

# FACTORS THAT CONSTITUTE ROAD TRAFFIC NOISE IN THE NIGERIAN ENVIRONMENT

A. I. MENKITI

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## ABSTRACT

Noise is sound that should not be present where it is not wanted. In an earlier study (Menkiti 1995) it was found that in the Nigerian environment the kind of noise that bothers people most is the traffic noise. It was decided to explore the ramifications of this type of noise.

Suitable towns and cities were selected in the southern part of Nigeria, questionnaires were administered to people for their reactions to aspects of noise and noise measurements were also made. Results of this study reveal that, among others, traffic noise bothers people more when traffic flow increases; fumes, horns, slamming of vehicle doors add to traffic noise in the perception of people. Awareness to pedestrian danger as a road traffic factor was found to be low.

**KEY WORDS:** Noise, Traffic, Environment, Awareness

## INTRODUCTION

Sources of stress in our environment are now on the increase. Consequently, concern has been growing about the problem of disturbances emanating from road traffic. An earlier survey made on noise bother (Menkiti 1995) not only confirmed this but also indicated that, for the population exposed to traffic noise, there is more to road traffic than just vehicle movement. Usually, it is adequate to categorize motor traffic noise into those of motor cycles, cars and heavy (largely commercial) vehicles. The overall noise which is due to the passage of a single motor vehicle arises from a number of identifiable sources which include engine, gears, transmission, fan-cooling system, road-tyre interaction, exhaust and inlet, brakes and aerodynamics (Delancy *et al* 1976). The relative importance of each source depends on the size and type of vehicle, on its driven speed, on the load it carries and on its level of maintenance.

When considering traffic noise, one should also bear in mind that there are emissions from the individual vehicles as well as emissions from the overall traffic flow or continuous traffic flow as a whole, in addition to the continuous traffic flow itself. Each of these flows constitutes a part of what the population exposed to road traffic noise experiences. To this population, the experience is the sum total effect of the combination of the individual components. The object of this study is to find out the components that constitute road traffic noise in the Nigerian environment, to determine what contribution each makes to the overall traffic noise concept and to evaluate the degree of bother or annoyance created by these components.

## METHODOLOGY

### Site selection

The first stage was to select suitable towns or cities. Because there were many variables envisaged, it was decided (to cut cost and time) to divide the Country into three zones, North, Middle and South, for the purpose of this study. This pilot study is on the South.

The selection of the cities in this zone was based on areas stratified by population density. The earlier study guided the choice of the cities finally selected. They were Lagos, Ibadan, Benin, Onitsha, Port Harcourt and Uyo.

The second stage was to choose the particular areas of the cities suitable for study. Although it was appreciated that the study was not going to be based entirely on reactions to physical noise, it was felt that areas on bus routes and those not far from these routes would be suitable.

### Questionnaire

Since one of the main aspects of this project was to obtain the reactions of the population exposed to this noise, a questionnaire was designed. It was in three parts. The first part sought to find out how the respondents felt about their homes, their neighbourhood and their places of work. They were given the opportunity to indicate particular aspects (Sando *et al* 1974). Information was sought from them on how long they had resided in their homes and neighbourhood, and how long they had worked in an establishment.

The second part of the questionnaire, the main one, was directed to road traffic. People were asked about their reactions to aspects of road traffic which surfaced in the earlier survey. These were noise, vibration, horns, vehicle fumes, parking, pedestrian danger, dust, squeal of vehicles, banging on vehicles (including door-slamming) and braking.

**TABLE 1: TRAFFIC ASSESSMENT OF RESPONDENTS AND INTERVIEW COUNTS OF PEAK HOUR TRAFFIC (VPH)**

ASSESSMENT OF RESPONDENTS TO TRAFFIC	LAGOS		IBADAN		ONITSHA		BENIN		PORT-HARCOURT		IYO	
	MEAN	%	MEAN	%	MEAN	%	MEAN	%	MEAN	%	MEAN	%
VERY HEAVY	600	14	380	18	450	22	390	12	320	15	200	8
FAIRLY HEAVY	300	36	205	17	150	24	200	28	105	10	140	12
MODE-RATE	150	28	82	34	95	21	120	17	70	19	100	35
LIGHT	60	11	44	21	55	18	58	29	48	41	52	31
VERY LIGHT	27	20	15	8	30	14	32	13	28	14	31	15

