Getting it together - Interdisciplinary Sound Environment Research

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The recently published report "Burden of disease" from The World Health Organization (WHO) states that health impact of environmental noise is a growing concern both for the general public and politicians and policymakers of Europe.

The so called Environmental Burden of Disease (EBD) are measured in DALY´s - Disability Adjusted Life Years (the sum of potential years of life lost due to premature death and the equivalent years of healthy life lost by virtue of being in states of poor health or disability). The report estimates that 61,000 years are lost in ischaemic heart disease, 45,000 years for cognitive impairment of children, 903,000 years for sleep disturbance, 22,000 years for tinnitus and 587,000 years for annoyance. In other word more than one million life years are lost every year in Europe (WHO 2011).

The novel, if somewhat adventurous, way of measuring the effects of noise on society clearly shows that noise as a public health problem is a growing topic today on the agenda of taking control of environmental threats of modern society. Persistent research from acoustics, environmental medicine and other academic disciplines is now showing results, as this conference shows. Noise awareness can be added to other environmental issues in public consciousness such as climate change, water, air and food pollution and similar threats.

Researchers and laymen involved in the struggle for better sound environments and sound awareness however know that sound environments and disturbance often turns out to be complicated things to handle for many reasons.

INTRODUCTION

The Sound Environment Center at Lund university in Sweden has been the first interdisciplinary research Center created with an aim to especially coordinate research on sound and soundscape issues. The center connects areas of the academic field that often exists in separate worlds and seldom has possibilities to meet or conduct research together.

Ranging from acoustics to medicine and psychology as well as musicology and cognitive studies, soundscape research addresses many interdependent areas and topics. To be able to get a more complete comprehension on soundscape and sound environments, the need for this multitude to be synchronized and be put in relation to each other is put in focus in this center.

Human perception of sound environments and how sound is interpreted by human mind and body is a complex one in itself. As sound is always perceived in combination with other sensory sensations and inputs, studying the reactions to sound in man involves measurements and description of a multitude of qualities, raising a need of quantification of many parameters, including some that have yet to be defined. This goes for the complex perception of quality and character of sounds. The characteristic of the sound environment experience is that it almost never stops at sound alone,

but involves multisensory perception as well makes it all the more difficult to handle scientifically.

The sound environment experience includes the perception of auditive space and perspective to be taken into account, the sonic space in which a certain degree of auditive transparency allows you to hear distant or weak sounds. This can largely affect our sense of orientation and security. One could almost say that sound environments can be a question of democracy in the sense that small sounds must be able to also be heard!

Sound environment studies involves cognitive and emotional aspects and also ethics in our ways of dealing with, and generating sound, reflecting individual and social behaviors. Heavy parts are however about data interpretation and analysis. Especially disciplines like acoustics and audiology are largely dependent on instrumentation, measurement techniques and protocols, raising questions of uncertainties and theory, and standardizations.

Another one of the characteristic issues of sound is the intangibility: when its there, its there and when its gone, it´s gone as if it´s never been there, leaving no scars (if your hearing hasn't got seriously damaged of an extreme exposure, or your blood pressure or stress hormones hasn´t risen as an effect of the traffic outside your bedroom window. The intangibility aside, the costs of noise doesn´t disappear. The more we take into account of prevention and health care that can be related to noise, the costs rises momentarily.

SOUND ENVIRONMENT RESEARCH

A rough list of topics reported on in this conference gives quite a good picture of where sound environment research stands today and the scope of the whole field. This ICBEN conference encompasses some 190 presentations (including poster ones) and a preliminary list of themes includes the following: hearing, health, sleep disturbance, noise dosimeters, hearing in high noise, mp3 listening, transport noise, wind turbine noise, cardiovascular effects of noise, blood pressure, cognitive impairment, room acoustics and work performance, intensive care unit noise, multisensory experience in historical places, health costs, noise policies, noise sensitivity, noise during pregnancy, children health and noise, noise as social determinant, urban soundscapes, hearing loss among classical musicians, hearing and age, vuvuzelas and health risks, acoustics and noise exposure among musicians, hyperacusis, classroom acoustics and fatigue, quiet areas, cardiovascular noise tests on rats, memory and noise, metrology and noise, masking noise, shooting noise, pesticides, noise and farm workers etc. etc.

Each one of these makes perfect sense, we understand easily what is meant, our common everyday experiences clicks in at once. We experience all the topics as relevant, and the list makes the vastness and the scope of this field clear. Back home in our everyday life and in research institutions, however, we are often stuck within our different disciplines.

