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SOCIAL RESPONSE TO NOISE FROM INTERRUPTED TRAFFIC FLOW

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After nearly a century of motor car travel there remain considerable pressures on the road transport system. Every activity, such as industry, commerce, education and leisure depends on the movement of goods and people consequently the number of road vehicles is now increasing(1). Traffic environmental issues have accompanied growth in the transportation industry. Motor vehicles do have drawbacks because of noise, air pollution,visual effects and accidents. Traffic noise is one of the significant problems facing the modern society. It continues to increase and this growth has led to an increase in noise levels alongside urban roads and motorways to a point where a greater proportion of the population is disturbed(2).

The influence of traffic noise on the environment and on people's health is evident(3 and 4). This is particularly true of urban traffic noise which accompanies the people in their daily activity outdoors and at home. Noise in built-up areas is completely different from that generated by motorway operation, aircraft and railways. Urban noise is emitted from road networks surrounded by buildings and a high density of inhabitants, while other noise affects only specific land use. Under urban conditions the vehicles follow specific driving needs such as decelerating, stopping and accelerating which predominate at traffic lights, roundabouts and priority junctions and constitute important factors in any urban road design in contrast to the steady continuous speed situation for motorways(5).

A road vehicle is defined as a complex source composed of several elementary sources such as the engine(6). It was concluded(7) that in urban traffic, vehicle engine is the main source of noise but manoeuvres, accelerating and decelerating of vehicles and the percentage of heavy goods vehicles has a great influence on the level of noise.

Noise exposure in urban society depends upon many variables, such as traffic flow and speed, distance from noise sources, the sound insulation of facades with windows that are open or shut, road layout, and the presence of intersections(3). In addition, the relative importance of these factors will be different for each building, depending on the building location, design and use(8 and 9).

People's response to road traffic noise is shown in several ways such as: expression of annoyance, difficulty in communications, interference with sleep, degradation of task performance and physiological damage such as noise induced hearing loss(10). With the growing urbanisation and widespread motor vehicles, there is growing awareness by the public of the drawbacks of vehicular traffic, bringing about increased pressures on highway engineers and planners to take account of the environmental issues.

A traffic noise study has been carried out in the City of Bath, which incorporated 244 urban and suburban sites. The investigation considered the variables associated with noise levels from non-free flowing traffic. Prediction models have been developed. The Bath survey has provided an

opportunity to study social response to traffic noise and other parameters which characterise the urban environment.

A social study was developed to determine the interaction between social responses and noise exposure; the relation of these responses to the urban environment parameters used in planning; and the correlations between interview response items as well as between noise indices.

Physical Measurements

Road traffic is the dominant form of noise in most of Bath. In the study, land uses were covered - residential, shopping, commercial, and main traffic routes. A representative 48 sites were chosen as a sample of traffic conditions (light, medium and heavy)[11], for each of these types of land use. Thirty minute noise level recordings were made hourly at each site between 06.00 and 24.00 hours. Traffic noise was measured as L_{10},L_{50} and L_{90} dB(A)[12]. Traffic variables such as flow, composition and speed, distance between kerb and buildings facades flanking the road, road width and distance to the nearest intersection[13] were recorded.

The Social Survey

The social survey was carried out at the 48 sites where there are already complaints about the effects of road traffic on the community. Sites were alongside the accelerating and decelerating streams of traffic. Traffic lights, roundabouts and junctions at various distances were featured. At each location a sample of 6-12 subjects from properties fronting onto the road were interviewed. The population had to be living or working along the roads and experience the effect of the traffic. The social survey questionnaire consists of: firstly; 32 questions concerning the subjects' attitudes on traffic noise outside and indoors including the roles of types of vehicles, presence of intersections, accelerating of vehicles, brakes, interrupted traffic, window status, sleep disturbance and interference with TV and radio, conversation and concentration. Secondly, 27 questions concerning the areas such as: period of living and working, source of noise and feeling about the area. Thirdly, 6 questions were concerning basic information; fourthly, the second part of the questionnaire was general data filled in by the author who acted as interviewer.

