

# PROGRESS REPORT ON TEAM 6 RELATED ACTIVITIES

## COMMUNITY RESPONSES TO NOISE

T Gjestland<sup>1</sup>, S Job<sup>2</sup>

<sup>1</sup>Team 6 Chair, SINTEF Telecom and Informatics, Trondheim, Norway

<sup>2</sup>Team 6 Co-chair, University of Sydney, NSW, Australia

**Introduction** There has been very few positive changes in the financial situation for community noise studies. Most studies have been conducted as a result of the actions of groups or organizations with quite narrow noise concerns. The developer of a new airport for instance may be forced to conduct a survey as a result of community protests. Without doing so his main project: building the airport, will not proceed.

Even if there is a lack of long-term desires to build new knowledge about noise reactions among the general public, our research colleagues have in many cases been successful in creating studies that have added to our general knowledge, regardless of the fact that the primary target of a study may have been to "solve" a more limited problem.

There are no signs that this situation will change. It is therefore very important that new studies are properly designed so that they not only provide answers for the problem immediately at hand, but also add to the general knowledge on noise.

**Standardized questions for social surveys** Members of Team 6 have developed a set of *calibration questions* that we urge people to include in their own studies in order to create a synergetic effect. In that way it will become more easy to compare the results from different studies, and to do analysis on the bases of several studies involving a larger number of respondents.

The wording of questions in a social survey is critical. The standardized general-purpose noise reaction questions have so far been translated into ten different languages: Dutch (Flemish), English, French, German, Hungarian, Japanese, Norwegian, Polish, Spanish, and Turkish.

A standardized procedure for establishing the modifiers for a verbal annoyance scale and to translate the standardized questions into other languages has also been developed. We encourage researcher with a native tongue other than those mentioned above, to contact us in order to expand the number of languages.

**New noise limits and guidelines** In 2000 the World Health Organization, WHO, published *Guidelines for Community Noise*. They stress in the introduction that it is not an official WHO document, but never the less these guidelines have been widely used for reference purposes. This is a *good start*, but we also see the possibility that this document (and similar documents from elsewhere) can be misinterpreted or misused.

WHO, for instance, gives a guideline value for outdoor living areas of LAEQ = 55 dB (16 hours) for *serious annoyance, daytime and evening*. This is often interpreted as if levels below this limit must be OK. That of course is not right. In that sense limit values may have a negative effect, if the result is that whatever happens below that limit is of no concern.

The European Union has started work relating to the assessment and management of environmental noise. New directives on noise will have an impact on millions of people across Europe.

In their work the EU has introduced two new noise indices: LDEN and Lnight. LDEN is an equivalent level with a night penalty of 10 dB just like the well known LDN, but in addition there is a four hour evening penalty of 5 dB. We favor this extra weight on the evening hours which are important for recreation and social interaction.

Lnight is the 8-hour equivalent level for the night time period. We applaud the introduction of a special night index, but if the purpose of Lnight is to control noise that affects sleep, the maximum levels should also have been taken into account.

As a first step the EU has started to produce noise maps and to make plans for future noise reduction. The noise maps include people exposed to LDEN = 55 dB and above. For road traffic this is equivalent to LEQ (24 h)  $\approx$  52 dB, which is still too high to include the vast number of people that on the average are *just annoyed* but not necessarily *seriously annoyed*. This can mean that a large portion of the whole community noise problem will not be taken into consideration. On the other hand the EU is also making plans for identifying and for preservation of quiet areas. If these ideas are properly managed, the introduction of any new noise source will have to be carefully considered.

The EU calls for action plans to manage noise issues, but specific limits or standards are left to be decided by each member country. At this point we can therefore not conclude that the new EU noise policy will reduce the noise impact across Europe. We will consider the work a very good start, and the potential for reducing the noise annoyance is definitely within reach.

Norway is, to our knowledge among the very few, perhaps the only country, that has passed a parliamentary act that calls for the reduction of noise annoyance. Interestingly enough, the target is set not as a certain reduction in decibels, but is expressed as a reduction of the annoyance. The annoyance is scored on a scale zero to one, where zero represents no annoyance, and one is very seriously annoyed. The magnitude of the total noise annoyance in Norway, called the annoyance index, is taken as the sum of the annoyance score of every inhabitant. The target for the noise reduction plan is to lower this annoyance index by 25 percent over a 10 year period, a very ambitious goal, indeed. According to recent calculations the annoyance index of Norway is about 600.000. This number can be interpreted as 600.000 people (out of a total of 4.5 million) being very seriously annoyed, or 1.2 million moderately annoyed, etc. The goal is to reduce this index to 450.000.

**Universal dose-response relationships ?** There has been a growing demand for updated dose-response curves for predicting annoyance caused by community noise. Someone will argue that such functions can only be established on a regional basis due to cultural or regional differences, whereas others will claim that such functions are universal.

The first real attempt to establish a general dose-response function for community noise (actually transportation noise) was done by T. Schultz, and published in 1978. Later on the data has been re-analyzed several times, and data from new studies have been included.

The most recent presentation of “global” dose-response functions for transportation noise has been prepared by HME Miedema et al from TNO. Their results are shown in figure 1, annoyance score vs. noise level expressed as DENL (day-evening-night weighted equivalent level). The end points of the annoyance score scale represents “not annoyed” and “very seriously annoyed” respectively. This presentation is not the same as the commonly known curves for “percentage highly annoyed”.

