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## COMMUNITY RESPONSE TO CHANGES IN RAILWAY NOISE EXPOSURE - A REVIEW

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### ABSTRACT

As background to the noise impact assessment of the proposed Airport Rail Link in Melbourne, Australia, a review was undertaken of studies into community response to changes in railway noise. There appear to be very few such studies. The types of change investigated included increases in the number of trains per day, changes to the type of rail vehicle used (faster, newer, etc), noise reduction due to grinding of tracks and the introduction of a new railway line where none existed previously. It is difficult to draw conclusions from such a small number of studies, but it appears possible that the initial community response may be relatively short-lived (compared to say, road traffic noise) and that community perceptions (before the change) of the future noise exposure may influence community concerns about noise after the change occurs (possibly similar to other forms of environmental noise). Results from a survey of residents potentially affected by changes in noise exposure to due the Melbourne Airport Rail Link are also discussed.

### INTRODUCTION

Community exposure to rail noise can change relatively quickly when a new railway line is built where none previously existed or when changes occur to existing lines which result in a change in noise exposure. Changes on existing lines which can result in the change of noise exposure include change in service frequency; extension of rail service into new time periods (eg at night); track maintenance such as grinding tracks; vehicle maintenance; replacement of existing rail vehicles with new vehicles having different noise characteristics; and addition of noise control measures to existing lines. I have reviewed the current literature concerning community response to changes in rail noise exposure, with particular emphasis on two questions:

- Is the level of annoyance different from the steady-state condition?
- If the community response is greater than for the steady state condition, how long does this exaggerated response persist?

Rail noise is known to be less annoying than other forms of transport noise such as aircraft or road traffic [1, 2]. This may explain, to some extent, why there appear to be relatively few studies of community response to changes in railway noise exposure.

## STEADY-STATE NOISE EXPOSURE AND COMMUNITY ANNOYANCE

Dose-response relationships have been developed describing the relationship between community annoyance and exposure to transport noise [2]. It appears that the studies upon which such relationships are based have not been filtered to exclude studies in areas where there has been a recent change in noise exposure. However, it is likely that such changes in noise exposure are relatively infrequent and the dose-response relationships are generally considered to reflect the “steady-state” situation where the community has predominantly been exposed only to gradual changes in noise exposure.

## COMMUNITY RESPONSE TO CHANGES IN RAIL NOISE EXPOSURE

The following is a brief review of the studies I was able to locate, focusing primarily on the proportion of the community who were highly annoyed with the noise (%HA). Note that where the results were not recorded in terms of %HA, I have, if possible, converted the results into %HA using data in the reports or provided by the authors.

**The "new infrastructure" effect.** This study [3] re-analysed data from French socio-acoustic surveys, grouping the responses according to whether the residents were affected by noise from new infrastructure (road or railway built less than 5 years ago, while respondents were resident) or existing infrastructure (road or railway built more than 10 years ago). The "new infrastructure" effect (the difference between community response to noise from new infrastructure and community response to noise from existing infrastructure) was generally much greater for road traffic noise than for noise from railways. In fact, for railway noise the new infrastructure effect was only a few %HA for daytime noise levels ( $L_{eq}$  8am-8pm) less than 67dBA. Above 67dBA however, the effect was highly marked with %HA near new infrastructure more than 30 percentage points higher than near existing infrastructure.

**Kungsbacka, Sweden.** This railway line was expanded in 1992 with a second track for a shuttle service. The new track was laid within the existing rail reserve [4].

Prior to the changes, the railway line carried a total of 59 trains per day (34 passenger trains and 25 freight trains). Among other investigations, the study compared two areas [5]. In area E there was no change and in area A, where the new track was laid, there were an additional 90 passenger trains per day. In both areas over 100 residents were interviewed about 3 years after the changes. Before the changes, the  $L_{eq}$  noise levels were in the range 45-65dBA [6].

The %HA in area E was 7.5%, and in area A, after the additional 90 trains per day were added, the %HA was 8.9% [7]. This difference (expressed as mean annoyance, not %HA) was found to be statistically significant [4]. However, as this component of the study is not longitudinal, the difference in annoyance may be due to non-noise-related factors such as demographic dissimilarities.

There was a “before” survey undertaken in area A. However, prior to the additional trains, the %HA was 18.9%. This was probably due to anticipation that the noise disturbance would be greater than it actually was [7].

The steady-state response to rail noise exposure in the range 45-65dBA would be about 2%-10%HA [2].

**Zoetermeer, Netherlands.** In May 1977, a new railway line became operational. In one of the few true longitudinal studies found, over 200 residents were interviewed 2 months before, 4 months after and 18 months after the line became operational [8]. Figure 1 shows the level of community annoyance plotted against the noise level, together with the curve [2] for steady-

state community annoyance. It can be seen that four months after the opening of the railway line, community annoyance is very much greater than would be the case for long term noise exposure.

Eighteen months after opening, community annoyance at lower noise levels has dropped considerably while at higher noise levels the %HA has only dropped 3-4%. Note that these figures are for people who were living in the area at the time that the new railway line was built. For a small group of 15 newcomers who moved into the area between 4 months and 18 months after the railway line opened, the %HA at 18 months was 0%.

