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Patterns of Attainment

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INTRODUCTION

In a previous paper (Fogelman & Goldstein, 1976), the relationship between changes in relative attainment of children between the ages of 7 and 11 and certain social factors was examined. In general it was shown that the gap in attainment among children of different social class and family size increased between the two ages. The purpose of the present paper is to extend this analysis, again using National Child Development Study data, to the age of 16 and to increase the number of social factors investigated.

The background factors on which we shall be concentrating are: sex, social class, family size and region. The overall question which we hope to answer is whether differences between groups of children defined by these factors, which are known to appear early in their school careers, are relatively stable, or whether they increase or diminish during the time which children are attending school.

Such questions can only be answered adequately by large longitudinal studies. It is not surprising, therefore that previous work is limited to the National Survey of Health and Development (NSHD), a study of a sample of children born in one week of 1946 (see for example, Douglas, 1964, Douglas, Ross & Simpson, 1968), and to the National Child Development Study, (NCDS) a study of children born in one week in 1958 (see for example Davie, Butler & Goldstein, 1972; Fogelman, 1976).

The National Survey children were tested at the ages of 8, 11 and 15, with a range of tests. We shall, however, concentrate on reading and mathematics since these are the areas which were covered in the NCDS.

In relation to each of the background factors listed above, Douglas, Ross & Simpson (1968) report the following findings from the NSHD.

Sex—girls obtained higher test scores than boys in both reading and mathematics up to the age of 11, but at 15, boys had moved ahead on both tests.

Social Class—an increasing divergence among the social classes was found on both tests with the social class gap in attainment greatest at 15.

Family size—at the age of 8, children from larger families obtained lower test scores than children from smaller families. However, there was no further increase in this gap at either of the later ages. Furthermore, for working-class children separately, the smallest differences in attainment among children of different-sized families were found at 15.

Region—at the age of 8, Scottish children did better on the two tests, particularly in reading. By 11, the English and Welsh children had caught up in their reading, but the Scottish children were still ahead in mathematics and remained so at 15.

Fogelman & Goldstein (1976) presented comparable findings (apart from regional differences) from the National Child Development Study, based on tests carried out at the ages of 7 and 11.

These analyses produced similar patterns to the National Survey with respect to social class. There were contrasts, however, in the findings in relation to sex and family size. At the age of 7, although girls had had higher mean reading test scores than boys, there was only a very small difference (and that in favour of the boys) in the arithmetic test means. By 11 the boys had caught up with the girls in reading and there continued to be little average difference in mathematics attainment between the sexes.

Whereas Douglas *et al.* concluded that the attainment differences associated with family size did not increase after the age of 8 and were 'determined by factors which exert their effect before the age at which they start school', the NCDS children exhibited an increase in the differences among children of different-sized families between the ages of 7 and 11.

In this paper then we shall be examining how such patterns of attainment have developed now that the National Child Development Study children have been tested again, at the age of 16.

THE NATIONAL CHILD DEVELOPMENT STUDY

In 1958, a study was mounted of all children born in England, Scotland and Wales in the week 3–9 March of that year, the major purpose of which was to examine factors associated with perinatal mortality (Butler & Alberman, 1969). The surviving children (with the addition of those born in the same week who entered this country after 1958), were subsequently followed up by the National Children's Bureau at the ages of 7, 11 and 16.

At each follow-up information was collected from a number of sources: schools administered tests and completed a questionnaire; each child was examined by a local authority medical officer: and the parents (most commonly the mothers alone) were interviewed by a health visitor. At 11 and 16 the children themselves completed a questionnaire.

The specific variables incorporated in the analyses reported in this paper are as follows.

Seven-year data (1965)

Sex.

Social class: fathers' occupations were ascertained in the course of the parental interviews, and have been categorised according to the Registrar General's (1960) classification of occupations into the following groups: I, higher professional; II, other professional and technical; IIINM, other non manual; IIIM, skilled manual; IV, semi-skilled manual; V, unskilled manual. Children with no male head of household, or whose father's occupation could not be classified have been excluded from the analyses.

Number of children in the household: this is the number living in the household who are under the age of 21, subdivided in our analyses into the number older and younger than the study child.

