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Citation for published version:

Andringa, TC, Weber, M, Payne, SR, Krijnders, JD, Dixon, MN, v.d. Linden, R, de Kock, EGL & Lanser, JJJL 2013, 'Positioning soundscape research and management', *Journal of the Acoustical Society of America*, vol. 134, no. 4, pp. 2739-2747. <https://doi.org/10.1121/1.4819248>

Digital Object Identifier (DOI):

[10.1121/1.4819248](https://doi.org/10.1121/1.4819248)

Link:

[Link to publication record in Heriot-Watt Research Portal](#)

Document Version:

Publisher's PDF, also known as Version of record

Published In:

Journal of the Acoustical Society of America

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Positioning soundscape research and management

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(Received 13 February 2012; revised 27 March 2013; accepted 8 June 2013)

This paper is an outcome of a workshop that addressed the question how soundscape research can improve its impact on the local level. It addresses a number of topics by complementing existing approaches and practices with possible future approaches and practices. The paper starts with an analysis of the role of sound annoyance and suboptimal soundscapes on the lives of individuals and concludes that a good soundscape, or more generally a good sensescape, is at the same time pleasant as well as conducive for the adoption of healthy habits. To maintain or improve sensescape quality, urban planning needs improved design tools that allow for a more holistic optimization and an active role of the local stakeholders. Associated with this is a gradual development from government to governance in which optimization of the soundscape at a local (administrative or geographic) level is directly influenced by the users of spaces. The paper concludes that soundscape research can have a greater impact by helping urban planners design for health and pleasant experiences as well as developing tools for improved citizen involvement in local optimization.

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PACS number(s): 43.50.Qp [BSF]

Pages: 2739–2747

I. INTRODUCTION

The Universal Declaration of Human Rights ([United Nations, 1948](#)) states: “Everyone has the right to rest and leisure” (article 24). However, as a recent WHO-report ([WHO, 2011](#)) demonstrates, noise is, after air pollution, the second most important environmental cause of death and disability in Western Europe. With the current exposure and protection levels in place, more than million healthy life years in Western Europe are lost annually due to the long

term effects of noise induced stress and annoyance. This does not indicate that the right to rest and leisure is universally guaranteed in Western Europe. We argue that this right can be guaranteed more pervasively if the current top-down government policies are complemented with effective local governance approaches.

The natural reaction to a serious problem is to demand central governments to come up with better legislation, lower noise thresholds, improved measures, and stricter reinforcement. While this may be part of a solution, it is a centralist approach that is not taken in this paper. Future optimization by local stakeholders (sound producers, citizens, and local governments) should lead to improved well-being, improved prevention from long-term noise exposure, and improvement of situations where public health is threatened. National noise

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mitigation policies designed to prevent excesses should therefore be augmented with local soundscape optimization processes. Here we aim to provide an outline of local optimization processes in which the interests of local stakeholders are effectively addressed.

To do so this paper addresses sonic environments, soundscape research, and soundscape approaches from a quality-of-life point of view that can be described in terms of a number of assumptions. First, we assume that human responses should not be equated to acoustic measures; instead we start from intelligent, living, breathing, feeling, and communicating individuals who are able to like, or dislike, certain sonic environments. These people are key stakeholders that can help to improve their own living environment (Bowles and Schulte-Fortkamp, 2008; Schulte-Fortkamp, 2011).

Second, we foresee a core role for soundscape research in the creation of healthy living environments. We assume that good (local) governance entails the creation and maintenance of living environments that provide ample opportunities for their inhabitants to self-regulate health and happiness. This entails that prolonged or structural (sound) annoyance should be treated as an indicator of suboptimal living conditions to be taken seriously and, if at all possible, avoided. In particular, when living environments are markedly degraded (typically by policy decisions and long term developments in society) inhabitants have a justified right to demand healthy living conditions, including the opportunity for restoration from stress.

Third, our societies involve a multitude of activities and many of these produce sound as a by-product. As a further assumption, we therefore assume that a core contribution of soundscape research is to provide options and strategies to balance high quality living conditions with opportunities for economic and social activities. This balancing process is, like everything in politics, multifaceted. Unlike most existing national noise mitigation policies, the soundscape approach potentially offers many non-acoustic options for local improvement. However, choosing an effective and optimum set of options is not that easy as their achievement depends on the situation and the creativity and willingness of those involved. We need an improved way to talk and think about the problem—a change in mind-set—which this article should help facilitate.

