Research on community response to noise – in the last five years

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GENERAL

There have been few significant research projects on community response to noise during the last five years. Funding has been limited. However, there has been some activity, especially in the following areas:

- some new social surveys, notably in Asia
- re-analysis and meta-analysis of existing survey data
- laboratory studies on the micro-structure of annoyance issues
- attempts to establish a firm link between annoyance and health
- development of the soundscape concept

New social surveys

Several new surveys on annoyance reactions to transportation noise have been conducted in Japan. These surveys seem to confirm that the annoyance response is source dependent, as stated by Miedema and Vos (1998). However, the responses are different from those adopted by the EU.

Yano et al. (2007) have studied the response to road traffic, rail and aircraft noise in Japan (see Figure 1). Their results seem to confirm the Miedema and Vos (1998) relationship for road traffic noise, but they report a much higher annoyance due to aircraft noise. Their results also show that noises from railroads are more annoying than noise from road traffic.

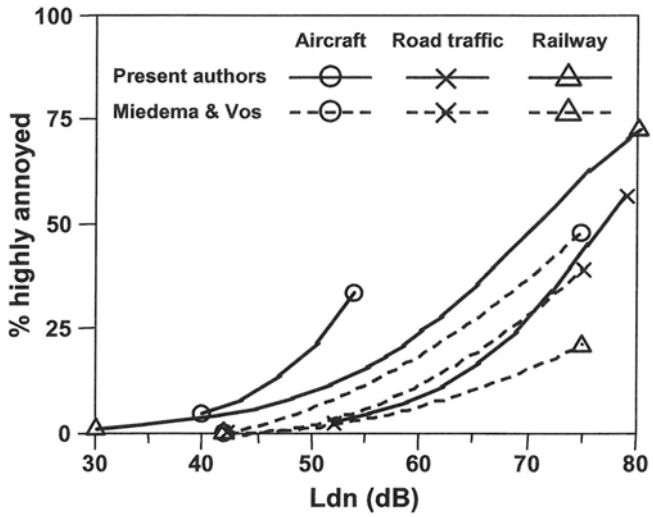

Figure 1: Dose-response functions reported by Yano et al. (2007)

Similar results have been reported by Ota et al. (2007) (see Figure 2). They have found that the response to conventional railroad noise and road traffic noise is quite similar, whereas noise from high speed trains, the Shinkansen, cause reactions similar to aircraft noise. There is no indication of a so-called “railroad bonus” in Japan.

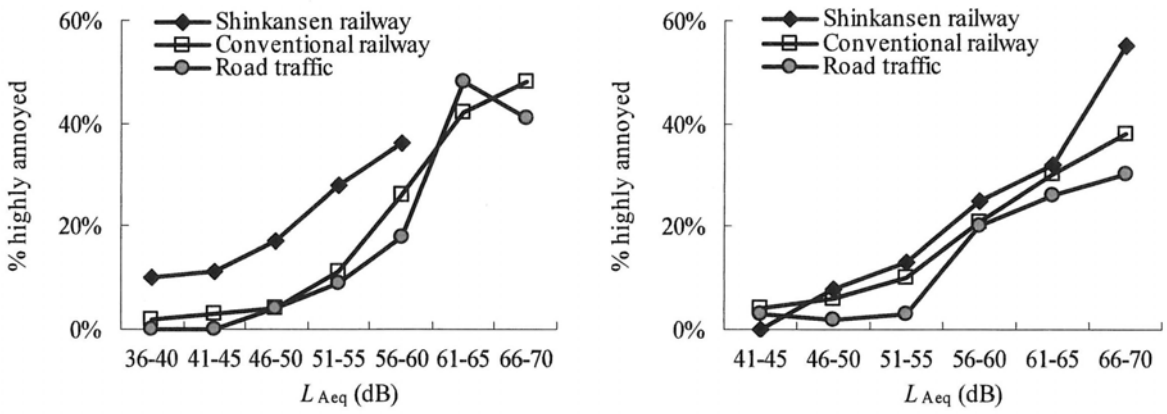

Figure 2: Dose-response functions reported by Ota et al. (2007). Residents living in detached houses (left) and apartment buildings (right)

Phan et al. (2007) have studied the response to road traffic noise in Vietnam (see Figure 3). The results are similar to those reported by Miedema and Vos (1998).