**TABLE 2: ATTITUDES TO TRAFFIC BOTHER EXPERIENCED IN HOMES**

	LAGOS		IBADAN		ONITSHA		BENIN		PORT HARCOURT		IYO	
	A	B	A	B	A	B	A	B	A	B	A	B
% OF ALL RESPONDENTS	40	60	35	55	45	53	40	60	25	75	20	80
MEAN VPH IN PEAK PERIOD	450	108	290	880	300	90	290	100	200	80	165	88
AVERAGE	200		140		180		150		110		50	

The questions wanted to know how much respondents were bothered by each of these. Bother here was meant to embrace annoy, worry, trouble, irritate and concern.

The last part of the questionnaire dwelt on the effects of traffic noise on home activities of the respondents. They were encouraged to suggest what remedial actions they believed should be taken to reduce the problem of road traffic noise in their areas.

### The Study

A sample of 200 addresses was taken from each city and one adult was selected from each address. A total of 980 interviews were finally achieved, giving a response rate of 82%.

In addition to the interviews, some physical measurements were made. The number of vehicles passing in front of an address was counted in two ten-minute periods, one during peak-period condition. Noise levels at these sites (using the same instrumentation as in the survey reported by MENKITI in 1995), the time delay in trying to cross the roads immediately in front of the addresses, as well as the number of parked vehicles around were measured. Some local features were also taken note of; approximate slope of road in relation to a selected address, distance of house from the road, its nearness to a bus route and the type of building.

The percentages of the population exposed to the complex traffic noise who were disturbed by

the various components as traffic flowed were obtained. Finally the level of noise exceeded for 10% of the time  $L_{10}$  was calculated for each city (recording) using the Bruel and Kjaer Noise Level Analyser type 4426.

## RESULTS AND DISCUSSIONS

### Noise Level Result

Measurements showed that the levels of noise (in dBA) depended on the rate of flow of traffic (hence the speed of traffic), on the composition of the traffic (bigger vehicles increase the noise level) and on the gradient (noise level increases with gradient). These results appear to be in agreement with the findings reported by FISK in 1974 and by JOHNSON and SAUNDERS (1968).

The calculated  $L_{10}$  average shows the generally-accepted relationship with mean hourly flow  $q$  of

$$L_{10} = \underline{C} \log q \quad (\text{HMSO 1972})$$

where  $\underline{C} = 7.5$  for level roads, and  
 $= 9-12$  for urban conditions (Fisk 1974)

For this study, the reference levels adopted were 88dBA for heavy vehicles and 82dBA for others. With these, the experimental  $\underline{C} = 10.76$ , hence for this study  $L_{10} = 10.76 \log q$

### Traffic

The flow of traffic was based on the ten-minute counts multiplied by 6 to give estimates of the number of vehicles per hour (vph). Results show that most people in the areas chosen were

subject to flows of traffic, some heavy, some medium and some light. The different results are shown in tables 1 and 2.

**Traffic Assessment**

**Table 1:**

Table 1 shows the interviewer counts of mean peak hour traffic in vehicles per hour compared with the Respondent's assessment of traffic. The assessments agree closely with the actual traffic count in some places and disagrees sharply in others. There is a good agreement in Lagos and Benin and general agreement in what constitute moderate, light and very light traffic. This table indicates that in peak periods vehicle flow is from 27 to 600 per hour in Lagos, 20 to 380 in Ibadan, 30 to 450 in Onitsha, 32 to 390 in Benin, 28 to 320 in Port Harcourt and 31 to 200 in Uyo in the areas surveyed. It also shows that as far as heavy traffic (of 200 vehicles per hour) is concerned, the respondents exposed are 14% in Lagos, 18% in Ibadan, 22% in Onitsha, 12% in Benin, 15% in Port Harcourt and 8% in Uyo. These are really sizeable percentages of the population. Table 1 confirms the fact that most people in the chosen areas were exposed to flows of traffic. Figure 1 shows the cumulative distributions of the number of vehicles passing an address in each location at the peak time.