Finally, although we generally focus on *sounds*capes, we also generalize it to *senses*capes to denote the full breadth of sensory modalities that allow us to interact with the environment and the full richness of the way we experience it.

The definition of soundscape as “the sonic environment as perceived and/or understood by people, in context” fits with the task we set ourselves in this paper. However, we interpret this definition broader than usual. We address the local optimization of sonic environments, and with that the living environment, in such a way that people—in the context of their whole life—perceive and understand the sonic environment as conducive for a high quality of life. And we position soundscape research and management as a central process in a wider societal context.

This paper arose from a workshop held in Assen, The Netherlands, in October 2011, which addressed a problem

posed by the authorities of the city of Assen and the province of Drenthe. Although Assen (64 000 inhabitants) complies with all national and European noise legislation, sound-related annoyance complaints are still received and the local government takes these seriously. Therefore, they wanted to know how to improve the locals’ experienced soundscape quality, above what is demanded by current legislation. With the above assumptions in mind, the authors approached this question from three perspectives: Political Science, Psychology, and Urban Planning. Through these perspectives our proposed soundscape approaches are described before analyzing the dangers and opportunities associated with local soundscape optimization.

II. FROM SOUND-RELATED ANNOYANCE TO HEALTHY SENSESCAPES

Sound-related annoyance is a phenomenon in which exposure to some sounds, or rather noises, may lead to a range of detrimental effects on experienced pleasure, well-being, and health resulting in stress (WHO, 2011). Importantly, “acute noise effects not only occur at high sound levels, but also at relatively low environmental sound levels when, more importantly, certain activities such as concentration, relaxation, or sleep are disturbed” (Babisch, 2002). This is reflected in the definitions of stress and annoyance which emphasize the importance of how an individual *feels*. This is fundamentally at odds with both a human-as-dB-meter or a loudness-is-toxic paradigm.

To understand annoyance we need to understand the factors that result in sounds producing different emotional evaluations; we need to know how pleasurable sounds contribute to the processes that keep us alive and happy, and how annoying sounds frustrate aspects of our lives and impede health. As our daily activities, especially our needs and habits, can be affected by the sounds. Understanding their importance helps explain in part our emotional reactions to sounds.

A. Needs and habits

We all have needs, which vary from individual basic physiological needs and safety, to collective societal needs. Neglecting ones’ needs always leads to problems; that is why they are needs and not mere desires. Ideally needs are to be satisfied proactively: Before they become uncomfortable and long before they endanger existence. For example, buying food before losing weight, drinking before experiencing dehydration, and making friends before loneliness.

Needs shape our lives and daily activities. Sleep is a vital need for restoring our capacity to interact with the world, thus we build bedrooms to facilitate high quality sleep. We need food and water, so we create regularly reoccurring situations to eat and drink. We need both privacy and interpersonal contact so we create moments for both. We need to work and relax so we structure our days to include both. To satisfy these needs daily and weekly rhythms arise, resulting in habits, thus proactive need satisfaction and habits are closely related. Good habits address multiple needs so that very few needs are ever insufficiently

satisfied. Each bad habit leads, in some way, to a situation in which needs are insufficiently addressed. The habit of listening to loud music via earphones may lead to hearing-loss as the needs of the hair cells in the ears are neglected resulting in hair cell loss.

Habits are behaviors activated by a specific situation (Wood and Neal, 2010). At first the individual consciously activates and executes a behavior during a specific situation in a given environment, on a number of occasions. Eventually the individual's perception of the social or physical environment will activate and guide future behavior, leaving the mind free to think about other things.

As William James concluded (James and McDermott, 1978), good habits are a sign of mastery because one receives great benefits with little effort. A bad habit can be viewed as a form of "slavery" as one does things that one knows or feels may have unfavorable consequences, but does them anyway. With good habits the individual is in control of the environment, with bad habits the environment to some extent controls the individual. If something interferes with executing your good habits you also lose some control. It is therefore important to create living environments that facilitate the adoption of good habits.

When stimuli help to satisfy ones needs one is in control and is free to act. This allows one to address needs before they become pressing, thus avoiding problems from unsatisfied needs. If one satisfies all needs, viability is maximized. This is, for that reason, a highly pleasurable situation (Maslow, 1943).

For stimuli that hinder need satisfaction, the reverse holds true. Now the source of the stimulus is in control and not the individual. This may prevent sufficient need satisfaction, which entails that some needs become pressing and force themselves to be prominent in consciousness. One must do something now (or soon) and one should do it well. One becomes aroused, motivated, and focused enough to satisfy the need as soon as possible. This situation corresponds to the concepts of the left side of Fig. 1, while the pleasurable situation corresponds to the right side.