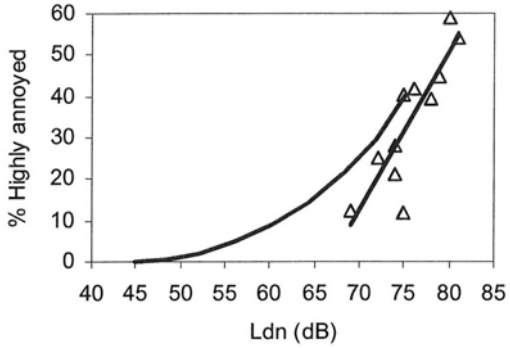

Figure 3: Dose-response functions reported by Phan et al. (2007, straight line) compared with function reported by Miedema and Vos (curved line)

The results from new surveys indicate that existing, commonly used, dose-response functions need to be updated. The issue of railroad bonus is quite controversial. ISO 1996 specifies that the bonus should not be applied to trains at higher speed than 250 km/h. The Miedema and Vos curves have a railroad bonus of about 6 dB, and no restrictions on train speed.

Similarly new surveys on aircraft noise yield in general higher annoyance scores than older studies. One possible explanation is that “the equivalent level does not tell the full story”. For aircraft noise, in particular, the exposure situation has changed significantly over the past ten years. The aircraft have become more quiet, and more aircraft movements are required today to produce the same equivalent level as with the older ones. Some authorities therefore recommend supplementary metrics, for instance N75, to describe a certain aircraft noise situation.

An alternative noise metric

It is an often forgotten fact that one “does not hear an equivalent level”. In a community noise setting, the noise is perceived as a series of more or less distinct events. In most cases the annoyance refer to an indoor situation. An assessment based on indoor maximum levels may be a possible supplement.

Consider the most recent set of data from surveys on aircraft and road traffic noise. For simplicity we may use the following equations:

Aircraft: Lmax ≈ Leq + 15 dB
Road traffic Lmax ≈ Leq + 10 dB

If we assume 25 dB facade attenuation, the original data set in Figure 4: annoyance versus outdoor LEQ, can be transformed to the data set in Figure 5: annoyance versus indoor maximum levels. The two linear trend functions will nearly coincide, and the annoyance functions appear virtually source independent. The onset of annoyance is between 40 dBA and 45 dBA, which is when a noise event is clearly audible in a typical indoor setting. A more detailed analysis of existing survey data along these lines may be well worth trying.

