

Forty-five years of surveys on annoyance from road traffic noise

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ABSTRACT

The Miedema & Vos curve for predicting road traffic noise annoyance was based on 18 different surveys conducted over a period of 9 years. The curve was developed using a statistical regression technique. An extended analysis comprising 46 surveys conducted between 1969 and 2013 yields a very similar dose-response relationship. This analysis was based on the CTL method (Community Tolerance Level). There are no obvious temporal trends, and contrary to claims by other researcher the prevalence of highly annoyed residents exposed to road traffic noise today is the same as 45 years ago.

Keywords: Noise annoyance, road traffic, temporal trends

1. INTRODUCTION

In recent years several researchers have published articles claiming that annoyance due to environmental noises have increased. In other words, the prevalence of highly annoyed people today is higher than it was 25 or 50 years ago (1). As a consequence, The World Health Organization, WHO, last year presented new noise guidelines for Europe recommending lower exposure limits for both aircraft and road traffic noise in order to avoid adverse health effects (2). These recommendations were based on results from noise surveys published after 2000.

Gelderblom *et al.* have published a comprehensive analysis of 62 social surveys on aircraft noise conducted between 1961 and 2015, that shows there has been no change in people's reaction to this type of noise (3).

In this paper a similar analysis will be conducted of results from surveys on road traffic noise. The CTL method (4, 5) is a very convenient tool for this type of analysis. The method, further explained in the international standard ISO 1996-1 (6), provides a single number characterization of a noise situation, a CTL value, that defines a complete dose-response curve, from 0% to 100% highly annoyed. Differences in people's reaction to various noise situations can therefore be discussed in terms of differences in CTL values.

2. RESULTS FROM PREVIOUS SURVEYS

Forty-seven surveys of annoyance from road traffic noise conducted over the past five decades were identified for which sufficient information was available to calculate their CTL values. The surveys included in this analysis is shown in Table 1. The reference codes refer to the catalog by Bassarab *et al.* (7).

Table 1. Data from 47 surveys of road traffic noise annoyance

Study year	Location	Reference	Respondents	CTL value [dB]
1969	Paris area	FRA-041	700	79.6
1971	Basel	SWI-053	3939	81.6
1972	Copenhagen area	DEN-075	960	77.3
1972	London area	UKD-071	2933	77
1974	Dordrecht	NET-106	383	68.6
1975	Antwerp	BEL-122	1319	85

1975	Amsterdam, exp.	NET-258	622	80.3
1975	Western Ontario	CAN-120	1150	74.6
1975	Toronto area	CAN-121	1786	87.6
1976	Brussels	BEL-137	495	81.3
1976	Sweden 3 cities	SWE-142	1377	85.3
1976	Gothenburg	SWE-165	464	92
1977	Germany, 26 areas	GER-192	1080	77.6
1977	London area	UKD-157	1363	78.3
1978	Canada, 4 sites	CAN-168	965	78.6
1982	GB, 5 sites	UKD-242	2097	77.3
1983	Neth. 3 cities	NET-276	798	69.6
1984	France, 4 sites	FRA-239	1032	84.6
1984	Schiphoel	NET-240	581	75.3
1984	Arnhem	NET-362	1322	75
1984	Glasgow	UKD-238	608	78.3
1985	Germany, 2 cities	GER-372	564	82
1987	Germany, Ratingen	GER-373	516	74.6
1989	Austria, Alpine	AUS-329	1989	69.3
1990	Italy, Modena	ITL-350	908	73
1993	Multi area	NET-361	4038	78.3
1993	France, 15 sites	FRA-364	895	78.3
1995	Istanbul, motorway	TRK-367	154	74.3
1996	Gothenburg, detached	SWE-368	436	68.6
1996	Gothenburg, apartment	SWE-368	706	78.3
1996	Kumamoto, detached	JAP-369	378	74
1996	Kumamoto, apartment	JAP-369	458	75.3
1997	France, 61 sites	Cremezi <i>et al.</i> (8)	673	81.3
1997	Sapporo, detached	JAP-382	411	76.3
1997	Sapporo, apartment	JAP-382	369	76
2000	Sweden, 2 cities	SWE-526	956	78.3
2002	Copenhagen	DEN-529	1149	86
2005	Hanoi	Shimoyama <i>et al.</i> (9)	1503	78.3
2006	Alpine motorway	Lercher <i>et al.</i> (10)	3630	75.1
2006	Alpine main road	Lercher <i>et al.</i> (10)	3630	72.3
2007	Ho Chi Minh	Shimoyama <i>et al.</i> (9)	1471	84.3
2009	Hong Kong	Brown <i>et al.</i> (11)	10077	82
2011	Da Nang	Shimoyama (9)	492	88.3