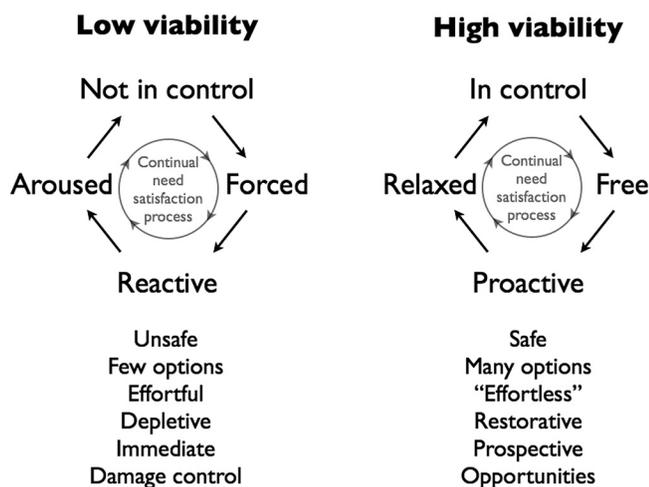


FIG. 1. Concepts associated with frustrated need satisfaction (left side) and with optimal need satisfaction (right side).

Some sounds, at particular times, interfere with need satisfaction, while other (or even the same) sounds, at other times, may help you to satisfy needs. As indicated in Fig. 1, the manner in which the sounds are evaluated depends on the combination of the stimuli and the needs of the moment. For example, the sound of a cockerel at dawn may be evaluated positively by a farmer as it satisfies his need to wake up in time for his early morning farmyard activities. In contrast, for the urban tourist in their holiday home, it can be evaluated negatively as it disturbs their desire for sleep during their break from work. While considering these different perspectives, we propose that insights from soundscape research should contribute to the realization and protection of living environments on the right side of Fig. 1.

From a need satisfaction perspective sound annoyance—or any form of annoyance for that matter—can be interpreted as a "welcome" indicator of the prevalence [what Maslow (1943) referred to as prepotency] of a factor disturbing need satisfaction. Reducing experienced annoyance is a first, but essential, step toward improved structural need satisfaction and a health promoting living environment. In fact it seems that the attentional resources that are claimed by annoying stimuli directly connect to need satisfaction and quality of life challenges (Andringa and Lanser, 2011b).

B. The auditory cognition of annoyance

Recently, research aimed at the auditory cognition of pleasurable and annoying sounds showed the diversity of how sounds can become annoying (Andringa and Lanser, 2011a), or, more generally, how a pleasant soundscape can degrade. For example, three categories of answers were produced from the question "Why is [a particular annoying source] for you the most annoying source?" The most often cited category comprised of being involuntarily reminded of the presence of the sound. While loudness was the most important single aspect in this category, other aspects like the annoying sound's constancy, frequency, or unpredictability of occurrence, duration, and particular or tell-tale source properties, were together far more frequently mentioned. A second category of answers comprised of reduced opportunities to perform desired or needed behavior especially relaxing, sleeping, or using one's house and garden. A third category comprised of being confronted with avoidable and/or unfair aspects of policies and regulations. This suggests that annoying sounds are those that attract involuntary attention, potentially leading to reduced options to relax and sleep in and around the house, which can be evaluated as unfair and unnecessary.

Important quality-of-life-issues that annoying sounds disturb are reducing options to relax and sleep, changes in living conditions such as the absence of peacefulness, and reduced profitability from the home, garden, or larger living environment (Andringa and Lanser, 2011b). These physical activities and needs were supplemented with reported mood changes, as people felt positive less often and negative more often, because of annoying sounds. Attentional, perceptual, and health problems were also mentioned,

highlighting the far ranging effects annoying sounds can have on quality-of-life.

When annoying soundscapes and sounds prevent people from their necessary sleep, rest, or relaxation they are preventing cognitive and emotional restoration. Psychological restoration is necessary when an individual has become fatigued from focusing on one task for a sustained period of time (Kaplan and Kaplan, 1989) and is no longer productive and/or performing safe behaviors. Without restoration, stress levels can rise (Kaplan, 1995). Prolonged stress may lead to burn-out, which has substantial health implications for the individual (Selye, 1978). It also has an economic cost on society, with reported welfare costs of billions of euros, through sick leave, hospital bills, and rehabilitation (Grahn and Stigsdotter, 2003).