AN INTERDISCIPLINARY ACADEMIC RESEARCH CENTER

At Lund University in the south of Sweden, a few years ago the thought was born to constitute an interdisciplinary Center for research and information on our sound environment. The Center was designed after a preliminary study made by prof. Henrik

Karlsson (Karlsson 2006). This was a study relying on a lifetime work and engagement in soundscape issues and together with some diplomacy and energy the study managed to convince the vice chancellor to provide funding for *The Sound Environment Center* at Lund University.

The main thought behind this was as mentioned that the complexity of sound environmental research must involve many different perspectives in a wide array of academic traditions and faculties. This goes for both the defining of the problems as well as searching for solutions and answers.

To illustrate the situation with a simple picture: The general situation of how sound environment issues are dealt with by society could be described as large commode with many different drawers (Karlsson 2005). Each one in it´s own way dealing with sound and sound environments. One drawer for traffic noise, one for railway transports, one for toys, one for music and entertainment, one for research, one for architecture etc. etc. The same fragmentation happens in the academic world: one drawer for ethics, one for acoustics, one for health medicine, one for sound design and so on. One for road traffic... and never shall they meet!

Questions of soundscapes, health and noise problems are slowly emerging to a common awareness today. Research and invention are being done on fine detailed levels and must avoid the risk of this fragmentation, and the Sound Environment Center at Lund University in Sweden believes that it is important to do what we can to create and stimulate networks for interdisciplinary research.

ORGANIZATION

The Center has a board of representatives of academic subjects as acoustics, ergonomics, psychology, musicology, audiology, environmental medicine, health economics etc. and has been provided with a three year period of funding at a time for basic functions, such as keeping a coordinator, daily costs of office tasks, printing costs etc. In addition to this, the Center applies separately for funds for the specific research projects to external sources. Administratively the Center belongs to the faculty of humanities and the department of cultural studies, but is independently run.

In addition to the board of the Center, a research reference group has been put together as well as an international group of mentors connected. The Center has also initiated an informal meeting with other interdisciplinary resources at the university and representatives of the industry working with sound environmental problems such as Volvo, Sony Ericsson, Trelleborg and others. It keeps its own website (www.ljudcentrum.lu.se) on the Lund university server and promotes networking in general when and wherever possible. Plans are being made for a local *Sound Environmental Advisory Board* and a *Friends Of The Sound Environment* network open to funding by private persons as well as co-operations. In short the center tries to stimulate collaborations among soundscape researchers, practitioners, and designer/composers to establish knowledge in this emerging area.

The Center has established cooperation with the Swedish counterpart to the International League for the Hard of Hearing, *Hörselfrämjandet,* in promoting the annual *International Noise Awareness Day* in April. Other collaborators to be mentioned are Swedish Noise Network and The Swedish Acoustic Society. The Center was awarded The Swedish Acoustic Society´s Large Sound Prize 2008 for "the innovative mobilization of power the center constitutes with an aim to coordinate and initiate interdis-

ciplinary sound environmental projects with the human being in focus. Though interaction with society and contacts with industry and enterprise knowledge on sound is transmitted for the benefit of human health and well-being."

The Center was evaluated by the university after it´s first three year of activities and was there described as an activity (quote:) "bringing substantial added value to the university". It has recently also received a renewed three year funding for further development of interdisciplinary research that today provides seed money for a line of new projects.

SYMPOSIUMS AND PUBLICATIONS

The Sound Environment Center has since its start arranged a number of interdisciplinary symposiums on specific themes with relation to the study of sound environments. To each one a number of prestigious speakers and researchers has been invited. They have been able to present new research and discuss their findings with each other and a well filled auditorium crossing the borders of their individual disciplines. Recent themes have been: "Noise in the Wind" (Buller i Blåsväder) on wind turbine noise [2011], "Sound Environment Health and city planning" (Ljudmiljö, hälsa och stadsbyggnad) [2010]. Among earlier themes can be mentioned "Sound, mind and emotion", "Sounds in History", "Sound and health", "Sound Design" etc. Each symposium producing a collection of published papers. The Sound Environment Center has published a number of reports on various sound environment themes and topics (Mossberg 2006 - 2011). These can be ordered from center´s website, and are also available as full text pdf-files for download. So far most publications are in Swedish, but a growing number are published in English for international readers (Mossberg 2008; Mossberg 2009).

PROJECTS

The center is by now responsible for a number of ongoing research projects that has received funding from various external sources. Among ongoing and previous topics of study and projects within the framework of the center may be mentioned:

Traffic noise, recreational values and health

Investigating associations between residential exposure to traffic noise, positive recreational values of the natural surroundings, and health, using extensive longitudinal data from a baseline and a follow-up survey combined with Geographic Systems (GIS) data. Some of the major aims are: 1: Improved tools for modeling of exposure to traffic noise and access to positive recreational values, 2) To explore associations between these aspects of the residential environment and neighborhood comfort, physical activity, performance, recovery, overweight and hypertension.

