to noise for long periods.' Furthermore: 'Noise should be controlled at source. Sources can include telephones, trolleys, interactive toys, alarm panels and monitors. These should be monitored and policies should be in place to turn down tones on phones and nurse call systems at night. Designers should ensure that patient areas are located away from external sources of noise, such as road traffic. Noisy spaces, such as restaurants and day rooms, should not be located next to quiet spaces, such as bed areas.'

Unwanted sound, or noise, has long been acknowledged by researchers and policy makers to have detrimental effects, but it is only very occasionally that this concern has been translated into investigations of the health care environment. In 1996 the European Commission issued a Green Paper in which it was stated that an estimated 20% of the EU citizens were exposed to noise levels that scientists and health experts considered to be unacceptable, at which most people become annoyed, sleep is disturbed and health may be at risk. In the UK, *The National Service Framework for Mental Health* (Department of Health 1999) set out the need for improvements in inpatient care, including physical environment. In response, The UK's King's Fund's *Enhancing the Healing Environment* (EHE) Program was launched in 2000 and by the end of 2006, 120 NHS trusts across England had participated, with more than 1,200 staff and patients involved in improving their hospital environments (Department of Health/King's Fund 2006). However, apart from a brief case example for environmental improvement that refers to noise reduction, the issue of soundscapes in mental health settings is largely unaddressed. The need for this issue to be tackled is implicit in policy guidance, which calls for a code of conduct of service user behaviour to be in place that covers the issue of 'management of noise (TVs, radios, etc.) and how disputes over such matters are to be resolved' (Department of Health 2002: 13). The Department of Health's (2007a) *Healthcare Environment*, revisits the issues of physical environment, stating: 'Good healthcare environments are key drivers of patient experience. Good environments matter to patients, their visitors and carers and to staff' (Department of Health 2007a: 3). This document deals in part with the need for privacy, dignity and a healing environment. Under privacy and dignity, it states: 'When we are ill, we want care, rest and comfort in pleasant hospital surroundings and to know that healthcare staff will do all that they can to protect our privacy and dignity.' In the key section on healing environment, it states: 'Good environments have a powerful effect on patients and staff. They can enhance clinical outcomes and patient recovery and improve staff working lives. Careful use of colour, light, texture and sound combine to create a healing environment' (Department of Health, 2007a: 23). Whilst this focus on sound is welcome it is limited to a single dimension of the environment, rather than dealing with the complex matter of managing existing soundscapes in mental health settings. Given a recent emphasis and recognition that '[n]oise can be stressful' and '[r]eduction in noise levels can reduce the risk of violence' (Department of Health 2007b), it is clear that there is a need to investigate the impact soundscapes can

have on the incidence of conflict and violence in mental health settings. We know that professionals working in acute mental health trusts have a higher risk of exposure to violence and aggression (The National Audit Office 2003) and that assessing the impact of the social/ physical environment has become part of the NHS Special Management Service training syllabus for mental health staff, 'Promoting safer and therapeutic services' (Nyberg-Coles 2005). The NHS Confederation (2010) reported that an increasing proportion of patients said they were disturbed by noise originating from the staff. Yet despite these indications that policy makers and practitioners are aware of the problem, much more needs to be done in attaining evidence about the nature and impact of soundscapes in mental health settings to the benefit of service users and staff. Accordingly, we believe it is valuable to examine some of the perspectives and findings that existing in the literature on noise and health care and work out its implications for mental health care.

Like many of the world's major health care systems, the UK's NHS is committed to offering compassionate care in restorative therapeutic environments. In this context, noise and its management may make a substantial difference to the welfare of patients and staff. The adverse consequences of noise are recognised in a variety of legislation and policy which aims to reduce people's exposure, especially in workplaces. Mental health care establishments are both places of work and, at best, sites of recovery, yet we know very little through formal research about the role noise plays in these environments.

Literature review strategy

The literature search on which this paper is based was deliberately wide ranging and multidisciplinary. The authors' careers have included aspects of sociology, psychology, mental health nursing, health communication, architectural acoustics, psychoacoustics as well as a collective concern with the healthcare environment. This search looked at both contemporary and past literature dealing with acoustics, noise perception and noise abatement in health care environments. Data sources comprised relevant UK policy documents and the results of a literature search of Pubmed, Scopus and Web of Knowledge using terms such as noise, health, hospital, soundscape and relevant additional terms derived from the papers retrieved.

All searches reported here were up to date as of October 2014. Policy documents included items published by the Department of Health and the Kings Fund, including those published from 2000 to October 2014, with a view to identifying policy advice and stipulations which were current in the 21st century. This was also useful as an index of extent to which policy makers and senior service providers are taking cognisance of the issue and attempting to address it. Documents referred to here are those which make substantive comments on the role of sound or noise in the environment.