Reading attainment: measured by the Southgate reading test (Southgate, 1962), a standardised test of word recognition. Arithmetic attainment: measured by a problem arithmetic test constructed for use in this study with the help of the NFER.

Eleven-year data (1969)

Sex, social class and number of children in the household as at 7. Region: based on the following Registrar General's standard Regions: North England (Northern, N. Western, E. & W. Ridings of Yorkshire, N. Midlands and Midlands), South England (remaining regions of England), Scotland and Wales.

Reading attainment: measured by a test constructed by the NFER to be parallel with the Watts-Vernon test of reading comprehension.

Mathematics attainment: measured by a test constructed by the NFER for this study and containing a mixture of problem and mechanical items.

Sixteen-year data (1974)

Background variables as at the earlier ages.

Reading attainment: measured by the same test as at 11.

Mathematics attainment: measured by a test constructed by the NFER for use with this age-group.

Copies and technical details of the unpublished tests are available from the authors.

Levels of response

Although the general levels of response at each stage of the study have been satisfactorily high (see Fogelman, 1976 for details), there are inevitably quite dramatic reductions in sample size for analyses such as those reported here when, in order to be included, a child must have complete information from several different sources and at each stage of the study. Detailed analyses of the implications of the NCDS response levels have been reported by Goldstein (1976). To summarise, children on whom information was obtained at 16 (87% of those known to be alive and in this country at 11) contain a slight under-representation of certain 'disadvantaged' groups such as those receiving special education and those illegitimately born, and have, at 11, somewhat higher mean test scores than those for whom data were not obtained at 16. There is no evidence of any bias in relation to social class or various indices of physical development.

More crucially, for our present purposes, Goldstein (1976) has explored the effects of recalculating the earlier analyses on progress between 7 and 11 (reported in Fogelman & Goldstein, 1976), omitting those children on whom data were not subsequently obtained at 16. The result is shown to be to increase the size of the most extreme contrasts (for example, between non-manual children and those from social class V, or between children from one- or two-child households and those from five or more-child households), but only by between 1 and 3%. It seems therefore safe to conclude that our findings are not significantly affected by any response bias.

METHOD

As in the earlier analyses, we attempt to answer our questions by examination of the relationship of the 16-year test scores to the earlier test scores allowing for the relevant background factors. Preliminary analyses demonstrated that, for both tests, there was a relationship with 7-year score, even after taking 11-year score into account. Test scores at both the earlier ages have therefore been included in the analyses as independent variables (see Fogelman & Goldstein, 1976 for an explanation of the transformations and scales of the 7- and 11-year tests). Our analyses can therefore be interpreted as showing whether for given 7- *and* -11year score, the average scores at 16 are different for the various categories of social class and other variables considered.

Two analyses have been carried out for each of the two 16-year tests. Each has 7-year and 11-year test scores as independent variables. The first analysis is concerned with social class and family size and includes social class at 11 and number of older and younger children at 11 as

further independent variables. Additionally we wished to investigate the association with test scores of changes in these variables across the three ages, so two 'change in social class' variables (7 to 11 and 11 to 16) and analogous 'change in family size' variables were also incorporated. In the event the changes in family size did not prove to be significantly related, when adjusted for the other factors in the analysis, with 16-year test scores. Thus they have been omitted from the final reported analyses.

The second pair of analyses is primarily concerned with regional differences. However, in order to allow for differences among regions in their social class composition, social class has again been included in these analyses as an independent variable. Because they are independent of any of the other background variables sex differences could have been investigated by inclusion in either set of analyses and have in fact been included in the second.

RESULTS

The results of the analyses of covariance examining social class and family size are summarised in Table VI. It is not appropriate, because of an interaction, to present the regional analyses in the same form (see Figs 1 and 2 and Discussion below). In presenting the results we shall consider each variable in turn and in relation to the unadjusted differences shown in Tables I—V.

Raw scores on the two sixteen-year tests have been transformed to have a normal distribution which has a mean of zero and a standard deviation of one. Thus the means and standard errors. in Tables I—V and the fitted constants in Table VI and the figures are in terms of standard deviation units.