There is growing evidence that sounds can also play a key role in an individuals' opportunity for psychological restoration (Payne, 2009). Soundscapes dominated by natural and happy people sounds are perceived as more likely to offer recovery from any psychological fatigue. Having access to nearby green spaces is also beneficial for reducing sound-related annoyance and stress-related illnesses for residents who are exposed to high levels of road-traffic noise that disturbs their daily lives and sleep patterns (Gidlöf-Gunnarsson *et al.*, 2007). Natural environments and their sounds, sights, and smells can therefore play an important role in moderating people's stress levels and offer opportunities for restoration.

C. Creating healthy sensescapes

To create a healthy society that has ample opportunities for psychological restoration, to prevent excessive stress levels, and to foster healthy habits, requires us to consider the role of sounds in our daily environments. This includes considering sounds that affect our conscious thoughts and emotions, but also those that disturb our physiology without conscious processing of the stimuli. Designing urban soundscapes that offer ample opportunities for restoration will be as important as producing soundscapes that are vibrant, exciting, or conducive to work. The key is to ensure that the range of people's needs and desires can be met in an appropriate order of importance.

Planning procedures must be influenced by the activities people are expected to need and want. The soundscape, while important, is only one aspect that needs to be considered. Humans use multiple senses to perceive and evaluate an environment (Russell *et al.*, 1981). We experience a *sensescape* and not only a soundscape. Thus a restorative soundscape would produce optimal satisfaction and restorative effects if it was perceived within a compatible multi-sensory restorative environment. One way by which such a situation could be enhanced is through the provision of naturalized, biodiverse spaces, such as parks within urban areas to help create sensescapes that are healthier for people compared to barren environments full of monotonous buildings and sounds.

To conclude this section, sound should not be treated as an isolated aspect but as one of multiple modalities that are

produced from human activities and their environments. All modalities facilitate or hinder need satisfaction. But soundscape research can lead the way in acknowledging the role of healthy sensescapes. Since healthy sensescapes are conducive for the formation of good habits they might be an effective way to reduce (future) health costs by contributing toward improved quality-of-life. The soundscape community can play an important role in raising awareness and bringing the necessary expertise together.

III. PLANNING URBAN SOUND- AND SENSESCAPES

Urban planners need tools to promote healthy societies. Designing sufficient opportunities for psychological restoration to prevent excessive stress levels requires a careful consideration of the role of sounds in our daily environments. Learning to design and adapt healthy local soundscapes that offer ample opportunities for restoration will be as important as producing soundscapes for other purposes. The soundscape may also contain special sound marks that provide the place with unique and recognizable qualities and social value. Urban planning for health should ensure that the full range of people's key needs can be met in the local environment. In particular, planners should avoid the creation and perpetuation of soundscapes that serve no *positive* purpose for those involved. This entails that the current noise limits, which are most suitable for excess prevention, are not a proper basis for urban planning. This section addresses a number of ideas to provide urban planners with tools that synthesize insights from urban planning and soundscape design.

A. Using listening modes

There is no single soundscape utopia, and sensory needs are also dynamic. However, using broad categories for sensory experiences may provide a useful "shorthand" for policy-makers and sectorial practitioners. For example, three states of human listening, broadly corresponding with certain activities and land uses may be helpful (see Table I). These three listening states are an approximation because in practice they are more of a continuum. Truax (2001) described "listening in search" as a form of analytical listening, where the individual is focused upon hearing sounds relating to one's activity. "Listening in readiness" is the intermediate listening state, where the individual is listening to certain aspects of the soundscape but is also alert for other sounds that provide the individual with important information. "Background listening" can also be termed as distracted listening, as the individual is focused on something that does not need acoustic cues, such as reading a book, so they are "tuning out" the sound and desire to minimize irrelevant intrusions (Andringa, 2010).

In the current state of knowledge, an activity-based approach may offer the best scope for structuring work on soundscapes and sensescapes, simplifying relationships with land use policies, different professions, and departments of central and local government.

Techniques for including sensescape quality in policy tools, such as Environmental Impact Assessment and Health

TABLE I. Listener state, typical activity, and land use.