The inquiry into noise, health and architectural aspects of acoustics went back further (c.1960 to Oct 2014) as a good deal of useful work was done in the 1960s and 1970s, particularly concerning sleep and stress responses, and human responses to noise in this respect are unlikely to have changed a great deal in half a century. Where studies of hospital environments were concerned the focus was on material published in the last ten years so as to provide a sense of how the issue is manifest in contemporary healthcare environments. Table 1 provides an indication of the numbers of 'hits' yielded by combinations of search terms used.

Table 1 about here

This large number of candidate papers was further narrowed down by excluding those which did not focus on human participants (such as animal studies) or which coincidentally contained the terms but were not studies of healthcare environments. The databases cover many of the same outlets so duplicates were eliminated and focus was narrowed to those items with substantive coverage of sound, noise and health, soundscapes. The eventual selection was concerned predominantly with in-patient hospital environments and a focus of a good deal of the literature was on intensive care and mental health. A small number of references reporting non-hospital empirical work relating to sound, stress and sleep disturbance have also been retained for illustrative purposes. The bulk of the material included reports original empirical work or field observations but review and position papers were included too.

The literature dealing with anthropology, history, communication studies and ethnography is less easily captured in a database, so this area relied on hand searching and background knowledge. In addition, books play a more significant role here than in the health sciences yet it was felt valuable to include this literature as it captures some novel themes concerning the human relationship with sound. We were assisted by the Applied Social Sciences Indexes and Abstracts (ASSIA) which yielded 2914 hits for 'soundscape' for example.

In addition the references of retrieved articles were scanned for additional relevant material and historical items significant in shaping the field. Each contributor, conducted their own searches of congruent terms relating to sound in their respective areas of expertise and these were then brought together in a synoptic literature review. This involved grouping the literature and issues in the field into themes concerning the general issues of noise in health care, implications for service users and staff and suggestions for new ways of conceptualising and researching clinical soundscapes with a particular focus on mental health care.

Of the approximately one hundred items eventually included in the article, we have endeavoured to include all the material concerned with noise in hospitals. Other fields were included more selectively and our intention was to provide a representative sense of the literature rather than be comprehensive. This approach was taken to material relating to health policy, the relationship between noise and stress and the role of sound in studies of culture, place and environment.

The literature of sound and health care environments

Because the literature on which this paper is based is deliberately wide ranging and interdisciplinary the organising themes with which we will present it are necessarily broad too. Whilst our central interest is in mental health care, we have drawn upon material grounded in more general concerns with noise and health, as well as literatures about noise and stress, sleep quality, noise in intensive care units as well as noise in the health care environment more generally. As this is an interdisciplinary review, we have included also towards the end some material that might be thought of as 'new paradigm' work, which, rather than being concerned with noise, focusses on sonic environments and a collectively intelligible soundscape rather than noise per se.

We have chosen to organise the themes in this way because there is a good deal of work which supports the idea of noise as a stressor, yet the implications for mental health care itself

have yet to be fully worked through. In addition, we wish to highlight the insights offered by the anthropologically and semiotically inflected literature which has hitherto been neglected in many studies of contemporary health care settings, yet which offers new opportunities to understand noise and people's reactions to it.

Noise, stress and health care systems

Firstly, let us consider the literature about noise and stress. This is a useful starting point because this is the parent literature from which a good deal of subsequent investigation has taken its cue. There is a great deal of evidence that factors such as noise level, as well as temperature, and the physical design in a work or leisure setting can yield profound effects on health, mood and productivity. For half a century or more, psychologists and medical researchers have been investigating the effects of noise on health and people's capabilities. Classic works such as *Urban Stress* (Glass and Singer, 1972) and *Decision and Stress* (Broadbent, 1971) pointed to noise as a key stressor and source of impairments in cognitive performance and wellbeing. This tradition of work is worthy of review because it has attempted to characterise the relationship between noise and impairment in a variety of laboratory and naturalistic studies and it is from this perspective that we might best grasp the possible negative sequelae of noise.

Noise as an environmental stressor has been explored in a number of studies, which have identified the potential for it to cause both psychological and physiological harm (Jansen, 1961; Nemecek and Grandjean, 1973; Boyce, 1974; Kjellberg et al., 1996; Maxwell and Evans, 2000; Schick et al., 2000; Kupritz, 2002; Leather et al., 2003; Wallenius, 2004; Fhyri and Klæboe, 2009; Quehl and Basner, 2006; Grebennikov and Wiggins, 2006), it has been shown to negatively affect virtually all aspects of daily life, reducing one's ability to adapt psychologically or physiologically to other stressors, therefore increasing one's vulnerability (Evans et al., 1996). Although various scholars have examined urban and rural soundscapes (Thompson 2002, Garrioch 2003, Smith 1999, Schafer 1994, Alarcon Diaz 2007) there has so far been little scholarship relevant to mental health.

