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CORRELATION OF ACOUSTIC INDICES AND DISTURBANCE REACTION FACTORS ON RAILWAY AND ROAD TRAFFIC NOISE

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INTRODUCTION

The Federal Ministry of Transport initiated the "Interdisciplinary Field Study of the Peculiarities of Railway Traffic Noise in Comparison to Road Traffic Noise" (abbr. IF-II)[1]. One particular aspect of this extensive study concerned the testing of which acoustic index best suited the disturbance caused by road or railway traffic noise.

METHODS

In altogether 20 residential areas of West Germany noise level measurements and interviews were carried out. In order to compare the acoustic indices with disturbance reactions only areas in which either rail or road traffic predominated were chosen.

Accordingly 7 "railway traffic areas" and 7 "road traffic areas" were at our disposal. In each area about 75 subjects were interviewed. From the questionnaire we construed variables to measure the special disturbance of reaction, health and sleep as well as the overall disturbance by day and by night (in each case with reference to rail or road traffic noise).

In each area the sound levels at a representative point for all subjects were measured during 24 h.

We evaluated the following sound levels: Leq, LN, NPL, TNI, as well as the percentiles L_1, L_5, L_{10}, L_{50} in each case separated for the day (6°° to 22°°) and night (22°° to 6°°), because in these periods occurs a typical difference in the traffic movement: usually there is no difference in the Leq,day and Leq,night for railway-noise while for road traffic noise there is a difference of 8 dB(A) in these two periods (for the same Leq,24h). This day/night differentiation is also generally applied in all relevant legal acts and standards in West Germany.

The disturbance reactions and acoustic indices were correlated on the basis of means of each area (N=7). The disturbance reactions were related to those noise levels for day and night which correspond to this time period.

Fig. 1 shows the regression for the estimation of the disturbance reaction caused by the sound level for the overall disturbance reaction day and night.

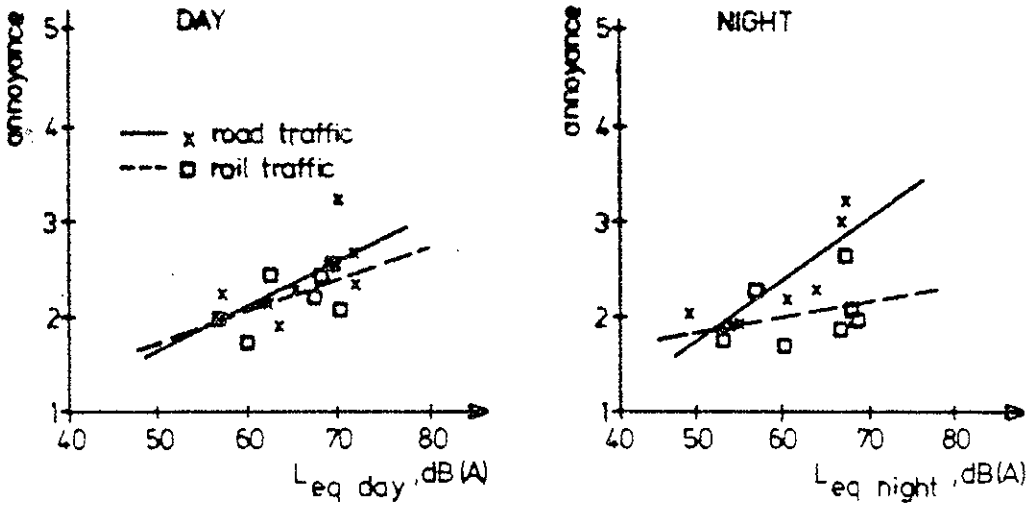

Fig. 1: Regression disturbance reaction day/night caused by sound level day/night of road and railway traffic

It can be seen that by day the Leq ranges between 55 and 70 dB(A), by night between 47 and 69 dB(A). In addition, the correlation between disturbance reaction and Leq is apparent; and here the disturbance caused by road traffic noise is higher than that of railway noise for the same Leq. (The disturbance difference between road and rail traffic noise is extensively covered in [1]).

RESULTS

The correlation coefficients of the acoustic indices with the special disturbance reactions - RUHE (indoor disturbance of rest and leisure); VEG (vegetative and somatic disturbances, ascertained by questioning); KOMM (disturbance of communication); and SCHLAF (disturbance of sleep) - are shown in Table 1 - in each case with reference to rail or road traffic.

Reactions		Leq	LN	NPL	TNI	L_1	L_5	L_{10}	L_{50}	
RUHE	road	.57	.66	.59	.50	.53	.63	.63	.53	day
	rail	.25	.29	.16	.37	.33	.50	.85	.94	
KOMM	road	.43	.48	.61	.65	.45	.52	.46	.30	
	rail	.54	.47	.35	.21	.58	.49	.74	.86	
VEG	road	.69	.81	.53	.27	.58	.71	.77	.75	
	rail	.51	.46	.30	.35	.52	.58	.79	.94	
SCHLAF	road	.78	.86	.80	.82	.75	.84	.85	.63	night
	rail	.23	.20	.28	.24	.27	.17	.31	.49	

Table 1: Correlation coefficients of acoustic indices and special disturbance reaction

The quality of the acoustic indices to predict the annoyance depends therefore upon the special disturbance reaction and on the noise source road or rail. For disturbance by road: LN, TNI and L_5, L_{10} are best suited; for the same disturbances by rail TNI, Leq and L_{50}.

Leq is capable of predicting both the disturbance by road and rail, because the other indices only correlate better either with road or rail traffic (excepting the percentiles). (For disturbances by rail traffic we also tested the Leq,q=4, normally used for aircraft noise. The correlation coefficients are only marginally higher than those of Leq).

CONCLUSION

In Fig. 2 are shown the corresponding correlation coefficients for the overall disturbance reactions separated for day and night respectively for road and rail:

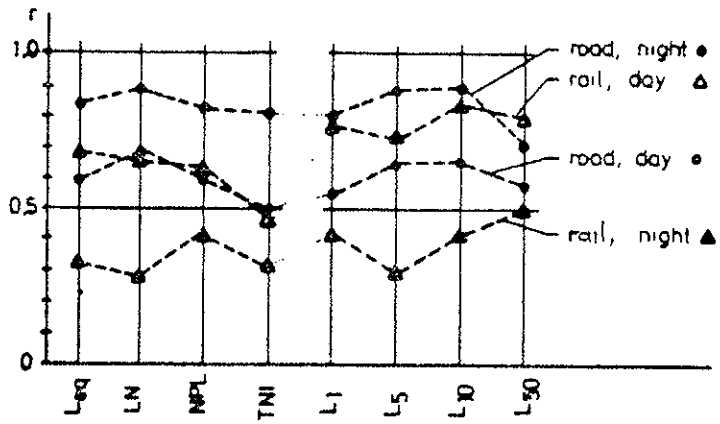

Fig. 2 Correlations (r) between acoustic indices and overall disturbance reactions for day, night and rail, road

- The high correlation between night disturbances by road and all selected acoustic indices is apparent, whereas the night disturbances by rail show considerably lower correlations.
- There is almost no difference between road and rail traffic in the correlations with the day disturbances (excepting percentiles).
- Leq is comparatively well-suited to indicate the disturbance by road and rail traffic noise.

REFERENCE

[1] IF-II: "Interdisziplinäre Feldstudie über die Besonderheiten des Schienenverkehrslärms gegenüber dem Straßenverkehrslärm" Planungsbüro Obermeyer, München 1983
(Forschungsvorhaben im Auftrag des Bundesministeriums für Verkehr)