2012	Hue	Shimoyama (9)	688	92
2013	Swiss German	Brink (12)	2386	76.3
2013	Thai Nguyen	Shimoyama (9)	813	85
2015	Switzerland	Brink (13)	5431	78.3

2.1 Analysis

The surveys listed in Table 1 comprise interviews with more than 70,000 respondents. The grand mean CTL value for these studies is $L_{CT} 78.7$ dB. The dose-response curve associated with this CTL value is shown in Figure 1 together with the current EU reference curve for road traffic noise. The CTL curve under-estimates the annoyance at low exposure levels compared with the EU reference curve and indicates slightly higher prevalence of annoyance at high exposure levels.

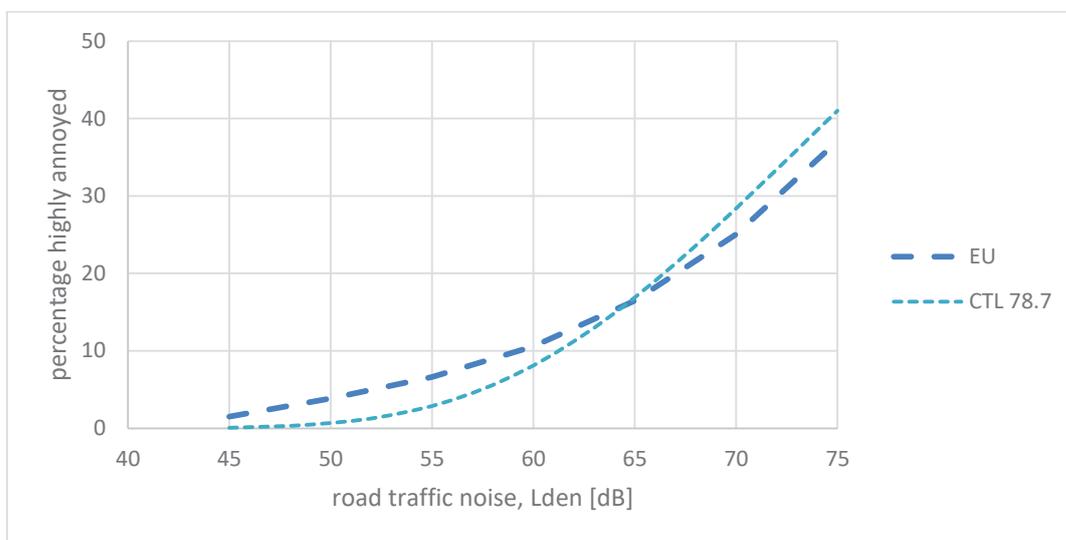


Figure 1. Comparison of the average dose-response function for 47 surveys of road traffic noise annoyance (CTL value 78.7) and the current EU reference curve.

The CTL value for 47 individual surveys has been plotted as a function of study year in Figure 2. The difference between the highest and lowest value is about 25 dB. The difference in CTL value between the various surveys can be attributed to non-acoustical factors. One such factor could be a temporal trend factor.

A linear regression function has been fitted to the dataset. This line is almost horizontal with a positive slope of only 0.032 dB/year. This indicates that the average response has been quite stable across the relevant time period. A positive slope means that the annoyance is decreasing.