Not everyone will be affected in the same way by noise. Schreckenberg et al. (2010) investigated the impact of environmental noise upon individuals who were noise-sensitive compared to those who were not. Their study found that noise exposure did not necessarily determine mental health effects, but rather noise annoyance was a predictor; noise sensitivity was found to influence noise annoyance. Similarly, Shepherd et al. (2010) found that noise level did not necessarily determine noise annoyance, but rather other factors played a role, in particular, noise sensitivity. Jahncke et al. (2012) simulated the noise effects of working in an open plan office, using individuals with normal hearing and hearing impairment; the study found that individuals with impaired hearing were more affected by high noise than individuals with normal hearing, when measuring physiological stress indicators, cognitive function (in particular, memory) and self-reported mood and fatigue. Jahncke's PhD thesis (2012) explores the sound-related effects of working in open plan offices more generally, including impact upon motivation and cognitive processes.

Wells et al. (2010) reiterate the importance of the sound environment to health outcomes, and suggest that future planning decisions should take account of the overall environment (including sound) within the planning process. As Frumkin (2001) also points out, an environment can have salutary effects as well as a negative impact upon health. Indeed, Alvarsson et al's (2010) study into the effects of different sound environments upon recovery from psychological stress provide evidence for the potential salutary effect of the sound environment. In their study, 'nature' sounds were found to have a positive effect upon the recovery process, compared with a 'noisy' environment. Peschardt and Stigsdotter's (2013) work addressing the restorative effect of 'green spaces' upon stressed users provides support for the perceived salutary effect of a natural environment; whilst their work does not focus specifically upon noise, 'absence of noise' is included within the perceived benefits of a 'serene' green space. Rocha et al. (2012) and Miles et al. (2012) echo the importance of environmental noise to the likely prevalence of common mental health disorders (CMD); Rocha et al. (2012) suggest that efforts to reduce the prevalence of CMD should be targeted at improving living environments. Honold et al. (2012) echo the importance of noise as a potential stressing factor in an individual's living environment.

The value of examining the sound environment in mental health care and its role in predisposing particular kinds of experience and behaviour is underscored when we consider aggressive incidents. Van de Schaaf et al. (2013) discuss the importance of the physical environment of inpatient psychiatric settings, and its role in the use of seclusion, which often follows an act aggression. Factors that increased the risk of seclusion include: 'The 'presence of an outdoor space', 'special safety measures' and a large 'number of patients in the building'' (van der Schaaf et al. 2013, p.142) contributing to crowding and excess noise. Factors that decreased the risk of seclusion included: 'more 'total private space per patient', a higher 'level of comfort' and greater 'visibility on the ward'' (van der Schaaf et al. 2013, p.142). An individual's mental wellbeing may be positively or negatively affected by their sound environment, pointing towards the importance of its inclusion in the design stage of buildings and neighbourhood planning.

From this body of work on noise and health, then, one might anticipate negative mental health effects. Yet there have been relatively few studies of this genre specifically focussed on adverse outcomes in mental health care. Nevertheless there are some hints that excess noise may be problematic. This impression is reinforced when we consider a further body of work where researchers have focused on the relationship between noise and sleep.

Sleep, noise and hospital environments

The relationship between noise and sleep quality and quantity has been researched over several decades and has been a central issue for sleep researchers (Topf and Thomson, 2001, Hong et al, 2010). As might be expected, when exposed to noise, participants report difficulty falling asleep, increased awakenings and decreased sleep quality and morning alertness (Öhrström et al., 2006; Passchier-Vermeer et al., 2002). This can lead to, for example, increasing napping throughout the day, reduced participation in rehabilitation classes (Cmiel et al., 2004) and may even, if sustained, induce sleep-related psychosis (Donchin and Seagull, 2002).

