

Summary:

Combined environmental effects of road traffic

In 1998 a strategic trans-institutional Norwegian Research Council programme (SIP) *Combined effects of road traffic* was established. The Public Roads Authority, Ministry of Transport and Communication and Ministry of Environment, were responsible for the initiative and allocated € 0.7 mill to the programme.

An important task was to investigate more closely why exposure-effect relationships failed to predict people's responses. One hypothesis was that environmental exposures could have combined effects and work synergetically thus producing what we have dubbed an *Area-effect*.

As noise, air pollution and other environmental exposures are usually dealt with separately in research as well as in praxis, a novel approach was warranted. The task undertaken in the SIP was therefore to analyse the combined effects of road traffic and establish exposure-effect relationships adapted to different situations. This report summarises the most important results in a format tailored for a broader audience than the scientific papers that the programme has resulted in.

Community survey data base

As part of the research programme a community survey database comprising 19 000 respondents from 17 community surveys and 50 sub-areas, has been established. Exposure estimates calculated on the basis of noise, air pollution or vibration modelling are available for about 8 000 respondents. The exposure indicators are of good quality and offer a good spread of values. They are thus ideal for analysing combined effects, and the modifying effects of interview period, city area, impact of demographic variables etc.

Standardisation work

To compare the results from different surveys a standardisation of measurement and calculation methods have to be undertaken. The programme has thus contributed to the establishment of a new Norwegian Standard for the measurement and assessment of vibration in dwellings from road and rail traffic NS 8176. The research programme has contributed to standardised question formats for use in future socio-vibrational surveys, Nordtest Method, NT ACOU 106. Members of the SIP also made contributions to a technical specification

ISO/TS 15666:2002 on the assessment of noise annoyance in socio-acoustic and social surveys.

Noise, air pollution and health

With respect to the relationship between traffic and health, focus is usually on mortality, sickness and trauma. But the concept of health also encompasses physical as well as social and psychological well being. The programme focusses on these less serious aspects of the environmental exposures such as annoyance and disturbances.

With respect to self-reported health questions, our research show that individual differences such as age, gender, smoking behaviour, chronic disease, are the most important variables. For analyses of annoyance reactions, it is the environmental exposures that are the most potent variables. However, self-reported sensitivity is important for the degree of environmental annoyance.

Combined effects shown

Road traffic gives rise to environmental exposures such as noise, air pollution, vibrations and the risk of accidents. These environmental exposures are perceived as annoying and also lead to insecurity. The analyses take the relationship between these environmental exposures and annoyance as a departure point for studying combined effects.

Important results are

- Sensitivity to environmental exposures play an important role. However, combined effects are still present when analysing "robust" persons.
- Road traffic noise does not alone account for people's noise annoyance while air pollution alone does not explain people's annoyance with dust/grime or exhaust/odour.
- When people are exposed to several environmental exposures, they become more annoyed than when exposed to a single.
- The whole neighbourhood plays a role, not only exposure at people's apartment.
- Traffic reductions lead to better neighbourhood soundscape than apartments exposed to similar noise levels in before the traffic reductions.

When the noise exposure in the neighbourhood is

not taken into account, but only the noise levels in front of the apartments most exposed facade, the environmental problems will tend to be underestimated. Apartments shielded by distance or intervening building structures from a main road, seemingly have a very low noise exposure. However when residents leave the apartment for shopping, visiting friends and neighbours, playing or taking a walking or cycling trip, they encounter the high noise levels associated with the major road.

The results from the research programme indicates that this exposure also plays a role for noise annoyance when in- and outdoors at home.

Dynamic relationships needed

Exposure-effect relationships (dose-response) are important tools for the authorities. They tell how strongly people react to different amounts of noise, vibrations and air pollution. Together with environmental mappings, they can be used to define problem areas and need for improvement.

The results from the research programme implies that for planning purposes and for environmental improvement programmes it is necessary to utilise different exposure-effect relationships depending on whether we have a single-exposure or multi-exposure situation.

In multi-exposure situations, measures targeting a single exposure will have less effect than static exposure effect relationships promise, while multi-improvement packages may provide larger effects than static exposure-effect relationships indicate.

In single-exposure situations single measures targeted towards the specific exposure may have better effect than static exposure effect relationships indicate because the static exposure-effect relationships are estimated on the basis of data with multi-exposure situations mixed in.

Ignoring combined effects mean that cost benefit analyses and societal benefit analyses become faulty. The authorities therefore risk taking actions that prove little effective and may neglect to put into operation measures that are cost effective. By taking combined effects into account, exposure-effect relationships can better be used also for prediction of dynamic changes, such as traffic reductions, noise insulation programs or other measures. This will provide a substantially improved input to cost benefit analyses.

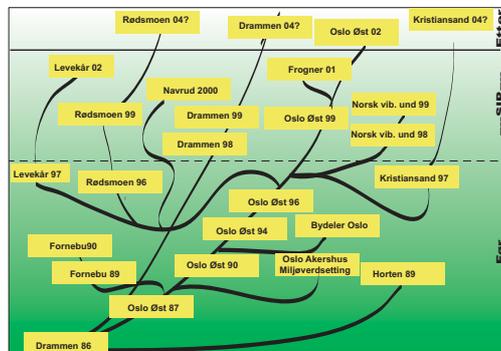


Figure S.1: Community surveys before, during and after the strategic institute programme. The programme builds upon as well as serves the separate survey research projects.

The effects of the multiple improvements with regard to road traffic noise, insecurity, air pollution etc. resulting from traffic reductions as the result of bypasses or environmental tunnels can be eight times as high as when the noise level is reduced.

Som results from the research programme are:

- Packages of measures targeting not only the situation at the residence but the whole neighbourhood will have greater effect than spot efforts.
- Environmental improvements targeting larger areas such as environmental zones will have better effects than spot efforts.
- In addition to targeting black spots, "grey" areas with intermediate environmental exposures need to be improved.
- Local authorities must seize the opportunity road construction and bypasses provide to restrict traffic in areas that are relieved of traffic. by downsizing and environmentally upgrading former major streets, twice the environmental benefits can be harvested.
- Measures targeting the noise source (vehicles) tyre/road surface noise will have better effects than targeting single houses with noise insulation.