The EU reference curve established by Miedema and Vos (14) was based on 18 different surveys, the last one being conducted in 1993. If the dataset is split in a pre- and post-1993 part, the average CTL value for 26 pre-1993 surveys turns out to be $L_{CT} 78.5$ dB and the corresponding value for the 21 post-1993 surveys is $L_{CT} 79.0$ dB. The difference from the grand average of $L_{CT} 78.7$ dB is negligible.

Guski *et al.* have analyzed a set of road traffic studies published from 2000 and onwards (1). The dataset comprises studies conducted from 1996 to 2013. They conclude that the annoyance has increased compared with earlier studies. Their work was part of a World Health Organization initiative to establish new recommendations for exposure to environmental noise. Unfortunately, the conclusion by Guski *et al.* was based on a set of incompatible survey results, see paper by Gjestland (15).

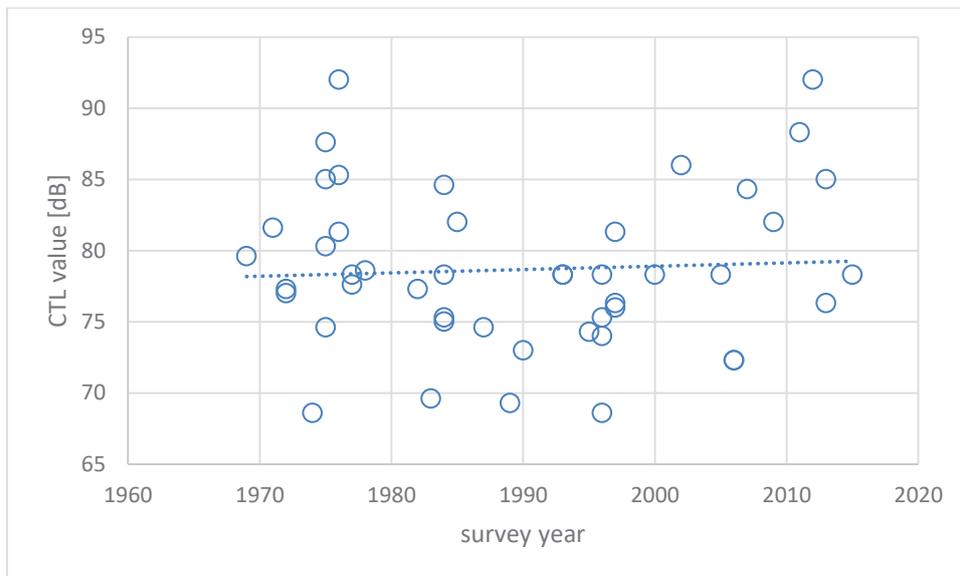


Figure 2. CTL values for 47 surveys on road traffic noise conducted between 1969 and 2015. The dotted line is a linear regression function fitted to the data.

The average CTL value for the post-1996 studies in Table 1 is $L_{CT} 80.0$ dB. The difference from the grand average is not significant, but a higher CTL value indicates a lower prevalence of highly annoyed. In other words, the average annoyance found from recent studies seems to be lower, not higher, than for earlier ones.

3. CONCLUSIONS

Detailed analysis of the results from 47 surveys of annoyance from road traffic noise conducted over the last half a century shows that there is a relatively large spread in the response data. The same degree of annoyance can be found for noise exposure levels that differ by as much as 25 dB. Such differences are attributed to non-acoustical factors.

A plot of CTL values as a function of survey year shows that there has been virtually no change in the average annoyance response over the past 45 years. A linear regression line fitted to these data is practically horizontal, indicating that the prevalence of highly annoyed people today is the same as forty-five years ago. The exposure-response curve established by Miedema & Vos in 1998 seems to give a reasonably good description of the average annoyance response. Thus, the new recommendation from WHO regarding road traffic noise is not supported by existing evidence.

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