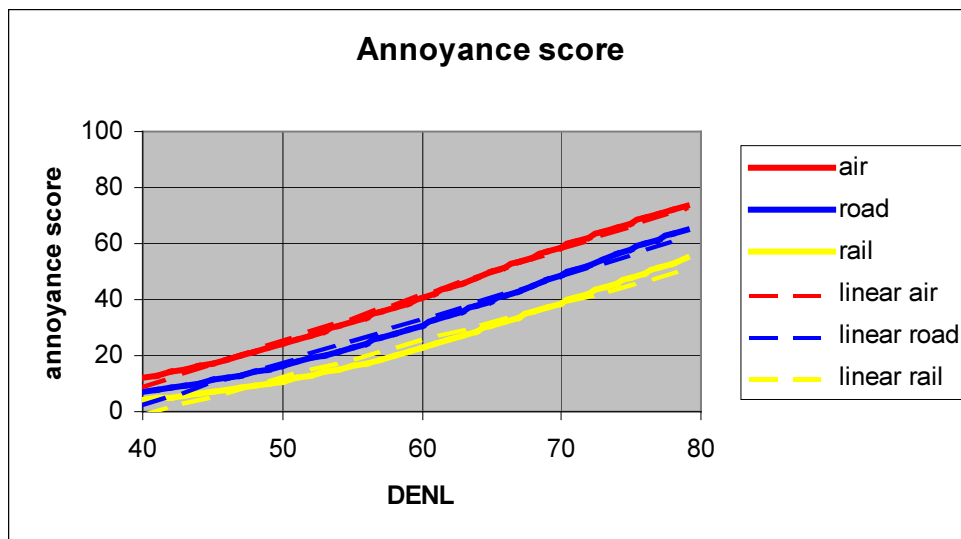


Figure 1 Dose-response curves for transportation noise

The response to noise by a single individual is nearly linear, but different people will have different “starting points” for their adverse reaction, and different “end points”.

The functions presented by Midema et al are valid for noise levels in the range of about 45 dBA to 75 dBA. This range covers the bulk of community noise studies.

In order to facilitate noise planning and comparisons across different noise sources, it may be advantageous to use simple linear functions. The annoyance score functions from TNO can be combined to yield one simple linear function valid for aircraft, road traffic, and rail sources:

$$A = 1.58 (DENL + k) - 62.25 \quad [\%]$$

k is a source dependent correction factor:

k (aircraft) = 6, k (road) = 0, k (rail) = - 6

**International standardization** The revision of the standard ISO 1996 is nearly completed. This standard is the most widely used reference for description, assessment and measurement of environmental noise. Several improvements, based on new knowledge, have been introduced. However, the problem of good objective methods for the introduction of correction factors for impulsive noise and tonal components has not yet been solved in a satisfactory manner.

**Soundscapes and complex interactions** A new dimension has been added to noise research through the introduction of the soundscape concept. The idea has been around for several decades, but lately more and more studies are focusing not merely on simple dose-response relationships, but also on the whole “setting” in which the noise or sounds are perceived. It has been shown for instance that a negative response to noise, i.e. annoyance, can be modified by both acoustical and non-acoustical parameters.

People that feel unsafe due to road traffic are more annoyed than others. Improvements that include traffic safety measures can therefore be an effective way of reducing the noise annoyance, even though the actual noise level remains unchanged. Negative reactions to noise can also be modified by other agents such as dust, fumes, etc. We look forward to see more studies that focus on complex community situations with interaction between noise and other relevant environmental parameters.

A special side of the soundscape issue is studies that focus on the exposure pattern. New studies indicate for instance that people who have access to a quiet side of their house, a quiet back yard or even a quiet nearby park or recreational area, are less annoyed by noise than people without access to such areas. This fact gives the city planner a new tool for reducing the noise annoyance without actually reducing the noise levels.

**Reactions to changes** Most studies on community reaction to noise are considering stable conditions: the noise situation has been stable for a considerable period of time, and the respondent has preferably been living in that area for years.

Sudden changes in the noise situation, such as the opening of a new airport or the introduction of major changes in the road traffic pattern, will cause reactions of a temporary nature. It is generally believed that one will observe an overshoot in the response function, and that this response will change over some time. The effect of the transition type impact is rarely taken into account.

In many cases this type of environmental impact can be rather significant, and we see a need for further research in this area.

**Noise and children** Studies on community response to noise are often limited to a “normal adult population”. Groups with special needs, and groups that are particularly vulnerable to noise can be easily overlooked. Children seem to be at risk. Lately there has been more research on the reactions of children, but again more is needed. This may help us to understand how noise effects children, including cognitive effects which may be mediated by reaction.

**Good noise environment** A noise meeting held in Nice in 2000, with participation of WHO, ICBEN officers, and ICBEN Noise team members, outlines a promising direction for future noise policies. In this meeting it was stated that in most cases current limits specify the difference between barely tolerable and not acceptable. The levels that identify a good sound environment are typically 10 – 15 dB below these values.

The following statement was issued from that meeting:

A supportive sound environment should promote health and is therefore characterized not only by the absence of disease or infirmity, but it is an environment that provides complete physical, mental and social well-being.

It should trigger good feelings, safety and positive and desirable activities. All groups of people and their respective environments should be of concern.

It should support sustainable development and generate benefits such as:

- improved health, productivity and performance
- lower health care costs
- improved educational conditions
- better sleep
- enjoyable perceptions of natural and man-made environments and music
- orientation in space and time
- lowered aggressiveness

A supportive sound environment should strengthen sustainable development and promote:

- health and rehabilitation
- safety
- social interaction as well as privacy

- sleep, rest, recreation and psychological restoration
- education, learning, and creativity
- performance and productivity
- esthetic values and perception
- orientation and personal confidence

In order to guaranty these rights to everyone, a supportive sound environment should support vulnerable groups such as hearing impaired persons, infants, etc., and it should not be in conflict with other demands on health and well-being.

It should be emphasized that the present situation in most places is far from ideal, but a *good* sound environment is within reach. Its achievement is a long term project. The ideal situation can be reached at low or no additional costs through careful planning.