In view of the above on possible response bias, it seems reasonable to use the maximum information and include all children with data on the relevant variables in the unadjusted comparisons. They are not therefore limited to those children who could be included in the analyses of covariance by virtue of having information on all relevant variables at all ages. Further checks have been carried out to ensure that no bias is introduced into these analyses through the exclusion of children with incomplete data at any age, as well as those with no data at 16 discussed above.

Social class

To make any comparisons between the unadjusted means in Tables I—V and the fitted constants in Table VI and Fig. 1 and 2 clearer, it should be borne in mind that the latter are not the actual mean scores of the groups concerned. It is the *differences* between the fitted constants, rather than their absolute values, which are of interest and which can be compared with the differences between the unadjusted means.

In Table I we find the expected large average differences between the social classes. On both tests the difference in means between the extreme groups as categorised (i.e. between children of fathers in non-manual occupations and those of fathers in unskilled manual occupations)

TABLE I. 16-year test scores by social class

	Reading			Mathematics		
	Mean	SE	N	Mean	SE	N
Non-manual	0·53	0·016	3241	0·50	0·017	3236
IIIM + IV	−0·15	0·012	5764	−0·16	0·012	5732
V	−0·63	0·040	527	−0·52	0·039	517

is greater than one standard deviation. Our question then concerns whether there is evidence that the differences represent an increase over the pre-existing differences between these groups.

The fitted constants in Table VI demonstrate that this is the case. After adjusting for 7- and 11-year scores, there are still relatively large mean differences between the social class groups. Again taking the extreme comparisons, they amount to just over one third of a standard deviation for reading and a little less for mathematics.

Thus the pattern over all three ages is of a widening gap between children of different social classes. Of course this does refer to means, and the standard deviations within each social class are fairly large—virtually as large as the overall sample standard deviation. Even so, the figures in Table I imply that at 16 only about 15% of the social class V children could be expected to score above the mean of the non-manual children. It would be interesting in the future to examine how these differences relate to the public examination results of these children.

Family size

A less clear-cut picture emerges in relation to family size. As already mentioned, we have divided this variable in order to look separately at the number of children older and younger than the study child. Tables II and III show the relationship of test scores to these two factors.

TABLE II. 16-year test scores by number of older children (under 21) in the household

	Reading			Mathematics		
	Mean	SE	N	Mean	SE	N
0	0·21	0·015	4291	0·15	0·015	4275
1	−0·07	0·016	3550	0·07	0·016	3528
2	−0·17	0·026	1421	−·15	0·026	1410
3+	−0·51	0·033	878	−·44	0·032	871

TABLE III. 16-year test scores by number of younger children (under 21) in the household

	Reading			Mathematics		
	Mean	SE	N	Mean	SE	N
0	0·17	0·016	3540	0·10	0·016	3520
1	0·11	0·017	3359	0·09	0·017	3347
2	−0·02	0·023	1847	0·02	−0·023	1834
3+	−0·34	0·028	1386	−0·26	0·028	1375

The contrasts in the two Tables are fairly large, although less so than those associated with social class. Generally, the differences in reading are a little greater than those in mathematics, and the differences associated with the number of older children greater than those for the number of younger children.

The relationship after allowing for test scores and social class is to be seen in Table VI. When these are taken into account the contrasts are inevitably much reduced, but remain statistically significant for the number of older children.

On both tests those with no older children in the household have moved about one seventh of a standard deviation further ahead of those with three or more older children in the household.

In relation to younger children in the household, however, the differences among the fitted constants are smaller, only just reaching statistical significance for the reading test, and not doing so for the mathematics test.

Thus it would appear that the gap in attainment related to the number of older children in the household is one which develops throughout the compulsory school years, but the further differentiation in relation to the number of younger children is extremely small, and may be non-existent for mathematics attainment.

Region

The simple differences at sixteen among the four broadly-grouped regions can be seen in Table IV.

TABLE IV. 16-year test scores by region

	Reading			Maths		
	Mean	SE	N	Mean	SE	N
North England	0·01	0·015	4294	0·02	0·015	4268
South England	0·16	0·016	3685	0·11	0·017	3664
Wales	−0·13	0·041	577	−0·07	0·041	572
Scotland	−0·06	0·028	1192	−0·05	0·029	1188

Once again the pattern of results is similar for each test. There are, however, immediate contrasts with the results obtained by Douglas *et al.* (1968), mentioned above, for the cohort examined 12 years earlier. Among 16-year-olds in 1974 the Welsh children do relatively poorly on the reading test and, contrary to Douglas's findings the Scots are certainly not ahead in mathematics.