A good deal of this research however has been focussed not so much on mental health care but on laboratory situations or on real-world settings where noise from machinery or

transport systems is significant. For example, the effects of wind turbine noise are shown to compromise the sleep of individuals living nearby (Nissenbaum et al. 2012), who subsequently experience increased daytime sleepiness, and impaired mental health. Zaharna and Guilleminault (2010) summarise the potentially negative impact that sleep disturbance can have upon physical and mental wellbeing. They point out that despite three decades of research there remains much work to be done to establish a robust evidence base for the effects of sleep disturbance through noise, and that the long term effects are not yet clear, in large part due to the fact that studies tend to be of short duration. In a study by Tassi et al. (2010) investigating the long term effects of living near railway tracks (and therefore experiencing prolonged exposure to railway noise at night), individuals who had lived near to a railway for a number of years showed less sleep disturbance at night compared to individuals living in quiet areas, when both groups were exposed to controlled noise during sleep. Perhaps then individuals can become habituated to nocturnal noise over time (if no adverse effects occur), and that this may result in a link between age and sleep disturbance by virtue of the fact that increased age may reflect increased potential for habituation. However, a study by Shepherd et al. (2010) found no evidence of habituation over time in relation to air traffic noise.

In mental health care, researchers have long noticed a relationship between sleep disturbance and schizophrenia (Afonso et al 2014), such that patients with more disturbed sleep are likely to suffer more severe symptoms and be less medication compliant. Insomnia is often present during both the acute and chronic phases of schizophrenia (Benson, 2008; Horn et al, 2013). Importantly, insomnia is a common prodromal symptom heralding the development of an acute episode of schizophrenia (Tan & Ang, 2001).

Sleep disturbance has not been the only avenue of inquiry. Noise has been noted to have a negative impact on communication and privacy regulation (e.g. Lincourt, 2002), where confidentiality and speech security are adversely affected by noise-related behaviour thus affecting interaction between providers and users. There is even some classic work to suggest that noise has a deleterious effect on healing (Fife and Rappaport, 1976).

Overall, throughout this body of work whether based in hospital, naturalistic settings or the sleep laboratory, noise is merely an aversive stimulus. There has been virtually no investigation of what it means to people listening to or, conversely, making the noise. This omission is all the more surprising given the knowledge that the predictability and controllability of stressors is significant mediator of their effects. We will return to the question of how noise is conceptualised later when we consider the 'new paradigm' work on soundscapes. There are further important findings relating to noise in clinical environments when we consider an aspect of hospital life that has been frequently studied, namely intensive care units (ICUs).

Noise in Intensive Care Units

Whilst mental health care systems have not been studied extensively in relation to noise, there is a much larger body of literature on noise in the intensive care unit (ICU). This focus on ICU environments is instructive, particularly as patients may be under stress, disorientated and distressed and there are therefore important parallels with acute mental health care in hospitals. Therefore a brief overview of this literature may be instructive.

The so-called Healthcare Acoustics Research Team (HART) are carrying out work focused in the United States (Ryherd et al. 2012). In Johansson et al's (2012) study 'The sound environment in an ICU patient room: a content analysis of sound levels and patient experiences' (carried out by the HART team), the authors examined the noise environment in an ICU room, where noise levels have been shown to be above the World Health Organisation's (WHO) 'Guidelines for community noise' recommended levels. ICU-related machines are a particular source of noise. Johansson et al (2012) also examine whether patients' outcomes were negatively affected by the sound environment, including a focus upon the onset of 'ICU delirium', which is described as follows:

> ... a state of acute confusion and change in cognition or a perceptual disturbance that develops over a short period (hours to days) and fluctuates over time (Granberg et al., 1996; Delirium and Cognitive Impairment Study Group, 2010 (www.icudelirium.org)). (Johansson et al. 2012, p.270)

The sound environment was found to be affected by noise from machines, staff, other patients and external noise (such as a nearby building site). These sounds were found to have a negative impact on the patient's described experience. However, sounds also achieved a positive impact on occasion for example, the sound of staff talking quietly nearby was sometimes perceived as comforting.

Also in the ICU environment, Xie and Kang (2012) found that noise levels exceeded the recommended guidelines, based upon measurements taken during the nocturnal period. Their study also found that types of noise varied according to the type of ward (single-bed versus multi-bed), with multi-bed wards having more intrusive noises, 'while more extreme sounds are likely to occur in the single wards' (Xie and Kang 2012: 230). Hsu et al (2010) sought to examine the association between noise within the ICU, and psychological and physiological responses (both assessed and self-assessed) of patients who had undergone cardiac surgery. There was a link between self-reported noise and perceived psychological and physiological responses such as annoyance and insomnia, and a significant positive relationship noted between measured noise and increased heart rate and increased blood pressure suggesting a need to address noise levels within ICUs in order to minimise detrimental effects upon patient recovery.