**Figure 1**

In Lagos, about 3% of those interviewed experienced vehicle flows in excess of 1200 vph as compared to about 1% in Ibadan, none in Onitsha and about 1.5% each in Benin, Port Harcourt and Uyo. 400 vph is experienced by about 36% of respondents in Lagos, 50% in Ibadan, 35% in Onitsha, 22% in Benin, 24% in Port Harcourt and 34% in Uyo. A general conclusion cannot be drawn from these figures since peak periods varied from city to city. However, in all the cities surveyed, more than 75% of the respondents experienced flows of more than 30 vehicles per hour.

**Traffic Bother**

**Table 2**

Table 2 shows attitudes to traffic bother experienced by respondents in homes, both along the bus routes and along other routes. It is arranged in sections to show the contributions of the individual parts that make up the complex traffic (noise) bother.

(i)

**NOISE**

The plots of table 2, figure 2, indicate clearly that in the zone studied, the percentage of respondents that heard traffic and the percentage bothered by it top the list of all the components. In Lagos, the corresponding percentages are 98 and 82, in Ibadan they are 96 and 81, in Onitsha 94 and 88, in Benin 92 and 87, in Port Harcourt 98 and 89 and in Uyo they are 71 and 60.

During interviews, it was observed that the degree of bother or dissatisfaction with noise depended on a number of factors which are largely socio-economic. These range from general standards of environmental acceptability through the attachment a respondent has to

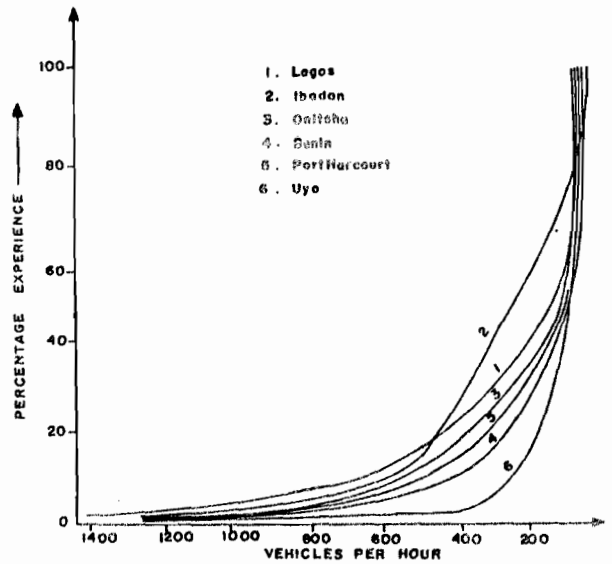


FIG. 1: VEHICLE FLOW AND EXPERIENCE (%)

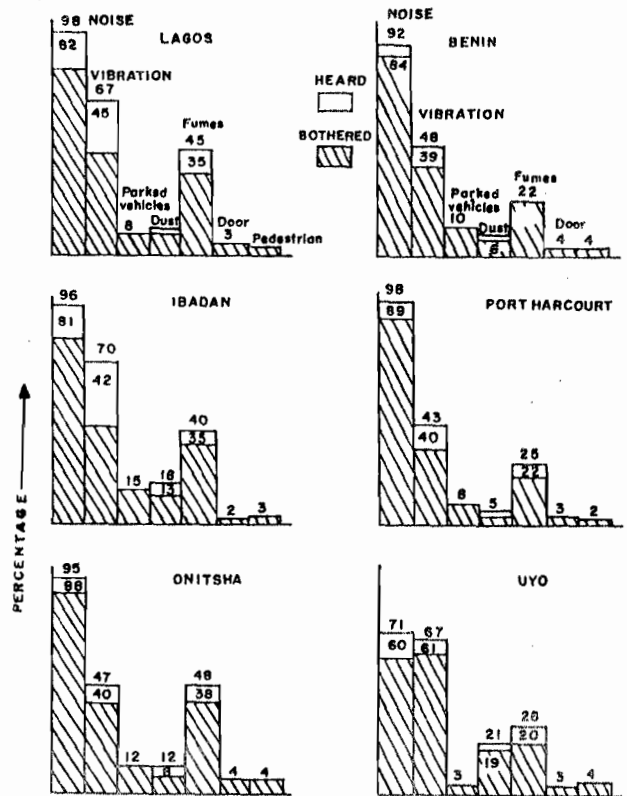


FIG. 2: NOISE SURVEY DUE TO TRAFFIC BOTHER ON BUS ROUTES.

the source of the noise to the economic capability of avoiding the noise. These observations are in partial agreement with the findings of LANGDON (Ref. 6).