Regional differences which take into account earlier scores are shown in Figs 1 and 2. In all the analyses reported in this paper, tests have been carried out for the presence of interactions, that is whether the differences associated with one variable, hold true for each category of another variable. For example, are the social class differences reported equal for boys and girls, or do they vary according to sex? In general, such interactions have been found to be non-significant or trivial in size with no apparent implications for our findings. With only one exception they lead to no changes in the order relationships.

The exception is for the mathematics test in relation to social class and region, where the relationships among the regions are markedly different according to the social class of the children concerned. The pattern which emerges is shown in Fig. 1, and it can be seen that the overall figures would mask a very different situation for each of the two extreme social class groups.

In the relatively large skilled and semi-skilled manual group, the differences among the regions are extremely small (apart from the Welsh children), as indeed they are between the North and South of England for the other two social class groups. In the, also large, non-manual group it is the Scots who have made the greatest average progress between 11 and 16, and the Welsh have done relatively poorly, while among the relatively small unskilled manual groups, these positions are reversed (but the differences are relatively small).

The fitted regression lines for the reading test, where no significant interactions were found, can be seen in Fig. 2. It is clear that for each social class group, children in the South of England

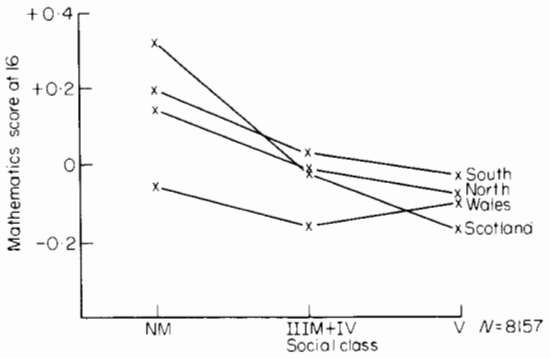

FIGURE 1. 16-year mathematics score for given 7- and 11-year score: region and social class.

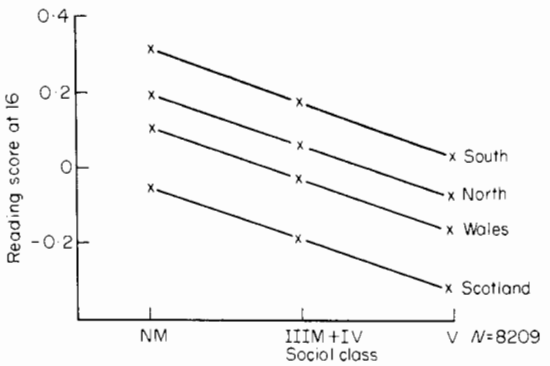

FIGURE 2. 16-year reading scores for given 7- and 11-year score: region and social class.

have made relatively good progress between the ages of 11 and 16, while the opposite is true for Scotland. At the age of 7, Scottish children were on average notably ahead of other areas of the country in their reading scores (Davie, Butler & Goldstein 1972), but by 16 they have been overtaken by children in England.

Whilst it is interesting to speculate on the reasons for these intriguing findings relating to region—for example, might they be related to selection policies, or methods of ability grouping within schools or parental interest in their children's education—none is immediately convincing without further evidence.

As already mentioned sex differences were examined in the course of the same analyses as those from which the findings shown in Figs 1 and 2 were taken. It was found that for both tests, for children of equal earlier test scores, by the age of 16 boys have moved ahead of girls.