Okcu et al. (2011) study the soundscapes of two ICUs – one recently built neurological unit and a medical surgical unit built in the 1980s – and examine the effect upon staff who work within those particular sound environments. The study found that the recently-built neurological ICU had lower noise levels, and was perceived as less detrimental to worker health and wellbeing. In addition, the study identified that 'mid-level transient sound occurrence rates were significantly and positively correlated to perceived annoyance and loudness levels.' (Okcu et al. 2011, p.1348). Ocku's PhD thesis (2011), investigates design strategies for carrying out soundscape research within a healthcare setting, including linking acoustic environment to occupant response.

As with Ocku's study, a growing interest is being shown in evidence-based design in health care environments but this has not yet embraced the role of sound in mental health care

settings. Despite this, as we have seen, there is a variety of research in the role of noise in health and wellbeing that can provide some clues as to key issues.

Implications for hospital inhabitants - service users and staff

From the literature reviewed so far, there are indications that clinical environments are often noisy places and that noise, especially when it is undesired and not controllable, may have detrimental effects on wellbeing, cognitive performance, sleep and recovery. The likelihood of confusion and poorer outcomes for patients has been relatively well studied in intensive care, but the implication is that similar problems might be found in mental health care settings.

Where service users are concerned, whilst not everyone is equally affected by chronic noise exposure (Stansfeld et al., 2002), perhaps those most profoundly affected are those least able to cope. That is, service-users within mental healthcare institutions may be vulnerable from the outset, since (a) they are often unable to escape from the noise, especially if they are detained under the Mental Health Act or do not have alternative accommodation (b) noise sensitivity may be a predisposing factor for mental illness (Tarnopolsky et al., 1978; Jones et al., 1981) and (c) there exists a demonstrable correlation between noise (its effects and manifestations) and the psychopathology of the individual affected (Jones et al., 1981; Arguelles et al., 1970; Westman and Walters, 1981; Melamed et al., 1994; Belojevic et al., 2001), eliciting greater 'stress' or arousal responses in those with psychological or psychiatric problems.

In addition to clients, the other major groups subject to noise in clinical settings are health professionals and support workers. A similar picture emerges to the situation we have described above regarding clients. However, less evidence exists concerning the effects of noise on service-providers or clinicians within healthcare environments. Stress-related illness is a pervasive problem in the health service (Messingher et al, 2012). It may even be a factor in the suicide risk among health personnel (Feskanich et al 2002, Pompili et al, 2006) where noise-induced stress has, for example, been cited as a contributor to burnout and psychosis in intensive care unit nurses (Topf and Dillon, 1988). Whilst the long-term physical health of the individual may be seriously affected (e.g. Kam et al., 1994; Fontaine, et al., 2001; McLaughlin

et al., 1996; Joseph and Ulrich, 2007, Johnson, 2001), the challenge of coping with the stressor may place demands on attention, resulting in diminished mental efficiency (Wasserman and Segool, 2013) thereby increasing judgment errors and impacting on patient safety. Indeed, McClaugherty et al. (2000) conclude that noise may have caused workers within long term residential care facilities to take out their frustrations on patients and other staff. The prevailing soundscape may fundamentally disrupt the social networks that play a key role in the rehabilitation process and management of care, reducing for example inter-individual contact, and willingness to help, as discovered in some classic studies of noise in urban environments (Glass and Singer, 1972; Cohen and Lezak, 1977). Moreover, recent anecdotal evidence from a study on boredom in acute mental health settings supervised by Crawford has suggested that both television and radio are being used widely as a substitute for user/provider interaction therefore going against best practice in the field (Nelson et al., 2001) and yielding additional noise for other residents and staff.

Once again, the picture which emerges from the literature is one where noise is an aversive stimulus, a view of the phenomenon which has changed little since the classic studies of noise as a stressor such as Glass and Singer (1972). Here also, the research literature by and large has not examined people's individual and collective attributions of meaning to the noise. Nor has it usually explored what information the sound conveys about the working environment, what is happening and what matters in the workplace. Therefore in the later part of this review let us consider a different kind of literature, namely that which views sound as inherently meaningful and intelligible. In undertaking our review, this was why the literature surveyed for this paper was deliberately interdisciplinary so as to incorporate material that went beyond the conventional notion of noise as a stressor and exacerbater of ill health, powerful though it may be. From this new point of view, noises might, for example, divide up the day into meaningful segments, give reassurance, and warn of an impending adverse incident as well as simply being stressful. Moreover, there is relatively little work to suggest how clinicians on the ground can be empowered to improve the sound environment in the clinical setting to the benefit of patients and themselves.

Towards a new paradigm in the study of clinical noise: The meaning of soundscapes.