Listener state	Listening mode	Typical activity, e.g.	Urban use	Current policy
In search	<i>Engaged, receptive</i>	Walking, recreation, events, shopping...	<i>Park, street, square, market, shops...</i>	Soundscape design
In readiness	<i>In flux</i>	Conversation, routine tasks...	<i>Kitchen, restaurant, bathroom...</i>	Noise and soundscape
Distracted	<i>Detached, tuning out</i>	Reading, writing, learning, watching TV...	<i>Library, classroom, bedroom, living room...</i>	Noise control

Impact Assessment, need to be developed. A “sensescapes approach” could help facilitate more citizen involvement. For example, in a future development of Environmental Noise Directive 2002/49/EC, moving from “quiet areas” to soundscape quality and a multi-sensory assessment of tranquility, citizens may be invited to nominate sounds of local interest, and identify areas of special soundscape quality, perhaps using applications like Googlemapping, SoundAroundYou, and AudioBoo. Audio trails could develop links with tourism and economic development. We need to show that improving sensescapes supports moves toward more sustainable economies, as well as improving human health and well-being.

A broad hierarchy, as outlined in Table II, could provide rough guidance on priorities. It is, of course, generally prudent to reduce “negatives” before enhancing “positives.” Acting at the source wherever possible, accords with the “polluter pays” principle in first considering the responsibilities of those introducing fresh impacts. Pragmatically, it also focuses attention on the sound quality of machines, where product regulation, too often dominated by narrow marketing concerns, could benefit from an earlier involvement of citizens. The recent “Quiet Mark” by the British Noise Abatement Society, is an excellent example of this (Noise Abatement Society, 2012). Planners, architects, landscape designers, and others need to work with sounds already being produced by activities, and influence how these propagate and are “colored” by built form, surfaces, vegetation, and other elements.

In the current state of knowledge, we need to be cautious and selective about adding sound with loudspeakers, perhaps using them only after other soundscape-related interventions, such as outlined in Table II, have been considered. Creative use of added sound may at present be best used in the context of experiments to improve understanding of perception and behavior. These should generally be site-specific, in terms of

place and function, and responsive to changing ambient conditions through time. Some people may still object to the principle of putting the sound environment on “loudspeaker steroids.” However, artists have a license to experiment in ways not available to planners or landscape designers, stretching popular imaginations. While it may be beneficial to direct attention away from potentially annoying sounds, to offer “therapies” (such as learning ways to cope with the sound) and other “indirect” options, it is vital that citizens do not feel that their sensory experiences are being cynically manipulated.

B. Planning for spatial quality

Spatial planning allows for a participatory approach; it is also a highly knowledge intensive process that involves, ideally, contributions from many different disciplines including the (prospective) users. However, spatial planning is still mainly top-down without prominent contributions from the involved citizenry; the Nauener Platz project in Berlin is a notable example (Schulte-Fortkamp, 2011). Soundscape approaches can help provide these key, but missing, contributions because sounds can carry over greater distances. Thus by affecting many it can function as a factor that unifies the users and serves as a starting-point for design.

Spatial quality in urban planning and landscape architecture must continually be redefined according to the time, place, and people concerned. The multidimensionality and multisensorial aspects of spatial quality requires ways to stimulate creativity and to structure ideas and plans. Traditionally physical space assessment and planning was based on physical qualities. Values on the other hand are more subjective and change with time and person. It is widely acknowledged that the quality of a space is a complex interaction of functions, shape, and value, but the more the users of a space experience a coherence of these factors

TABLE II. An indicative hierarchy for soundscape planning and design.

Listener state		
Listening in search <i>Active</i>	Listening in readiness <i>Stand-by</i>	Background listening <i>Tuned out</i>
	Improve sound quality at source, e.g., <i>reduce use of cars, aircraft, improve product regulation</i>	
	Use land use, design, and conservation to influence soundscape, e.g., <i>avoid too fine a land use mix so that work and leisure sounds do not need to be sealed in to protect residents, retain popularly-valued soundmarks</i>	
	Enrich biodiversity, e.g., <i>birds, insects, wind in trees</i>	
	Modify pathway, e.g., <i>barrier, ground modeling, absorption, lowering receptor</i>	
	Semi-natural masking/mix, e.g., <i>fountain, weir</i>	
	Self-protecting layout/design, e.g., <i>at least 1 room on quiet side, acoustic balconies</i>	
Relocate paths, seats		Sound insulation of habitable rooms
Sound art	Personal audio	Therapies

the better they understand it and the higher they value it. If the aim is to improve well-being, we should, while planning and designing, protect existing values and invest in new values that further enhance a coherent experience.

The high population density in the Netherlands has spurred Dutch planners to come up with the “Habiforum matrix” (Hooimeijer *et al.*, 2001) to approach spatial quality. In this approach spatial quality is built up from three values: “Use” values, “experiential” values, and “future” value. These values are claimed to be universally applicable in planning decisions. For example, if someone buys a house, consciously or not, these values are applied: How do we expect to use it, what do we think it will be like to live in, and what is the perspective for its future value?