Since, as we have said, there were minimal sex differences in the test results at 11, the outcome at 16 is the difference in favour of the boys shown in Table V. Although statistically significant it can be seen that the average differences at 16 between the sexes are not very large,

TABLE V. Mean 16-year test scores by sex

	Reading			Mathematics		
	Mean	SE	N	Mean	SE	N
Boys	0·03	0·012	6132	0·08	0·013	6106
Girls	−0·02	0·012	5858	−0·09	0·013	5818

TABLE VI. Summary of analysis of covariance: social class and family size

Independent Variable	Categories	16-year reading score ($N = 4332$) (Total variance = 0·90) Fitted constant	χ^2	(d.f.)	16-year mathematics score ($N = 4360$) (Total variance = 0·96) Fitted constants	χ^2	(d.f.)
Seven-year score	Per year	·05	99·31	(1)***	·04	47·7	(1)***
Eleven-year score	Per year	·24	3671·01	(1)***	·29	2606·0	(1)***
Social class at 11	Non-man (a)	·16			·16		
	IIIM + IV (b)	·02	63·3	(2)***	−·02	54·4	(2)***
	V (c)	−·18			−·14		
Older children at 11	0	·07			·08		
	1	·02	22·5	(3)***	·01	22·9	(4)***
	2	−·02			−·03		
	3+	−·07			−·06		
Younger children at 11	0	·04			·01		
	1	·01	9·5	(3)	·02	1·8	(3)*
	2	−·03			−·01		
	3+	−·02			−·02		
	7 **11**						
Change in social class, 7–11	c a + b	−·02			−·02		
	b a	−·06			−·10		
	a + b c	·02	4·5	(4)	·04	12·9	(4)*
	a b	·05			·02		
	No change	·01			·06		
	11 **16**						
Change in social class 11–16	c a + b	·04			·01		
	b a	·07	·6	(4)	·04	7·6	(4)
	a + b c	−·11			−·01		
	a b	−·01			·01		
	No change	·02			·00		
Residual mean square		·30			·42		

Significance tests: $P<0·001$***; $P<0·01$**; $P<0·05$*; otherwise $P>0·05$

particularly on the reading test where it amounts to only about one twentieth of a standard deviation. The small difference in mathematics raises the question of whether it is compatible with the considerably larger number of boys who enter and, among those who enter, who pass public examinations in mathematics (DES, 1975). It may be that there is still much female talent in this area which is not fully developed by our schools.

Changes in social class and family size

As already mentioned, changes over the three ages in each child's social class or family size were also examined in the course of the analyses presented in Table VI. As can be seen the difference in 16-year scores for given earlier scores reached statistical significance only in the case of the mathematics test and for children whose social class changed between 7 and 11. In fact, even here the actual size of the difference is rather small.

It is interesting to note that on both the mathematics test, and on the reading test where the effect does not reach significance, children whose families are upwardly socially mobile between the ages of 7 and 11 show a relative deterioration in their performance by the age of 16, which might be taken to suggest that it is the social class earlier in the child's life which is of first importance. However, the pattern is reversed in relation to change in social class between 11 and 16 and these differences are in any case very small. Given also the lack of significance on the reading test it would be wrong to place too great an emphasis on this result.

As mentioned, change in family size is not included in the final analysis reported in Table VI, as preliminary analyses showed there to be no relationship between this variable and 16-year test score after allowance for earlier test scores.

DISCUSSION

Before discussing our findings further, consideration must be given to a more general point concerning their over-all validity. Following the publication of our earlier findings it has been suggested (Douglas, 1976; Richardson, personal communication) that the implication of our using different tests at different ages may be greater than we appreciated. That is, that different tests may have contrasting relationships with, for example, social class which would produce results such as these even if, say, the two tests had been given at about the same time. If this were the case one could not argue that our findings indicated a widening gap, only that the gap is greater in some content areas than others.

This problem is not in fact disposed of by using the same tests on the two occasions. Given the large difference in ages, it would not be possible to find a single test where discrimination among children resulted from the same items within that test. In practice, the older children would answer correctly the majority of items on which younger children varied, and would themselves vary on a group of (harder) items which most younger children had got wrong, or had not attempted.

It is not possible to resolve this dilemma in a clear-cut fashion. However, we would argue that what is of first importance is the *appropriateness* of the test to the age group concerned. Does the test content sample from those skills which are important, which teachers are trying to teach, and which will subsequently be built upon, at the age in question? Nevertheless, one one must acknowledge that different tests might produce different results. However, it can be noted that the general pattern of a widening gap in relation to social class, which is likely to be the most problematic variable in this context, appears for both reading attainment—where the same tests were used at 11 and 16—and for mathematics attainment—where different tests were used at each age. Furthermore, this pattern also resembles that found in the NSHD, although none of these tests was common to both studies. Such evidence would seem to suggest that differences due to using different tests are not likely to be dramatic.