Whilst we know that noise can have adverse consequences and has often been identified as a stressor that impairs performance, let us finally explore how a new paradigm can be created to explore the full complexity of the soundscape of health care. There is a body of literature which attempts to set the study of noise in the workplace into a broader ecology of sound. An approach of the kind we are advocating explores the ecology of the individual, the social collective and the behavioural setting as a whole. This more rounded ecological approach therefore provides, for example, insight into (a) how the link between noise level, individuals' exposure and the personal consequences is not straightforward or predictable (Kjellberg et al., 1996; Leather et al., 2003; Banbury et al., 2001; Schick et al., 2000) and (b) the many non-physical variables that govern individuals' responses, such as predictability (Kjellberg et al., 1996; Leather et al., 2003; Schick et al., 2000; Quehl and Basner, 2006), controllability (Glass and Singer, 1972), attitude towards the sound (Cohen et al., 1981; Kjellberg et al., 1996; Quehl and Basner, 2006), and ongoing activity (Kjellberg et al., 1996). Moreover, by exploring examples that progress beyond noise and stress research and into the domain of 'soundscapes' or 'sonic events', much can be learned about the complex psycho-sociological and situational interrelationships involved. That is, by embracing the concepts of acoustic communication and the 'acoustic community' (Schafer, 1994; Truax, 1999; 2001; 2002), the symbolic, social, political, situational and cultural dimensions of everyday sound occurrences within specific behavioural settings can be contextualised and explored, thus providing a fascinating insight into how these soundscapes are understood and interpreted by either the individual or society as a whole (Augoyard and Torgue, 2008). In this view, there is a dialogic relationship between people and aural environments where, for example, a familiar soundscape may be seen as a 'semiotic system, conveying news, helping people to locate themselves in time and in space, and making them part of an "auditory community"' (Garrioch, 2003, p. 12). This is particularly evident in historical and anthropological studies. Viewing soundscapes in this manner helps us to understand why, for example, the sounds of motorbikes violated the traditional soundscapes of village life and induced fear in the Kui communities of north-eastern Thailand (Chengsatiansup, 1990). The anxiety-provoking sound of motorcycle engines resulted in what the locals called 'Suzuki disease'.

In some inpatient settings, there is a distinctive sonic culture. The resonant 'hard surfaces, with plastered walls, stone, and brickwork combined with stone and wooden floors"

(MacKinnon, 2003, p. 75) contributed to the sonic narrative of early 20th century Australian asylums, or how personal stereos help create an 'aurally mediated experience' that facilitates 'ontological security' therefore helping individuals withdraw from the world (Bull 2004). Indeed, Rice's (2003) study of Edinburgh Royal Infirmary is particularly poignant, indicating that the sensory-deprived nature of the hospital setting gave the soundscape 'particular sensitivity and force' (ibid.: 9), endowing it with 'complex meanings…..a sonic articulation of the patients' position' (ibid.: 8). Sound, in its broadest sense symbolised compliance, control and surveillance, its presence 'understood to be indicative of disorder and imprecision….. the sound of nurses moving suggests to patients that they are being watched' (ibid.: 8). Ultimately, the soundscape reminded patients of their 'patienthood', situating them within the 'biomedical discourse of which they have become a part' (ibid.: 9). Previous study highlights that context is crucial to mental healthcare - including both social and structural aspects of the care environment (Jordan, 2010); this could be extended in a novel direction via this research to analyse the aural context too. Further, residential settings that provide mental healthcare are encouraged to consider the nature of their institutional settings (e.g. the regime) and any potential negative mental health effects caused by institutionalisation (Jordan, 2011); thus, the examination of sound here proposed would be a welcome addition to the literature and its implications for practice would be beneficial for the provision of frontline mental health services.

Mental health care settings may be subject to high levels of noise, and it may be hard for inpatients to escape this often unwanted sound. The fact that patients cannot escape noise in hospital and it is not controllable from their point of view adds to the experience of stress (Stafford et al, 2014; Hegner et al 2009: 122). This further underscores the value of investigating in a comprehensive way the numerous personal, social, situational and symbolic interactions that occur within these settings. In doing this it would be valuable for researchers to explore the 'meanings of healthcare through the narratives of service users or recipients (Kearns, 1997: 272), therefore providing a fascinating insight into the significance of such issues as relationships, power, control and surveillance (Szasz, 1997; Rose, 1999; Foucault, 2006; Holmes and Federman, 2006).