The four aspects covered in the columns of the Habiforum matrix provide a division of aspects relating to spatial considerations: Economic, social, ecological, and cultural importance. The rows of the matrix involve usability, experiential, and future values. Filling in the matrix with statements or words is indicative for the quality of the design. These statements have the purpose of inspiring and stimulating ideas while not forgetting important aspects. Every participating expertise is invited to fill in the cells of the matrix by formulating their own statements which they themselves associate with the value/spatial aspect of that cell.

Sounds have generally played a minor role in the more visually oriented urban planning and landscape architecture community. However, the increased focus on usability and experiential values entail that a multi-sensorial and especially a soundscape approach becomes of central importance. Table III provides an example of a Habiforum matrix with soundscape related questions that show that these fit very well in the structure, thereby stressing the intimate link between soundscape research and urban planning.

IV. SOUNDSCAPE IN GOVERNANCE

Over the last three decades, environmental policy has substantially changed in terms of the policy discourse, the actors involved in policy formulation, and the policy instruments applied. In many Western European countries environmental policy is formulated in the 1970s and 1980s,

consisting of top-down regulations on, for example, waste, air quality, and noise, etc. Characteristic of an environmental policy in its infancy the focus was on source-based regulations and technical solutions for achieving health-based environmental limits. Since the 1990s, however, implementation deficits in the Netherlands as in other European countries, urged for a reconsideration of the traditional approaches. As a result, in some policy domains governance approaches have been established. “Governance” is, in general, regarded as the successor of “government,” i.e., political steering where state and non-state actors participate, applying new policy instruments such as negotiated agreements, and market-based incentives.

In parallel to these developments, noise legislation has been implemented by the Dutch Noise Abatement Act in 1979; similar regulations are found, for example, in United Kingdom, Germany, and USA. The Act introduced zoning as a new policy instrument, i.e., spatial separation of noise intrusive activities, such as transport and industries, and noise sensitive dwellings. Regional and local authorities are responsible for assessing nationally defined noise limits at the facades of dwellings for the (re)construction of infrastructure or housing. This approach fitted the positive attitude toward technologies and setting norms as adequate and effective instruments. In the mid-1990s, however, as the policy targets on the reduction or stabilization of the percentage of inhabitants annoyed, specifically by road and railway traffic, were not achieved various authorities urged for new instruments.

A major omission in the Dutch Act is that the autonomous increase of mobility is neither regulated nor enforced. Road traffic noise is the main contributor to noise pollution; however, vehicles have not become quieter since the 1970s; this is in harsh contrast to the significant reduction of air polluting emissions from vehicles that have been achieved.

Regarding this limited effectiveness of noise policy, a short intermezzo on the Dutch case is presented. Interestingly, policy goals have been adjusted in subsequent National Environmental Policy Plans (NEPPs). In 1989, NEPP1 formulated the goal of “the same percentage of annoyed citizens in 2000 as in 1985.” During the years to follow, higher percentages of noise annoyed people were

TABLE III. Habiforum matrix filled in with examples of soundscape issues.

	Economic importance	Social importance	Ecological importance	Cultural importance
Usability value	Cost of suboptimal soundscapes. Are healthy habits promoted?	Is the balance of privacy and contact with neighbors optimal?	Is the environment suitable for birds? Are parks situated for optimal sensescape quality?	Is the sonic environment characteristic and fitting for the place?
Experiential value	Is the sonic environment conducive for living, work, and tourism? Is it attractive?	Are the audible sounds congruent with user activities? Are social places “social”?	Are birds and other natural sounds audible at desired places?	Are soundmarks protected? Are new soundmarks properly introduced (so that they do not become annoying)?
Future value	Can the soundscape scale with changes of use?	Does the soundscape development match with demographic developments (older people prefer more natural sounds)?	Is ecology sufficiently protected, or is it land waiting for “development”?	Is the soundscape increasing in cultural significance or is it complying with globalization induced uniformity?

found at a municipal level. Although noise reduction had been achieved on highways and railways, the government reformulated the noise policy goals in its subsequent NEPPs. Today's noise policy ambitions are targeted at insulation of dwellings with noise levels of 65 dB from highway traffic and 70 dB from railway traffic by 2020. The goals on the percentage of annoyed citizens, whether due to municipal roads or highways, have been dropped. This is reflected in recent studies stating that in the Netherlands approximately 20% to 30% of the population is annoyed and 8% of the population is sleep disturbed by traffic noise (PBL, 2010; van Poll *et al.*, 2011). These percentages have been relatively stable during the last two decades, and reflect the recurring problems in prioritizing public health vis-a-vis economy, infrastructure, and spatial planning.