**(ii) VIBRATION**

Noise and vibration are closely related. However, in this study vibration is taken to mean that part of noise which shakes structures, foundations and individuals even when the noise that may have given rise to it is not particularly a bother itself.

% RESPONDENT IN EACH GROUP

HEARING TRAFFIC (NOISE)	98	90	96	90	94	82	92	71	98	88	71	82
BOTHERED BY TRAFFIC NOISE	82	81	81	80	88	76	87	58	89	72	60	48
EXPERIENCE VIBRATION	67	38	70	32	47	52	48	31	43	38	67	21
BOTHERED	45	18	42	30	40	44	39	21	40	30	61	19
BOTHERED BY PARKED VEHICLES	8	6	15	3	12	8	10	2	8	17	3	3
EXPERIENCE DUST	11	17	18	10	12	22	7	20	5	10	21	19
BOTHERED	10	9	13	9	8	22	6	17	4	8	19	10
EXPERIENCE FUMES	45	14	40	14	48	18	22	17	25	14	28	17
BOTHERED	35	12	35	11	38	16	22	16	22	12	20	14
BOTHERED BY VEHICLE DOOR BANGING	3	7	2	2	4	3	4	4	3	4	3	3
BOTHERED BY DANGER TO PEDESTRIANS	2	2	3	2	4	3	4	3	2	2	4	3

A ON BUS ROUTES  
 B ON OTHER ROUTES

Figure 2 shows that the bother due to vibration ranks second to noise. Taking the bus routes, the bother percentages are 45 for Lagos, 42 for Ibadan, 40 for Onitsha, 39 for Benin, 40 for Port Harcourt and 61 for Uyo. Apart from Uyo, the average is 42%, high enough for concern since the low frequency effects of waves have been shown to be harmful to the body and to task-performance (Ref. 8).

Since vibration is transmitted through structures as the traffic flows, one general comment may be that the houses near the bus routes were not well insulated. Concern for this may have been heightened by the suggestion of the danger it poses.

(iii) FUMES

The levels of bother attributed to fumes from traffic flow are really surprising. These are high in Lagos, Ibadan, Onitsha and Uyo where the percentage bothered ranges from 35 to 20. These effects are, unlike noise and vibration, felt outside rather than in the homes. Hardly any of the respondents was bothered by fumes in the home. The vehicle identified as causing offence in this respect is the motor cycle mainly with the diesel-powered bus coming a close second.

(iv) DUST

Dust appears to be present in objectionable quantity in the areas of Lagos, Ibadan, Onitsha and Uyo surveyed. Uyo roads are (at the time of the survey) undergoing a lot of construction, so it is understandable why there is a high percentage of bother for that traffic noise component. It bothers 10% in Lagos, 13% in Ibadan, 8% in Onitsha, 6% in Benin, 4% in Port Harcourt and 19% in Uyo.

(v) PARKED VEHICLES

The main bother due to parking of vehicles was from the fact that they occupied parts of the road which were already not wide enough. It bothered 8% in Lagos, 15% in Ibadan, 12% in Onitsha, 10% in Benin, 8% in Port Harcourt and 3% in Uyo where much parking could not be done due to the road works going on.