Lynch (1998) stated that 'the spatial setting does not merely set limits; it is the source of satisfactions'. The approach we are advocating draws on the notion of an acoustic communication and the 'acoustic community' (e.g. Schafer 1994, Truax 1999a 1999b 2001 2002) that provides a framework for the study of 'soundscapes' as a social, political and cultural sonic environment which is understood or interpreted in particular ways. Truax (1999b) defines a soundscape as 'an environment of sound (or sonic environment) with emphasis on the way it is perceived and understood by the individual, or by a society.' An acoustic community is 'any soundscape in which acoustic information plays a pervasive role in the lives of the inhabitants (no matter how the commonality of such people is understood)' and as 'any system of electroacoustic communication where acoustic information is exchanged' (Truax 2001). As such there is a dialogic relationship between people and sound environments. A familiar soundscape helps create a sense of belonging, giving a 'feel' to a place (Garrioch 2003). Garrioch's (2003) view of soundscape as a 'semiotic system, conveying news, helping people to locate themselves in time and in space, and making them part of an "auditory community"', is helpful and gives rise to a number of questions. How might this be achieved in mental health settings? What are the aural semiotics of mental health environments? How have the soundscapes of particular clinical settings within mental health 'shaped individual and collective identities and reinforced patterns of authority' (Garrioch 2003)? Who or what controls or influences soundscapes in mental health care? Which sounds are culturally acceptable? What are the sound symbols in mental health settings? Which sounds become meaningful? And in what ways do these sound symbols and the broader soundscape construct identities (Bal et al 1999)?

The roles played by sounds in environments have been the focus of various studies (e.g. Schafer 1994, Truax, 2001) and classified in the following ways, as keynote sounds, sound signals, sound marks and sound symbol(ism)s. Truax (1999b) defines keynote sounds as 'those which are heard by a particular society continuously or frequently enough to form a background against which other sounds are perceived'. These are 'not consciously perceived but they act as conditioning agents in the perception of other sound signals (e.g. the sound of a computer, washing machine or air-conditioning unit). A sound signal, however, is 'any sound or message which is meant to be listened to, measured or stored' (Truax 1999b). In mental health settings, for example, this might be the sound of a drugs trolley being wheeled out, a

door or personal alarm going off, the telephone ringing or any other sound that gives us basic information such as footsteps or coughing. If these sounds lose their immediate significance they may revert to keynote sounds that do not intrude on our consciousness. Sounds may be classified according to their meaning, as in 'speech sounds, the contexts of interview, story-telling, conversation, recitation, etc." (Truax 1999b). When a sound signal achieves particular cultural significance for any community, Truax (1999b) names it a 'sound mark'; that is, a sound which is 'unique, or possesses qualities which make it specially regarded or noticed by the people in that community.' Finally, sound symbol(ism)s occur when in 'countless repetitions, the images created in people's minds by … sounds and their contexts build up coherent patterns'. Such patterns can achieve the status of 'archetype' (Truax 2001), and be readily associated with various emotions and feelings, such as fear, happiness or nostalgia, or indeed be so deeply rooted as to be 'primordial' (Schafer 1994). Thus particular sounds may be especially evocative, fascinating or mysterious, for example wind and water. The latter, Schafer calls 'the fundamental of the original soundscape and the sound which above all others gives us the most delight in its myriad transformations' (Schafer 1994). A wide variety of sounds, of course, will present different sentimental associations for people.

Key to this kind of enquiry on soundscapes is the nature of the human voice and how this relates to environment. It is the primary resource for most individuals within soundscapes and has a fundamental role in the establishment of social identity. As Truax (2001) notes, it represents the concept of 'self and relationships with others' and the environment. The quality of voice will also be affected by environmental, spatial or architectonic contexts (e.g. absorption, echo etc). Paralinguistic aspects of voice provide information about a person's geographical origins, their mood, and their current attitude or disposition. Voice is also vulnerable to more formidable sounds or noise, and thus can be swamped. It is also a key means of feedback about soundscapes themselves. Finally, the use of voice (or indeed silence) is subject to particular social and cultural constructions, constraints or preferences. Inevitably, the issue of power and voice comes into the equation, especially in institutional settings. Who gets to speak? When can they speak? Where can they speak? What can they speak about and for how long? What, we may ask, is allowed or sanctioned in acoustic communities in mental health settings? Ultimately, who or what controls voice or other forms of sound-making (or indeed, silence-making) in particular soundscapes? Silence-making is a key element of

soundscapes that requires emphasis. Silence can be viewed as a 'rejection of the human personality' or as a state bordering on the sacred (Schafer 1994). Silence can evoke dissent or an assertion of rights (Garrioch 2003). It may signal acquiescence, passivity or even defeat. It may even be a sign or portent of increased social tension, a 'lull before the storm'. What can be learned about silence in mental health settings?