The limited performance or goal achievement of Dutch noise policy (from a normative stance) did not result in policy change. An explanation for this stems from the policy domain itself (Weber and Driessen, 2010). Municipalities are responsible for housing and infrastructure as well as enhancing public health and quality of life. However, in densely built cities, because of increasing car use and population, these tasks are challenging. As a result the health based preferred noise limit is frequently exceeded and maximum noise limits are applied as a rule instead of an exception.

In our opinion good governance entails providing healthy living environments, restorative homes, and public areas and in general offering many options for adoption of healthy habits. This means that a shift from a traditional government approach toward a governance approach is needed; or a shift from noise abatement toward soundscape approaches at a European, national, and local level. The implementation of the EU Environmental Noise Directive (commonly abbreviated END) underlines the latter approach in requiring competent authorities to delineate, protect, and manage areas where the sound quality is good. Although local administrations have been struggling with the END's requirement regarding quiet (urban) areas, new paradigms have been introduced and governance practices implemented. A major achievement is that citizens are involved in defining the soundscape of parks, inner courts, squares, etc., and, as such, obtain a voice in local policies and decision-making.

The European regulations described above focus on areas for recreation and restoration, but the current national regulations and policies, which are framed within government approaches, are aimed at dwellings and long term noise exposure in one's home. As mentioned in Sec. I, research have proven that annoyance, sleep disturbance, and other negative health effects are mitigated in situations where long term noise exposure is reduced and lowered below certain noise limits (WHO, 2011). This regulative approach, however, has not been successful in *solving* noise pollution. A substantial part of noise annoyance is explained by so-called non-acoustic factors. Recent studies (Devilee *et al.*, 2010; Kroesen and Bröer, 2009) showed that "having control" of (being exposed to) noise from specific sources is a relevant explanatory factor in people's coping mechanisms. Citizens and users, consequently,

should be given some form of control over local noise policies and urban development.

In line with Adams *et al.* (2006) "there is a disparity between what is being attempted in noise policy—i.e., the imposition of noise levels as determinants of wanted and unwanted sounds—and people subjective response." A participatory approach, well-known in governance literature, is required, in which citizens are involved as "key experts" in urban development. As a consequence other instruments and approaches might be introduced by policy and decision-making actors in regard to the urban development with sensescapes with combination with need satisfaction becoming the dominant paradigm.

V. POSITION OF MAXIMUM IMPACT

The discussion until now focused on Political Science, Psychology, and Urban Planning, as important contributing disciplines for healthier soundscape policies. With acoustics and of course medicine this leads to the emergence of "healthy sensescapes" as a research topic. Of course it is not a new topic. Through the ages everyone has been concerned with the qualities of their living environment and this has always been a social challenge. It is important that soundscape research is positioned so that societal benefits are optimal and further investments are justifiable.

A starting point is that soundscape researchers need to communicate with politicians and the public about the limitations and purpose of noise legislation while communicating the benefits to human health and well-being through the local optimization of sound- and sensescapes. A regularly reviewed, internationally supported research roadmap may be required to secure progress in this area. However, every neighborhood can start with a local optimization process. In fact, many of these processes—with and without the explicit role for sound quality—are already in progress [e.g., Schulte-Fortkamp (2011), and the process in Assen where this article originated from].

Fortunately, "soundscape" is a concept which many citizens and politicians appear to grasp readily, as the aural equivalent of townscape or landscape. There is also wide recognition that policies need to be integrated, that it is cost-effective for an intervention to meet multiple objectives wherever possible, and that human needs should be central. Non-governmental organizations devoted to noise are few and small, and are likely to welcome productive links with larger agendas. There is, thus, likely to be broad support for inter-sensory work. However, if demand for sound- and soundscape advice were to increase, could supply expand quickly enough?

Practitioners have a limited understanding of human responses in all relevant contexts. There are also few practical examples of successful soundscape design interventions. Most soundscape work is relevant to public open spaces, rather than other contexts. Most work has had a focus on a single sense, and there is limited understanding of exactly how one sensory input affects another, and how people prioritize varied sensory needs. The risk is that any rapid increase in the demand for soundscape interventions could

be met by people relying on a shallow understanding; by designers applying a new form of “acoustic perfume;” and by engineers grateful for an apparently cheap substitute where noise control would be more appropriate.

