Changes in the Sound- and Urbscape following Traffic changes in Oslo East

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Introduction

Finding means to adequately describe and model the multiple contexts of noise annoyance - the Environ-, Sound- and Psychscape (Job & al 1999) and their interconnections - are perhaps the most important tasks in noise annoyance research today.

Our previous efforts have mainly dealt with changes in the Environ- (or Urbscape) following traffic changes. We have shown that when a bypass caused traffic flows to change dramatically in a town area in Oslo East, that the town area changed character not only with respect to road traffic noise but also with respect to vehicular air pollution and residential traffic levels (Kolbenstvedt & al 1999). While changes in the 24h equivalent continuous sound pressure levels ($L_{pAeq,24h}$) took place on a logarithmic scale, changes in the other environmental effects of road traffic followed different scales and were thus disproportionally larger than the noise changes.

Previous research has shown that in situations where road traffic changes, noise annoyance changes more than one should expect. Psychscape processes have been thought to be responsible for the effect (Raw and Griffiths 1990). We were also able to show this effect for sub-areas in Oslo experiencing traffic reductions. However as we had showed that people exposed to higher levels of vehicular air pollution were shown to react more strongly to road traffic noise (Klæboe & al 1999) we provided an alternative hypothesis concerning what we saw as an area-effect. The disproportionate changes to the area (large air-pollution and road traffic levels) were responsible through their modifying effect on noise annoyance (Klæboe & al 1998). This paper deals with changes to the Soundscape as part of such an “area-effect”.

The first part of this paper focuses on changes to the Soundscape following the changes in traffic while the second examine whether the noise neighbourhood plays a role in predicting road traffic noise annoyance at people’s apartments.

Description of study area

The study area is located in Oslo East where the re-routing of the E6 by means of a bypass and two tunnel projects provided an ideal quasi-experimental set up for studying the environmental changes to the town area. Three socio-acoustic studies with 1000 respondents each were undertaken in the autumns of 1987, 1994 and 1996. The surveys have eight common sub-areas with uniform building types of mostly brick houses 2 to 4 stories high.

Method

24h equivalent continuous sound pressure levels were calculated in front of the most exposed side of each respondent’s apartment utilising the Nordic method. Two sets of calculations were provided. One set for the dwellings of the respondents in each survey. The second set was based on the 1996-survey respondents’ dwellings, with retrospective calculations for each of the traffic situations in 1987, 1989, 1994 and 1996. This ensured that the same version of the Nordic calculation method was used and that the imission points were held constant. For both data sets a geographical information system (ArcView 3.2) was utilised to obtain the maximum $L_{pAeq,24h}$ value for apartments of other respondents living within 75 meters.

The changes to the Soundscape were described by these neighbourhood maximum $L_{pAeq,24h}$s relative to the $L_{pAeq,24h}$s at each apartment.

Multiple monotonic regression models (Magidson 1998) were used for assessing whether the neighbourhood maximum $L_{pAeq,24h}$ play a role in explaining noise annoyance in addition to the $L_{pAeq,24h}$ at the apartment.

Results

Analyses of both data sets (for each survey and retrospectively) show that neighbourhood maximum $L_{pAeq,24h}$s are significantly and substantially lower relative to exposure at the apartment in sub-areas experiencing noise reductions . – See figure 1.