A five point scale was used ranging from (definitely satisfactory, not at all annoyed, never, not at all reduced and not at all noisy) to 5 (definitely unsatisfactory, extremely annoyed, all the time, very much reduced and extremely noisy) for twenty-three items.

The final structure of the questionnaire was adapted from previous experience[14] though significant changes were made for the purpose of this study.

Results

A total of 319 subjects were interviewed with a structured questionnaire. The proportion of female and male were 48.9% and 51.1% respectively. In terms of age characteristics a small percentage of people were over 60 (19.1%). The buildings in the study were mainly terrace, detached or semi-detached and they all had windows on the road facing facade. The percentage of subjects living at the same address less than one year was 12.5%. The predominant source of noise was road traffic noise in all locations. 41.1% of the selected sample live in the main route area where heavy traffic conditions were prevalent.

The average values of nineteen response items were 15.1% at point 2 (minimum)

and 27.86% at the highest point of the 5 point scale (maximum). Figures 1 and 2 illustrate envelopes showing range of disturbance responses and response to different sources respectively.

34.2% selected the middle point of the 5 point response scale when they were asked to indicate whether or not they noticed the noise inside their buildings. Figure 3 shows the relationship between people's responses indoors and outdoors and noise level. All main route subjects found the medium and heavy goods vehicles very annoying. The highest motorcycle score was 29.5% at number four of the five point response scale. Figure 4 explains the interaction between noise level L_{10} dB(A) and people's response to different types of vehicles.

The survey indicated that most of the noise nuisance resulted from vehicle manoeuvres but traffic lights, roundabouts and priority junctions were mentioned by 84.7%. The main factor associated with intersection is the distance of the range of influence. The main people responses were found for sites within 240 m from different kinds of intersections. Figure 5 shows the correlation between people's response to noise from intersections and vehicle manoeuvre and distance.

68.7% of subjects reported that they keep their windows shut all the time (number 5 on the scale), while 78.4% mentioned sleep disturbance (Figure 6). 32% of subjects felt that noise was reducing the financial value of their property and chose the highest point of the scale. 87% mentioned the financial effect at a different level.

The survey indicated that the most acceptable level was L_{10} = 68 dB(A) corresponding to number 2 of judgement of the five point response scale. The results also show the different sensitivities for each situation as depicted by the change of slopes on Figures 3-6.

Conclusions

Significant correlation was found between noise level L_{10} dB(A) and social response, the noise from light, medium and heavy goods vehicles at traffic lights, roundabouts and priority junctions besides vehicles accelerating and decelerating. Interactions also exist between social responses and urban environmental variables such as distance. The influence of different kinds of intersections was found for positions within a distance of 240 m. The influence of noise exposure on disturbing people during sleep, conversation or watching television has been established.

The level of L_{10} = 68 dB(A) at number 2 of the 5 point response scale was found to be the most acceptable level associated with people's response to traffic noise exposure in this survey. A high percentage of subjects felt that noise was reducing the financial value of their property.

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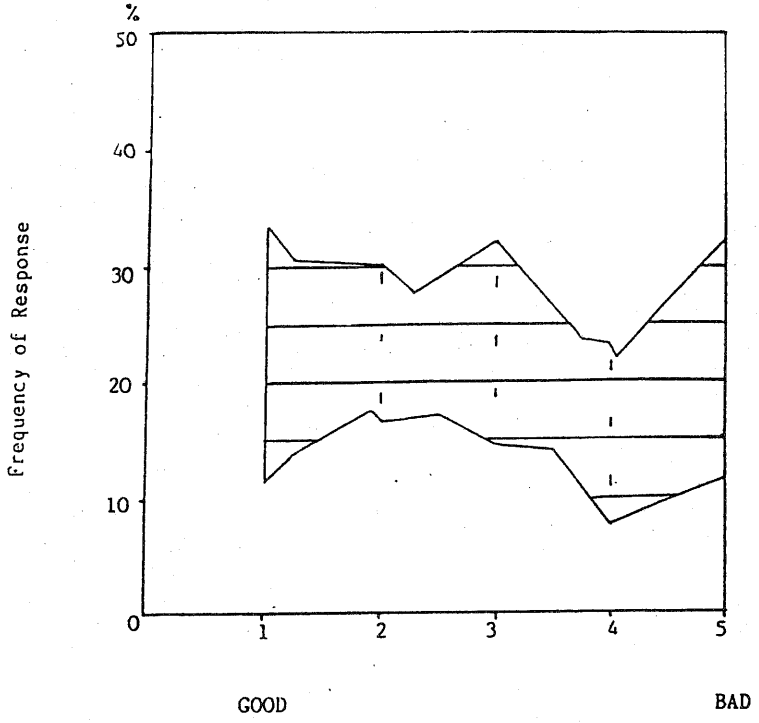