Yet, it is not just sound-making, whether verbal as in conversation, or by use of our body or objects, or even silence-making that is important. Just as crucial is achieving an understanding of modes for listening. Truax (2001, p. 15) has described listening as 'the crucial interface between the individual and the environment' and as a 'set of sophisticated skills that appear to be deteriorating with the technologized urban environment, both because of noise exposure, which causes hearing loss and physiological stress, and because of the proliferation of low information, highly redundant, and basically uninteresting sounds, which do not encourage sensitive listening.' Norman (1996, p. 2) defines listening as: 'a complex, multi-layered activity of which hearing is but a part. … References, memories, associations, symbols - all contribute to our understanding of sonic meaning.' Listening comprises 'referential listening' in which we connect 'sounds to objects, to measurements of time and place, and to learnt "symbols"'; 'reflective listening', which allows us to identify the conceptual meaning of the sounds and appraise 'the sound for its acoustic properties'; and 'contextual listening' which 'relates the material to the context of our individual history, and influences both the extent of our imaginative wanderings and the nature of the meanings they provide' (Norman 1996, p. 9).

Once we have understood the situation in hospital to be not just 'noisy' but a soundscape, we may ask: What are the listening habits of service users? What sounds are important to them in making sense of their space? Furthermore, we know that particular sounds can be the preserve of privileged groups, indicating status and power (Garrioch 2003). In psychiatry, in the era of the asylum, this was very obvious in the sound of keys carried by the 'turn-key', but more recently, perhaps by the sound of the medication trolley being wheeled out. What other sounds in contemporary mental health care settings construct asymmetrical relationships between professionals and service users?

Once soundscapes have been conceptualised in this way, it becomes possible to determine how best to provide more healthy or healing sound environments along the lines of Truax (2001), who proposes that the ideal and most balanced environment is the 'hi-fi' environment, where 'all sounds may be heard clearly, with whatever detail and spatial orientation they may have' (Truax 2001, p. 23). Truax claims that the 'hi-fi' environment presents 'a high degree of information exchange between its elements and the listener is involved in an interactive relationship with the environment.' (Truax 2001, p. 65). In contrast to the bulk of literature on the effects of noise, and noise in health care, in this view, the effect of sound in the healing environment is not necessarily negative. If the sounds are intelligible, controllable and make sense in the overall ecosystem of the hospital they may well not have a deleterious effect and might even bring benefits. This ties in with research which suggests that certain kinds of sound, such as music can yield reductions in stress, blood pressure and post-operative trauma compared to silence (Chafin et al, 2004; Hirokawa, 2004; Nilsson et al, 2005). Sound may contribute to healing as well as distress and decompensation.

Conclusion

Seeing the nature of sound in hospital settings as a soundscape, rather than merely noise, can enable a more subtle and socially useful understanding of the role of sound in clinical life, especially in the neglected area of mental health care. It is particularly important to examine this area of specialism because of what we know about the role of unwanted, uncontrollable and unpredictable sound in increasing stress, lowering cognitive efficiency and interrupting sleep.

In her seminal work *Notes on Nursing* Florence Nightingale (1860) wrote that noise was 'that which damages the patient'. The noise to which Nightingale referred included squeaking floors, crinoline skirts rustling, appropriate and inappropriate conversations. In other words, sounds that resulted in feelings of 'apprehension, uncertainty, waiting, expectation, fear or surprise' (Nightingale, 1860, p. 14). As we can see from Truax's work, the optimal soundscape may not be silence, but one which he describes as 'hi fi', where the sounds are intelligible and legible. Sound may be stressful, certainly, but it can also be soothing, reassuring and a rich source of information about the environment as well. It may be used to secure a degree of

privacy for oneself, to exclude others or as a source of solidarity among friends and colleagues. The challenge is then to understand the work that sound does in its ecological context.

It is by understanding sound in this way that we can aim for the kind of soundscape encouraged by the Department of Health (2007a): 'Sounds such as rain, a breeze, the sea, moving water and songbirds can calm and create a sense of wellbeing by triggering the release of endorphins, the body's natural opiates. Courtyards and landscaped gardens close to patient areas should include plants that encourage songbirds.' This call mirrors Schafer's emphasis on the emotional resonance of primordial sounds. The Department of Health (2007a) also emphasises the positive impact of music in terms of treating depression, 'reaching' autistic children, calming and relaxing 'agitated psychiatric patients', 'painkilling effect', and 'reduc[ing] blood pressure, heart and respiration rates', although it warns that some people might view music as 'noise'. It recommends that patients have easy access to music via headphones and live performances.

In other words we need to stop thinking about noise and start thinking about the social functions of sound in the mental health environment, and how these may be contoured into a soundscape every bit as rich and variegated as the physical topography.

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