Most psychoacoustic and related research has, of course, been on the negative effects of noise (on annoyance, sleep, cardiovascular risk, etc.), rather than on the totality of human responses to sounds in an inter-sensory context. There is a tendency to underestimate the scale of work required to implement a paradigm shift from noise control to managing sound- and sensescape quality. Many decades of research and practice have, of course, built up a huge interlocking infrastructure of understanding, legislation, and practice based largely on the A-weighted decibel. This may have closed minds. The differing legislative contexts in different countries will also influence how rapidly approaches can change. But they may also foster it because local soundscape optimization is generally (but not always) well within the legislative limits.

Economic recession and public spending cuts in Europe and North America may encourage local practitioners to focus on defending current laws and practices. On the other hand, this may also be an opportunity because effective sound- and sensescape optimization is not necessarily costly. In fact improvement depends more on creativity and communication skills than on costly investments. Response to economic slowdown could include shifts toward lower impact lifestyles. However, the scale of the effort required in implementing a shift from noise to sound- and sensescapes is massive, particularly given the change of mind-set associated with some of the new approaches.

Future steps in soundscape management are likely to include:

- (1) Making future health and current need satisfaction central in soundscape research, urban planning, architecture, local politics, computational audition, public health, etc., including establishing a working hierarchy of soundscape need.
- (2) A larger and more explicit *role of local optimization* through the involvement of all stakeholders, while still ensuring human needs are effectively reflected in international regulation.
- (3) More accounts of listener states and activities, sound qualities and meanings.
- (4) Automated new soundscape quality indicators that take the (likely) impact of the sonic environment on quality of life into account.
- (5) Incremental adjustment of standards, regulations, and guidance.
- (6) Protection, unmasking, and enhancement of positive soundscape characteristics.
- (7) Demonstrating and evaluating soundscape interventions.
- (8) New approaches to sharing acoustic space using ecological principles.

Climate change, the century’s greatest challenge, demands that we live in greater harmony with other living things. Reconnecting with our (local) living environments through all our senses could play a pivotal role in the cultural transformations this will require.

VI. TOWARD MATURE SENSESCAPE POLICIES

There is no magic bullet to solve soundscape problems and to design and maintain ideal sound- and sensescapes. A good city sensescape balances the needs of the whole community while respecting the needs of all individuals. Basically, a good sensescape provides a wide diversity of opportunities for individuals to remain healthy and happy. To help ensure this, a mature local governance in which all stakeholders participate is necessary. One might argue that soundscape processes in which legislation plays a central role is not fully mature because a judge may eventually play the role of a deciding parent. A fully mature process should be able to reach locally optimized results that are not necessarily close to noise policy limits (it might in theory even exceed these on occasion) as long as the overall situation for all involved is (much) better than is possible with any centrally imposed legislation. Note that this is not always possible because some problems might originate from activities that cannot be influenced from the local level.

In good governance a central government provides general norms, such as the current noise legislation, which are aimed at preventing excesses and offer a reasonable level of protection for most. It is the responsibility of local stakeholders to engage in a local optimization process that finds the best way to balance economic and social activities with individual interests and health risks. In the first place, the producers of sound usually provide direct (economic) benefits through activities that are audible by the people who receive no direct benefit. The latter form the second group of stakeholders, whose main responsibility is to contribute to a healthy sound- and sensescape by informing local government and sound producers about tendencies in desired or undesired directions. In turn the role of the third stakeholder, the local government, is to safeguard good local governance by ensuring that the needs of all stakeholders are weighted and taken into account so that the local sensescape remains or becomes healthy, or improves in other ways. This process is currently underway in Assen with soundscape researchers facilitating.

This leads to a new role for soundscape researchers that they may, or may not, accept: Namely to be an avant-garde of a movement that leads to the optimization of local sensescapes in terms of direct enjoyment of the living environment, facilitation of place-related activities, and conduciveness of healthy habits. Of course the benefits of an effectively optimized local sensescape are important since the inhabitants know that the balance between economy and living quality has been addressed. This represents a considerable value for the changed area that may lead to a higher value of property and other benefits. Finally, this may result in higher standards for the (perceived) quality of living everywhere, and eventually healthier living environments. In this way a local optimization of sound- and sensescapes may have a global influence. As such it will give substance to the 24th article of the Universal Declaration of Human Rights by providing “everyone the opportunity to rest and leisure” through soundscaping.

ACKNOWLEDGMENT

This work has in part been supported by the Municipality of Assen and the province of Drenthe (The Netherlands).

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