Figure 1 Envelopes showing range of disturbance response to: sleep, concentration, TV and radio, conversation, vibration, bedroom position and reduction of the financial value of the property.

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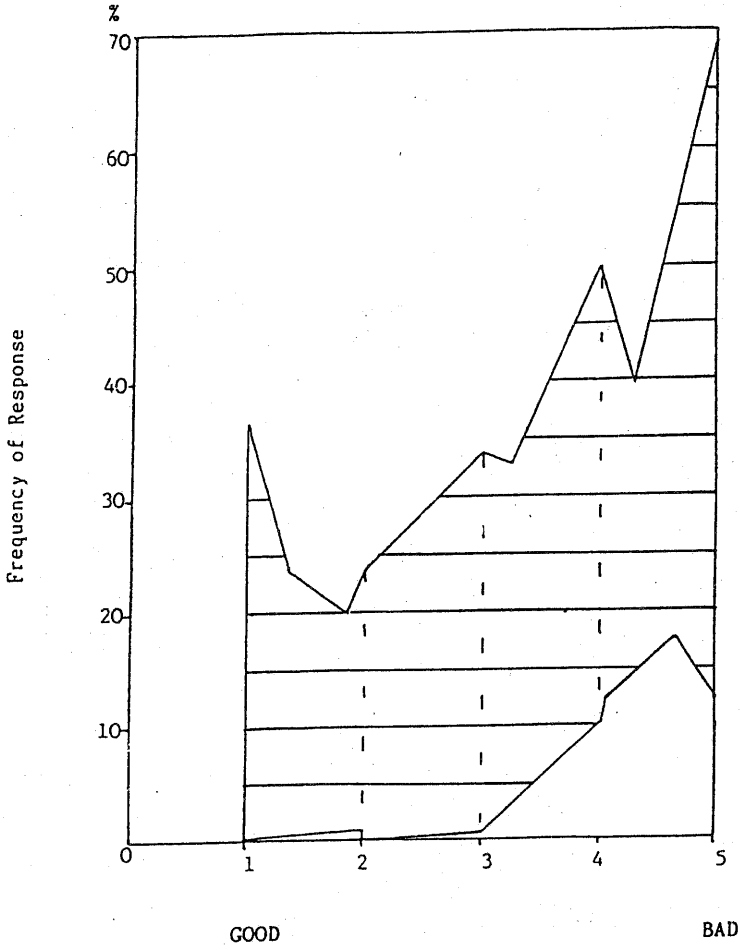

Figure 2 Response to different sources such as: outside and indoor noise, cars, buses, heavy lorries, intersection noise, squealing tyres, motorcycles, acclerating vehicles, closed windows and interrupted traffic.