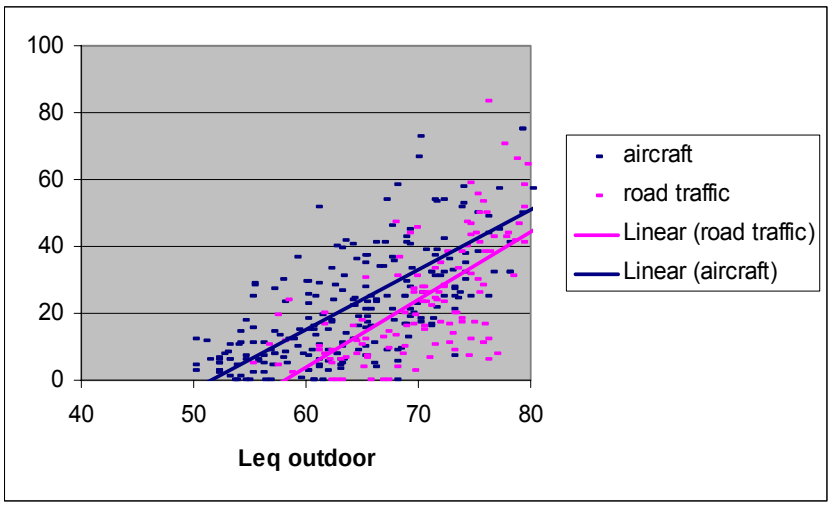

Figure 4: Annoyance versus outdoor LEQ

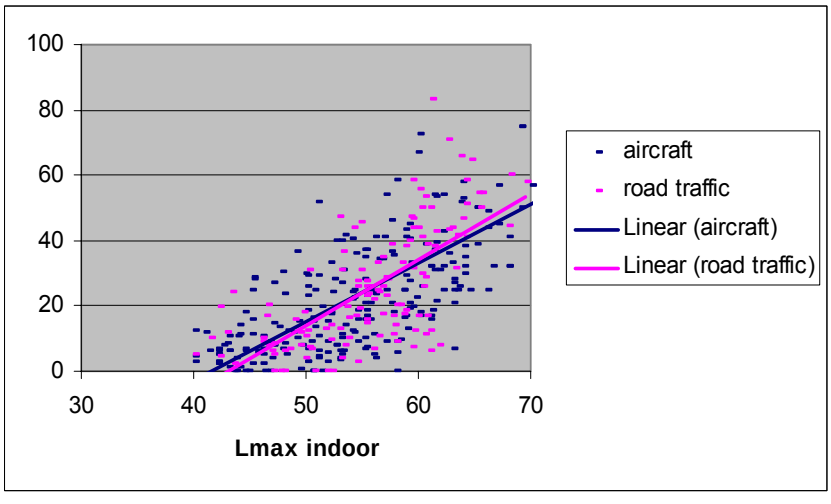

Figure 5: Annoyance versus indoor maximum levels

Dose-response functions

Miedema and Oudshoorn (2001) performed a re-analysis of 47 different surveys on transportation noise. Their results, which were later "adopted" by the EU for noise assessment according to the Directive 2002/49/EC (2002), are shown in Figure 6.

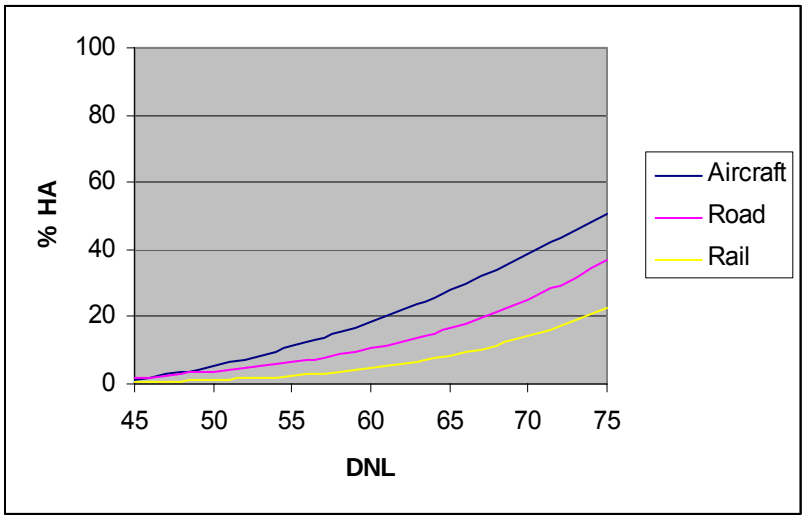

Figure 6: Dose-response functions for transportation noise according to Miedema & Oudshoorn (2001): percentage highly annoyed versus L_{DN}

The dose-response functions for aircraft, road, and rail are distinctly different, and separated by approximately 6 dB. This corresponds to a 6 dB "rail bonus" and a 6 dB "aircraft malus" compared to road traffic noise. These differences are not constant, as the three dose-response functions are different (and not only shifted sideways).

The revised international standard ISO 1996 – Part 1 (2003) suggests another dose-response function. This is the "original" Schultz' curve. The standard has a table for source dependent corrections. Aircraft noise levels are corrected "3 to 6 dB" relative to road traffic noise and the railroad bonus is also defined as "3 to 6 dB".

Figure 7 shows a comparison of the Miedema and Oudshoorn (2001) function for road traffic noise (adopted by EU) and the corresponding function suggested by ISO. The difference between the two is greatest around L_{dn} 60 dB, about 3 dB. The difference for railroad and aircraft can be much greater depending on the choice of correction factor.