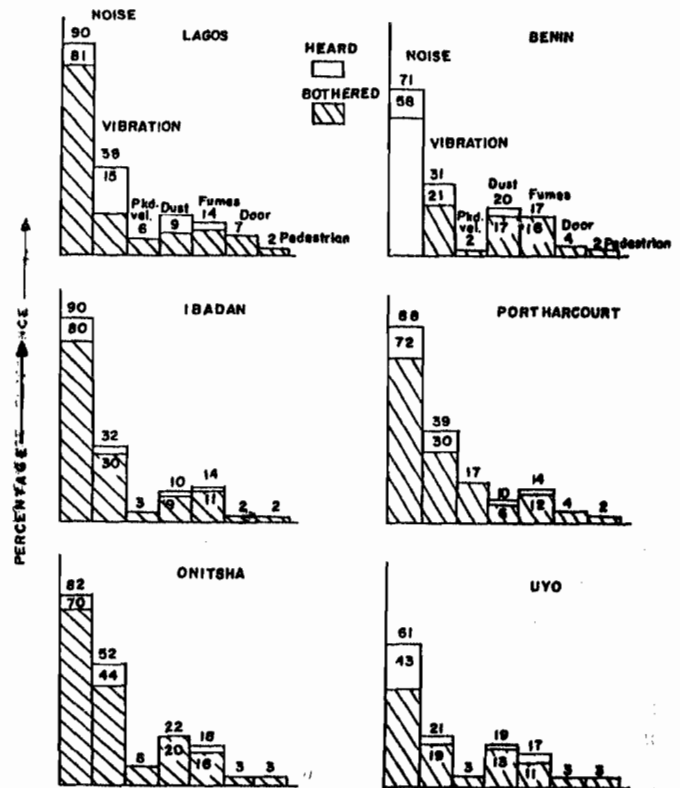


FIG. 3 : NOISE SURVEY DUE TO TRAFFIC BOTHER ON OTHER ROUTES.

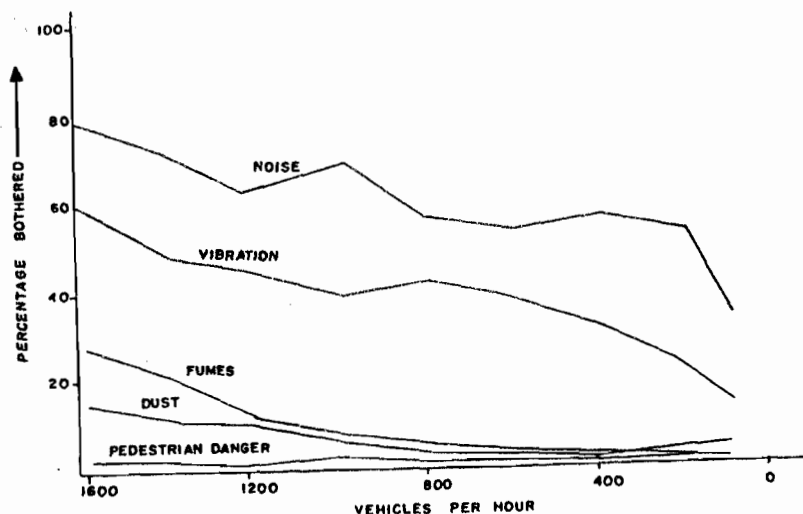


FIG. 4: PERCENTAGE BOTHER VARIATION WITH VEHICLE FLOW PER HOUR

#### (vi) VEHICLE DOOR BANGING

This aspect of traffic noise did not really constitute much bother to the exposed population. It did not bother more than 4% in any city.

#### (vii) PEDESTRIAN DANGER

Measurements showed that a fair amount of time was taken in crossing the roads in front of some addresses. It was therefore a surprise to find that danger-to-pedestrians was not a source of bother to many people interviewed. Like the vehicles and door-banging, it bothered a maximum of 4%. Part of the explanation may be because there were buses, pedestrian crossing points and accompaniment of children by adults. Part of course may be just that it is not regarded as traffic bother.

#### FIGURE 3

The histograms of figure 3 show the attitudes of people on routes other than bus. The trend is similar to that along the bus routes, except that the percentages are comparatively lower.

#### DISTURBANCE - VEHICLE FLOW

As was indicated in the study section of the methodology, a correlation was aimed at between percentage of respondents disturbed by the individual components of traffic noise and traffic flow. Figure 3 shows the relationship. Discrete values were obtained for particular flows and these were joined together to give the figure shown.

From the figure, the general trend is that as road traffic flow increases the percentage bother increases - though not linearly. (If a midway line is drawn through the curves, the resulting slopes are 0.03 (Noise), 0.02 (Vibration), 0.02 (Fume) and 0.01 (Dust) giving the impression of a possible empirical relationship between components of road traffic noise and bother.

#### CONCLUSIONS

The factors that constitute road traffic noise are complex. They include noise and vibration, fumes from vehicles, dust raised by moving vehicles, noise

resulting from opening and closing of vehicle doors, (awkward) parking of vehicles, braking of vehicles, and to a minor extent the danger for pedestrians crossing (busy) roads.

Measurements and surveys show that traffic noise bothers more people more when road traffic flow increased, people are bothered more outside their homes.

The disturbance experienced depends on how far the house is from the road and also on the road gradient.

The awareness of pedestrian danger as a road traffic factor is very low.

There appears to be an empirical relationship between road traffic noise components and bother.

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