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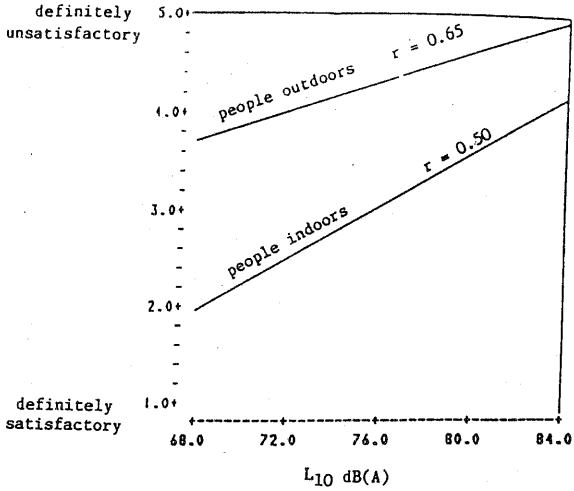

Figure 3 Noise Level and people's response to indoor and outdoor noise.

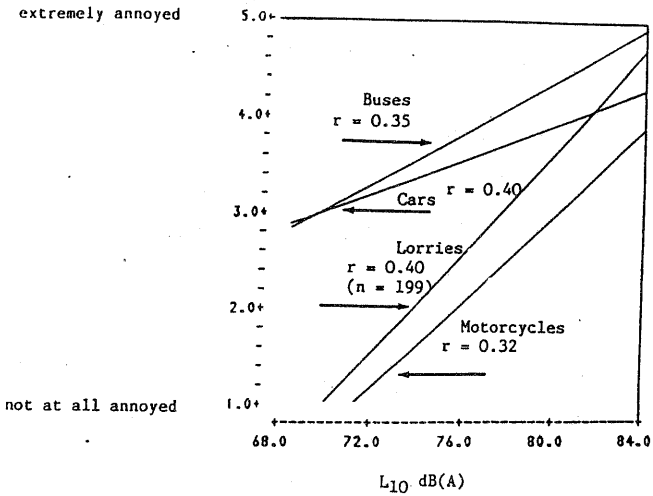

Figure 4 Noise level and people's response to different kinds of vehicle relationships.

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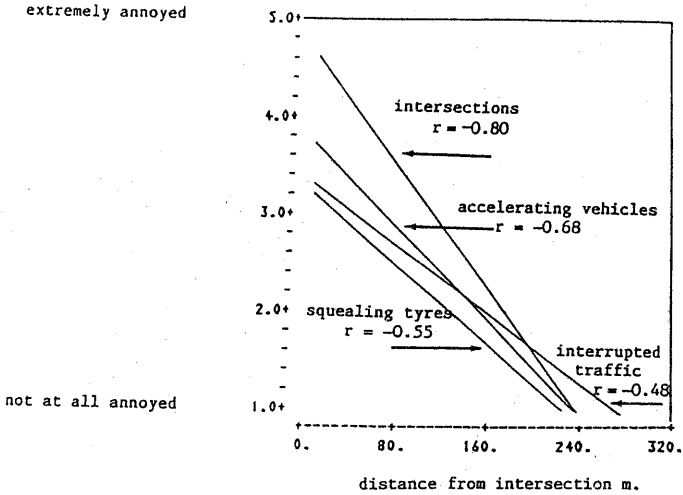

Figure 5 The interaction between people's response to different noise factors and distance.

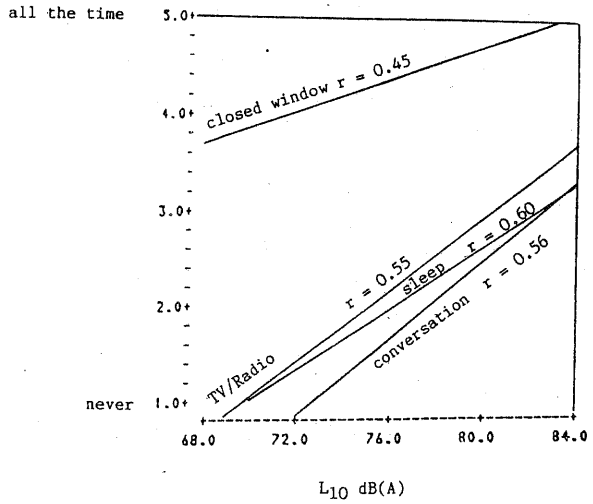

Figure 6 Noise level and people's disturbance response relationships.