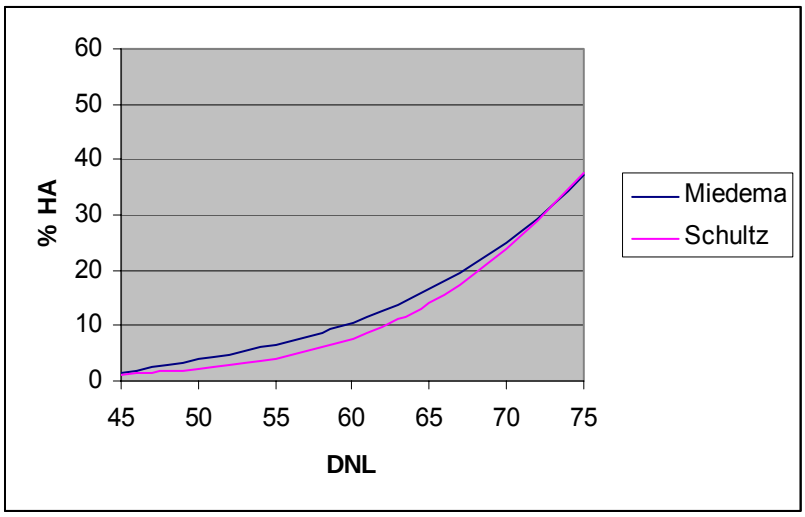

Figure 7: Dose-response functions for road traffic noise used by EU (Miedema & Oudshoorn 2001) and ISO 1996 (Schultz 1978)

The American standard ANSI 12.9 – Part 4 (2003) specifies yet another dose-response function. This standard uses the same function as ISO 1996, but the cor-

rection factors are different. There is no railroad bonus, and the aircraft noise penalty varies between “0 dB” and “5 dB”.

In other words, three recognized parties use three different dose-response functions for assessing the annoyance from transportation (and other types of) noise. And these dose-response functions are based on more or less the same set of data.

It would be desirable if the relevant parties joined forces and developed a single set of assessment functions.

Annoyance and the micro structure of noise exposure

There have been several studies, in particular in connection with the EU-funded SILENCE project (www.silence-ip.org), on the importance of the micro structure of the noise exposure situation. It is recognized that the equivalent level is not “telling the full story”. Different traffic noise situations with the same LEQ, may be assessed differently with respect to annoyance. This is important information for people who try to reduce the negative impact of road traffic noise through various traffic management measures.

Laboratory experiments have shown for instance that:

- an even flow of traffic causes the same annoyance as if the vehicles are clustered, but an even flow is more damaging to mental performance than clustered traffic,
- a large difference between LEQ and Lmax is more annoying than a small difference,
- trams should receive a 3 dB “bonus” compared with busses,
- different noises from a rail yard at equal LEQ may have a subjective difference of as much as 5 dB.

This is another indication that the “equal energy principle” should be challenged in future studies.

Annoyance and health

Community noise is often ignored by politicians and decision makers because it cannot “compete” with other pollutants. The fact that people “are annoyed” is often regarded not so serious that one needs to take any action.

Good health, as defined by the World Health Organization (WHO), implies a “state of complete physical, mental, and social well being”. Annoying noises are therefore per definition unhealthy.

WHO is now including noise annoyance in their document “Burden of disease”. Annoyance will be rated along with other negative health factors, and will be given a specific “weight” that can be assessed in the same way as other “ordinary” diseases.

Soundscapes

The soundscape issue has been growing in momentum. This is yet another indication that “LEQ is not sufficient” for describing a noise situation. Important results have been presented, for instance as part of the Swedish project “Soundscape Support to Health”.

One important finding, for instance, is that the annoyance experienced by a person is not only dependent on the noise level at the most exposed facade of the residence. The annoyance can be reduced if the residence also has a quiet side, and the person

has access to this side. By careful city planning it is therefore possible to reduce the overall annoyance experienced by the residents, without actually reducing the total noise emission.

The soundscape issue looks promising, but so far it has been difficult to express the ideas in quantitative terms. It is therefore not yet possible to apply the soundscape idea for regulatory purposes.

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