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TRAFFIC DENSITY AND SCHOLASTIC ACHIEVEMENT

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Traffic density was measured in the streets adjacent to 12 primary schools in Dublin city and the pupils (n=579) in these schools were tested in English reading at the end of third class and again at the end of fourth class After differences due to socio-economic status and gender were removed a significant drop in English achievement scores was observed in schools with high traffic scores The effect of traffic density is not large accounting for only 1 69% of the between subjects variance and there is no effect for traffic on the gain scores of individual pupils during 4th class The implications of the findings are discussed

It is generally acknowledged that the last few decades have seen a deterioration in the quality of the urban environment m Ireland The principal reason is the high level of property speculation in town and city centres, which has pushed house prices beyond the reach of all but commercial concerns As a result, better off families move out of such areas Associated with this population drift is a movememt of services, such as schools and hospitals, out of urban areas, which, accordingly, are left more and more to the poor and underprivileged

The effect of urban decline on scholastic achievement is by now well known Indeed the deterioration of the educational system is one of the more dramatic and predictable features of urban decline and has prompted large scale educational interventions in this country and elsewhere (8,9,11) While the effect of urban decline on scholastic performance is usually explained in terms of socio-economic and home background factors, there may be other factors involved which pertain to the physical environment of the inner city and which have their effect regardless of economic or social conditions

In this study we look at one such factor, traffic density For various reasons, including poor planning, heavy traffic is increasingly a feature of

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the urban environment. Apart from its contribution to the general unpleasantness of this environment, traffic is a source of two major pollutants, noise and exhaust emission. Both can be plausibly linked with scholastic achievement.

It has been found that background noise of around 50 decibels interferes with the intelligibility of speech when speaker and hearer are separated by two metres or more (15). Since this degree of separation would be usual between teacher and pupil in the classroom, and since a busy street produces 80 decibels of background noise, it is reasonable to conclude that the sound of traffic can be a significant disruption in the classroom if proper precautions are not taken to eliminate it – a conclusion which any city teacher will verify. As well as providing a high level of background noise, traffic also produces a variety of intermittent noises which constitutes a separate source of distraction.

Exhaust emissions, according to American research, are the largest single contribution to polluted air in most urban areas (16). A recent study of the effects of vehicle exhaust emissions on the air quality in Dublin noted with concern the steady increase in the quantity of pollutants over the last five years and the lack of legislation to control it (10). Of particular concern was the increase in lead levels in the city's air. At present the lead concentration in petrol available in Ireland is the highest of all the EEC countries, standing at 0.64 grams/litre. Ireland, alone among member states, was excluded from an EEC directive of 1978 which limited lead in petrol to a maximum of 0.40 grams/litre (5). For technical and economic reasons, the Irish government was given a further five years within which to comply with the regulation. In the meantime, it is estimated that 350 tons of lead are emitted into the atmosphere in Ireland from motor exhaust fumes every year.

The implications for education are not clear. It has long been acknowledged that overt lead poisoning has serious and sometimes fatal consequences. However, the effects of long-term exposure to low concentrations of lead is the subject of scientific debate. Various health effects have been ascribed to low-level exposure, such as mental retardation, kidney damage, and changes in cardiovascular function (13). The controversy centres on the degree of exposure that is necessary for such changes to occur. What is certain, however, is that low-level exposure is more dangerous for children than it is for adults (1, 6, 12).

In the earliest studies of childhood over-exposure to lead it was clear that classroom performance was adversely affected. A study of Boston

children provides convincing evidence that even low levels of lead exposure significantly affect learning ability, attention span, performance on an intelligence test (Wecshler Intelligence Scale for Children), and general class behaviour (14) A recent English study found evidence in a sample of 166 Greenwich school children of mental retardation at lead levels lower than those observed in the Boston study (17) A significant difference between these and other studies is that their index of exposure was the lead content of teeth rather than of blood This gives a more accurate picture of long-term exposure One of the main reasons for lead's toxicity is that it is not metabolized and excreted, but continuously accumulates in the body's tissues

As yet no comprehensive study has been carried out in Ireland on the long term effect of lead from petrol on the intellectual capacities of urban school children An EEC sponsored survey of the blood lead levels of the whole population found the average level to be 15 pgrams/100 mlitre, which is below the generally acknowledged danger level (4) However, as mentioned above, the blood measure is only indicative of recent exposure and gives no indication of the amount of lead accumulated over repeated exposures