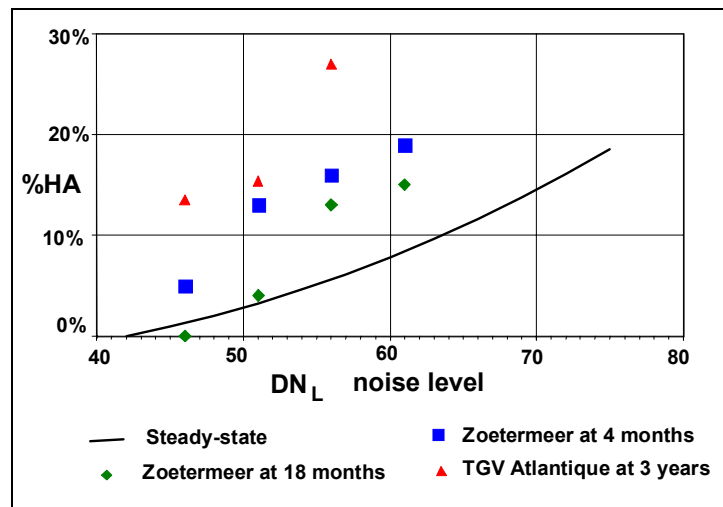


Fig.1. Results at Zoetermeer [8] and TGV Atlantique [11] compared to steady-state response [2].

**London, England.** When the Docklands Light Railway opened in 1987, community reaction was far greater than expected. This study [9] attributed the exaggerated reaction to aspects of the noise exposure such as the noise levels (higher than for older railways in the area) and noise character (due to low frequency noise radiated by elevated structures). Nevertheless, this study provides a fascinating (and entertaining) account of the ways in which the community expressed their anger, including an impromptu street meeting occurring in response to the presence of investigators taking noise measurements and an offer to the investigators of a one-way trip to the “dump” from garbage truck drivers.

**Munich – Salzburg railway, Germany.** By early 1995, the rails on the Munich-Rosenheim-Salzburg railway line were in poor condition and were badly corrugated. During the northern hemisphere summer of 1995, the rails were ground to remove the corrugations and restore a smooth rolling surface. This achieved a reduction in  $L_{eq}$  noise levels of 4-7dBA for freight trains and 6-12dBA for passenger trains, giving an overall noise reduction of 7-8dBA [10].

The study had a longitudinal structure. Residents were surveyed a few months before, a few months after and a year after the rail grinding took place. Community annoyance decreased significantly after the rail grinding and remained low for the first year. However, the results could not be converted into %HA, and cannot be plotted against the steady-state curves. The improvement was less significant when expressed in terms of specific effects. Sleep quality, for instance, was reported as slightly worse after the rail grinding.

**TGV Atlantique railway, France.** A comprehensive survey of residents’ attitudes was undertaken in 1993, 3-4 years after the opening of the TGV Atlantique [11]. As shown in Figure 1, levels of annoyance were much higher than the study-state curve. This may be because high-speed (300kmh) train noise is more annoying than conventional train noise, but is also likely (in part, at least) to reflect the community response to the change in noise exposure. According to one of the authors, it was observed that the exaggerated response may also be due to the attitude of the residents (at that time, the TGV was perceived as a luxury product for wealthy businesspeople) and to the poor quality of the communications between the residents and the French railway authority [12].

**Hannover – Berlin railway, Germany.** A study of the reactions of residents to the building of a new railway line and to the extension of existing railway lines is currently being undertaken [13]. So far, there is only one area where “after” surveys have been completed. In this area, the change in noise exposure was due to the replacement of existing trains with new ones. The noise levels were essentially unchanged and it was found that there was no significant change in annoyance. This is despite relatively high levels of mistrust and “future expected annoyance” reported by residents prior to the changes. In fact, this study provides an interesting insight into the relationship between community concerns prior to the changes and community effects (such as annoyance) after the changes.

**Discussion.** It appears that there is no reason to doubt that, similar to other forms of transport noise, there is an exaggerated community response to noise when railway noise exposure changes. However, it is clear that further research is needed in order to better understand the magnitude and the duration of the exaggerated response.

### MELBOURNE AIRPORT RAIL LINK

**URS Australia**, as part of the social impact assessment for the Melbourne Airport Rail Link [14], undertook a survey of residents’ attitudes near two railway lines in Melbourne that were potentially to be affected by significant increases in rail traffic had the Rail Link gone ahead. Several of the questions on the survey [15] concerned residents’ attitude to existing railway noise. When asked to rate on a scale how annoying railway noise was, 19% of respondents living next to the railway stated that they were “very much” annoyed.  $L_{DN}$  noise levels of 58-67dBA have been measured near these railway lines. According to the steady-state relationship, community response to railway noise would be about 7-13% highly annoyed at these noise levels. Either the term “very much annoyed” is milder than the term “highly annoyed” or the existing level of community annoyance may be 2-3 times higher in Melbourne than estimated from the steady-state relationship. This level of annoyance only occurred at residences immediately adjacent to the railway line. In the second row of houses and beyond, annoyance was considerably less (4-6%HA), and did not vary with distance from the railway line, even out to distances of several hundred metres.

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