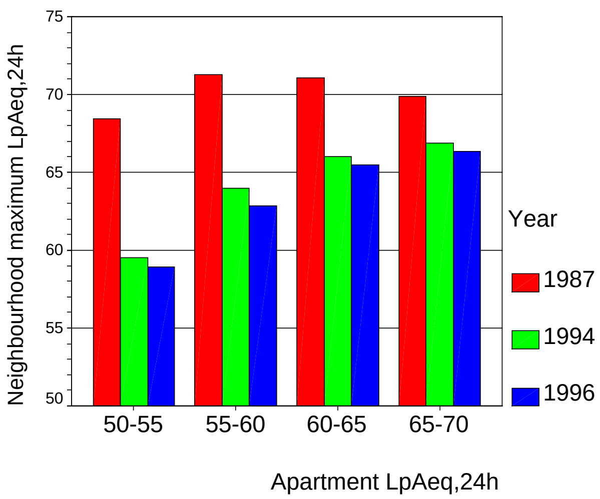

Figure 1: Maximum neighbourhood $L_{pAeq,24h}$ within 75m at given levels of noise exposure $L_{pAeq,24h}$ at apartment. Data for each survey year for sub-areas 2-8. N= 713, 549, 543.

Changes to the Soundscape are thus part of how a town area changes character as a result of traffic changes.

The differences between the neighbourhood maximum $L_{p\mathrm{Aeq,24h}}$ and the $L_{p\mathrm{Aeq,24h}}$ at the apartment were entered as a variable in monotonic regression models. The results for outdoor annoyance show that this variable is about half as influential as the $L_{p\mathrm{Aeq,24h}}$ at the apartment for explaining noise annoyance – See table 1.

Table 1: Parameter estimate and fit statistics for monotonic regression models for degrees of annoyance with road traffic noise while right outside apartment. N≈2000.

	L^2(Y)	df	p-value	Beta	exp(Beta)
LpAeq,24h	111,4	1	4,80E-26	0,30	1,34
Noise sensitivity	103,09	2	4,10E-23	2,57	13,04
LpAeq,24h Neigh - LpAeq,24h	32,3	1	1,30E-08	0,14	1,15
3-month NO2 periodic mean	17,98	1	2,20E-05	0,09	1,09
AADT 1000	1,95	1	0,16	0,04	1,04
Survey year	14,77	2	0,00062	1,17	3,22
Age group	14,51	3	0,0023	0,82	2,28
Married/Cohabiting	2,52	1	0,11	0,28	1,33
Child under 10	1,76	1	0,19	0,33	1,40
Decile Fit	6,63	8	0,58		

Age group, married, child under 10, noise sensitivity and survey year are categorical. 3-month periodic averages of hourly-calculated NO_2 values in $\mu g/m^3$ based on a combined line and area model are used as a general air pollution indicator. Residential road traffic AADT is level in thousands at apartment + 50% of max traffic volume within 50 meters.

Living in a noisy neighbourhood thus increases annoyance at the apartment. (Also for indoor annoyance – results not shown here). The results reconfirm that air-pollution play a role in explaining road traffic noise annoyance while road traffic volume is no longer significant in this run. Model fit is acceptable. Both Sound- and Urbscape changes can thus be seen to be responsible for an area-effect.

Discussion

Both the Urb- and Soundscape change significantly as the result of traffic changes and can both be seen as providing an area-effect through their modification of simple noise exposure-effect relationships. To determine the relative contributions of different elements of the Urb- and Soundscape, it is however necessary both to have more precise descriptors of these elements and provide better indicators of how they are perceived and reacted to. Better indicators than merely road traffic levels are needed to describe the traffic environment causing insecurity. Visual aesthetics also play a role (Kastka and Noack 1987) and aesthetic improvements will follow traffic changes.

The relationships described here are lacking in that they do not show the different Psychscape pathways that might be involved in bringing out the area-effect. Ambient stressors (Campbell 1983) share the characteristics of being chronic, non-acute and intractable. Coping activities may thus tax the same type of psychic resources or result in attitudinal changes affecting several annoyances. It is necessary to know more about the meaning of different noise sources (Schulte-Fortkamp 1999). People might also be generally sensitive to environmental stressors (Winneke, Neuf, and Steinheider 1996). Research taking into account noise contexts show up the inadequacies of simple models without yet providing more comprehensive alternatives. This is unfortunate but unavoidable. Before simplifying the complex, it is necessary to complicate the simple.

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