METHOD

Sample

The sample used in this study is a sub sample of a 20% sample of Dublin city and county primary schools, stratified by size (4 7 teachers, 8 12 teachers, 13 teachers or more) and gender served (boys, girls, mixed) (7) The present sample retains 12 schools which fell within the jurisdic tion of Dublin Corporation and for which measures of traffic density were available Only 4 of the original 9 strata were adequately represented in the reduced sample (see Table 1) A simpler stratification scheme was therefore introduced, distinguishing only between boys' and girls' schools Observations from the only mixed school in the sample were re-allocated to the boys' and girls' school strata according to the gender of the pupils

Independent variables

Socio-economic status The sample, now containing only two strata, was further stratified for socio-economic status (SES) Socio economic status was based on principal teachers' reports of the percentage of pupils attending the school who lived in privately-owned homes The SES of a school was rated low if less than 10% of the pupils lived in privately owned homes and high if 90% or more did If SES was neither high nor low, a school was assigned to a middle category The present sample contains only schools in the middle and low categories

TABLE 1

SCHOOLS IN THE FINAL SAMPLE AND SCHOOLS IN THE POPULATION BY SIZE OF SCHOOL AND GENDER OF PUPILS ATTENDING

Gender of pupils attending	Size of School		
	4-7 teachers	8-12 teachers	13+ teachers
	Sample/Population	Sample/Population	Sample/Population
Boys	2/21	2/20	3/43
Girls	0/19	0/27	4/50
Mixed	0/35	1/34	0/29
Total			12/278

Traffic density. Density was measured by a count of cars passing the school during school hours. Counts were provided by Dublin Corporation. Multiple counts were sometimes available for schools bounded by different thoroughfares. These were averaged to provide a single index. Car counts for the 12 schools in the sample ranged from 132 to 4,134. They are shown in Table 2 together with the number of pupils and class-groups falling into each category and the SES and gender of pupils in the school.

Dependent variable

The Drumcondra English Test, Level II, Form A (3) was administered to the pupils at the end of third class, in May and June 1979, and again at the end of fourth class, one year later, in May and June 1980. The total score for English reading, derived from 30 items in the vocabulary sub-test and 40 items in the comprehension sub-test, was the only dependent variable examined. An arcsine transformation was performed on the raw scores in an attempt to overcome the ceiling-effect which was apparent in the scores.

Pupils were not retained in the sample if they were absent for either testing. Pupils who 'gained' more than 25 points in the course of the school year or who 'lost' more than 8 point were removed from the sample. The distribution of test scores suggests that gains and losses of this magnitude are due to improper testing on one occasion or the other. Classes which were reduced to fewer than 15 pupils as a result of these restrictions were eliminated.

TABLE 2

NUMBER OF PUPILS AND CLASS-GROUPS IN EACH SCHOOL IN THE SAMPLE

School	Traffic density (Car count)	Socioeconomic status				Gender
		Middle		Low		
		No of pupils/	No of classes	No of pupils/	No of classes	
1	132			20/1		Boys
2	445			60/2		Girls
3	449			21/1		Boys
4	775			52/2		Boys
5	1013	74/3				Boys
6	1436	89/3				Girls
7	1773			75/3		Girls
8	2040			15/1		Boys
9	3341	52/2				Boys
10	3342	26/1				Mixed
11	3940			48/2		Boys
12	4134			47/2		Girls
	Totals	241/9		338/14		
					282/12	Boys
					271/10	Girls
					26/1	Mixed
					579/23	Total

Analysis

Variation on the dependent measure was partitioned by regression techniques It was first divided into two components, one between subjects and one within The between subjects component records differences between pupils which are constant over the two testings It can be further divided into components attributable to SES, gender, traffic density, and their interactions The within subjects component, which is the variation in the scores of individual pupils over the two testings, primarily records the effect of the intervening school year, controlling for the general ability level of the pupil It also records possible interactions between this effect and the other independent variables The complete partition of between and within subjects variation is equivalent to a split plot factorial design in analysis of variance, with individual pupils as plots and the two testings as conditions repeated within plots The correlation between scores over testings was 89