Health effects of simultaneous exposure of airborne particles and noise

Another large project associated with the Center investigates simultaneous exposure of airborne particles and noise and if this can have noticeable combined health effects on humans. This project will involve cooperation of researchers from acoustics, cardiology, laboratory medicine and ergonomics.

As a follow-up to this project a further study in collaboration with researchers from Copenhagen and Gothenburg, will study how noise actually can affect the walls of individual cells on a micro/cellular level.

Speakers comfort and voice disorders in classrooms (Brunskog et al. 2011)

Lead by ass. Prof. Jonas Brunskog of DTU in Denmark this project investigates the stress on voice production by different acoustic conditions with an aim to find guidelines for design of acoustic environments with focus on speakers as teachers and lecturers. The overall aim of the project has been to investigate the voice use of teachers in relation to the acoustic properties of the classroom, and to study whether speakers take into account auditory cues to regulate their voice levels, even in the absence of background noise (Brunskog et al. 2011) This project has received a four year funding from AFA – an insurance institute in Sweden and has as of today produced on dissertation (Lyberg Åhlander et al. 2011) and another one is on its way.

Railway noise at different climatic conditions

A visualization of how noise of trains move through the landscape at different conditions of dampness and temperature – i.e. "atmospheric inversion". This project has resulted in a film of the movement of the actual noise of trains affecting an exposed village close to Malmoe in an open landscape in southern Sweden. The film has been used in discussions with politicians on the planning of new railroad tracks through the area. This project was led by professor in landscape planning Erik Skärbäck at The Swedish University of Agricultural Studies SLU in Alnarp.

Eye movement and cognitive disturbance vs. exposure to noise, sounds and music

Using advanced eye movement equipment at the laboratory of humanities in Lund the project will study how reading and understanding is affected by noise and music, wanted or unwanted (Johansson et.al 2011). This project wants to create a deeper understanding of the reading behavior to background sound. This is a joint interdisciplinary project between cognitive studies, psychology and musicology. The project uses measurements from eye-tracking and GSR - Skin Galvanic Response measures to gain knowledge of cognitive effects of sound exposure, be it noise, music or birdsong.

Sound as sensory Impressions in virtual reality worlds - sound as determinant of orientation in virtual reality

At Ingvar Kamprad Design Center and the institute of ergonomics prof Gerd Johansson will look at how sound interact with the totality of sensory impression in virtual reality environments. This project will involve full scale virtual laboratory technologies in Lund.

Sounds of nature as sounds of well being

Together with the SLU department of Landscape Planning at Swedish University of Agricultural Studies, a new study will look at what happens to sensory awareness when common rooms are fed with "natural" sounds as those of low amplitude bird song och sounds of woods and water. It is easy to treat noise problems as something that would exclusively be an urban phenomenon, but we feel that is equally important not to forget the sound environment in the countryside. Even there the picture might be complex and contradictory.

Sweden might seem like a quiet place in comparison with other parts of the world with lots of reasonably peaceful countryside and a moderately trafficked road system compared to many sound environments in central Europe and otherwhere.

Allowing oneself to generalize rather shamelessly, one could say the large areas of wilderness and rural areas have provided Swedes with solid references to fairly peaceful soundscapes that has made many people notice, hear and worry about the differences between noise and tranquility, and to appreciate natural environmental values enough to miss them when they are gone. "You sure do miss the silence when it´s gone", Robbie Robertsson of the Band wrote in the song "Where do we go from here" in the late sixties and the words still rings true. The land reform in Sweden in the nineteenth century split up the villages in the countryside and resulted in farms and acres scattered all over the countryside. Something that today also have brought about that a lot of noise from the farming industry is scattered all over the land. This makes strong contrasts in sound environmental conditions apparent similarity at the same time, where you are very seldom allowed to forget about noise completely while enjoying tranquility.

CONCLUSIONS

All in all the existence of an experiment like Listening Lund The Sound Environment Center at Lund university within the framework of a resourceful university like that of Lund shows that interdisciplinary collaboration opens up new possibilities and horizons. The university already possesses unique skills and credentials in fields relating to sound, such as acoustics, medicine, working environments, and architecture. Areas that are now brought together and strengthened in a number of research projects and other activities. The Center has been enhanced with closer contacts with related disciplines, potential financiers, and other partners. This work continues, deepens and expands as well as the series of symposiums.

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