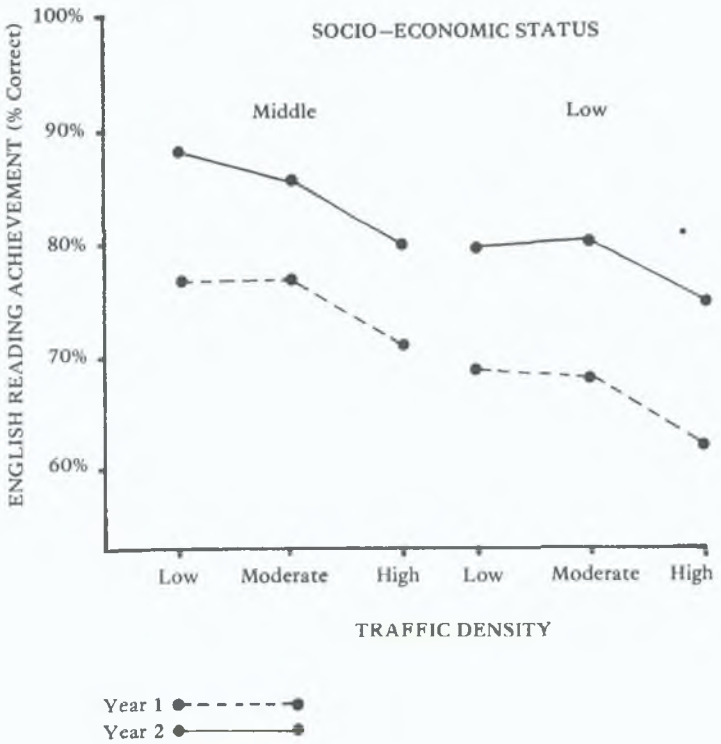
RESULTS

The individual ability level of pupils, estimated by their average score on the two testings, accounted for 85.25% of the variance of the dependent measure. The remaining 14.75% lies within subjects.

The effects of SES, gender, traffic density, and their interactions, were removed, in this order, from the between-subjects variance. SES and gender were entered into the regression equation as dichotomies, and traffic density as a continuous variable. Interaction terms were created in

FIGURE 1

ENGLISH READING ACHIEVEMENT AS
A FUNCTION OF SOCIO–ECONOMIC STATUS
AND TRAFFIC DENSITY



the usual way (2, Ch 8) SES had a significant effect (F = 24 99, df 1,577, p < 001), but gender did not (F < 1 00) The effect of traffic density was also significant (F = 7 91, df 1,575, p < 01) as was its quadratic component (F = 4 50, df 1,574, p < 05) when entered after the removal of the linear component

Using the usual adjustments to R^2 (2, p 106), components of the between subjects variance in the population were estimated as follows SES, 4 73%, gender, 0 00%, traffic density, 1 69%, interactions, 0 00% The remaining 93 58% contains the effect of different ability levels among the pupils, the primary determinant of between subjects variance

The effects of the school year and its interaction with SES, gender, and traffic density were removed, in this order, from the within subjects variance The effect of the school year (F = 1,806 90, df 1,578, p < 001) accounted for an estimated 60 93% of the within-subjects variance, or 8 99% of the total variance No significant interactions were found between the other independent variables and the effect of the school year

The principal findings are shown in Figure 1 For purposes of illustration, traffic density has been reduced to three categories, low (132–1,013), moderate (1,436–2,040), and high (3,341–4,134)

DISCUSSION

The data in the present study show a small but significant lowering of scholastic achievement in schools with a high density of traffic in the surrounding streets The effect becomes more pronounced at higher density levels

The finding needs to be interpreted with caution In the context of school level effects the sample is small, containing only 12 schools It is possible also that a finer differentiation of SES would account for the variance attributed here to traffic density And of course it should be noted that traffic density is, at best, only an indirect measure of lead toxicity and noise pollution, the two factors by which traffic could plausibly lower achievement scores

On the other hand, the fact that the effect is small does not greatly detract from its credibility One would not expect an effect due to traffic density to be of the same order, for example, as that due to SES Similarly, the failure of the effect to interact with the effect of the school year is also understandable, since any effect due to traffic density is most

likely a slow, long-term one, which might not show in an analysis of change-scores over a 12-month period. It should be mentioned too that the present analysis, conducted on student-level data, is relatively insensitive to school-level effects on account of the large within-school variance. This may be judged by the effect for SES, which would have been about six times as large had the sample size been sufficient to permit school-level analysis (7).

Bearing all of this in mind, the result is not easily explained away. The least that may be said is that it fails to support the contention that traffic density is still at levels too low to be of any educational or sociological significance.

The harmful effect of the inner-city environment on scholastic performance is not in dispute among educationalists, nor is there any doubt that poverty is the primary factor involved. The problems facing research on urban deprivation are, firstly, to identify the precise factors (physiological, psychological, and social) by means of which poverty hinders educational achievement, and, secondly, to say how such obstacles might be removed. Neither problem applies to the subject of this study. If indeed traffic density is an obstacle to educational achievement, either through noise or through lead toxicity, there should be no great difficulty in verifying this fact directly, i.e., by measuring noise levels and lead toxicity. And should the existence of such an obstacle be established, there should not be any great difficulty in proposing effective steps for its removal.

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