Turning to the findings, our results in relation to social class and family size show a continuation to the age of 16 of the patterns found earlier to the age of 11. That is that the relatively advantaged children, of middle-class parents and small families, continue to show an increasing superiority in their reading and mathematics attainment.

Although we should not claim that our analyses incorporate an adequately detailed study of social mobility, our findings suggest that the association between children's progress and changes in social class is slight and contradictory.

Concerning family size, interesting differences have emerged when this is divided according to whether the other children in the household are older or younger than the child being studied. Between the ages of 11 and 16 it would appear that it is the number of older children which has the greater association with progress.

In the past, two kinds of explanation have been offered for the relationship between family

size and children's development. The first kind assumes a rather direct effect, resulting from, for example, shared physical resources (e.g. Lambert, 1964), or reduced access to parents' time (e.g. Davie *et al.*, 1972). The second suggests a less direct relationship, family size simply being associated with parental attitudes which in turn are related to a child's progress (e.g. Floud, 1961).

If, as our results indicate, a change in family size does not have any implication for a child's educational progress, then this would seem to lend more support to the second of the above kinds of explanation.

On the other hand, our findings do not seem immediately compatible with the 'confluence model' proposed by Zajonc & Marcus (1975). Under this model the intellectual development of a child is related to the absolute (i.e. age-related) average level of the rest of its family. This model works well in explaining the relationship between development and family size and birth order at a single point in time. However, it would seem to predict that changes in a child's rate of progress would be related to changes in family size and equally to numbers of older and younger children. Neither of these predictions is supported by our data.

The relationship between progress and the other variables which we have examined, sex and region, has proved not to be so straightforward. Higher average scores of a group at one age cannot be taken to predict a similar position at the later age, there being considerable contrasts in such groups' relative progress between any two ages. Particularly interesting are the regional differences in mathematics attainment with the Scottish and Welsh children showing contrasting rates of progress, not only during different periods, but also for different social class.

Finally, it is worth noting that, in addition to their possible social relevance, the results reported in this paper would appear to have important methodological implications, particularly for educational researchers. In so-called quasi-experimental designs, for example, where children are matched according to their initial ability, differences may subsequently develop between groups which could be interpreted as treatment effects, but which might in fact be the result of differing social composition of the two groups. If such studies are to be adequately controlled they must take account of children's social background—in particular their social class and family size—in addition to measured ability on one occasion.

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REFERENCES

BUTLER, N. R. & ALBERMAN, E. D. (1969) *Perinatal Problems* (Edinburgh, E. & S. Livingstone).

DAVIE, R., BUTLER, N. R. & GOLDSTEIN, H. (1972) *From Birth to Seven* (Longman in assoc. with National Children's Bureau).

DEPT. OF EDUCATION AND SCIENCE (1975) *Statistics of Education* (School Leavers V. C. N.).

DOUGLAS, J. W. B. (1964) *The Home and the School* (MacGibbon & Kee).

DOUGLAS, J. W. B. (1976) 'No end to inequality', *Times Educational Supplement* 23 July, 1976.

DOUGLAS, J. W. B., ROSS, J. M. & SIMPSON, H. R. (1968) *All our Future* (Peter Davies).

FLOUD, J. E. (1961) Social class factors in educational achievement. in: HALSEY, A. H. (Ed.) *Ability and Educational Opportunity* (O.E.C.D. Paris).

FOGELMAN, K. (Ed.) (1976) *Britain's Sixteen-Year-Olds* (National Children's Bureau).

FOGELMAN, K. R. & GOLDSTEIN, H. (1976) Social factors associated with changes in educational attainment between 7 and 11 years of age, *Educational Studies*, 2, pp. 95–109.

GOLDSTEIN, H. (1976) A study of the response rates of sixteen-year-olds in the National Child Development Study, in: FOGELMAN, K. (1976) *op. cit.*

LAMBERT, R. (1964) *Nutrition in Britain*, 1950–60 (Codicote Press).

SOUTHGATE, V. (1962) *Southgate Group Reading Tests: Manual of Instruction* (University of London Press).

ZAJONC, R. B. & MARCUS, G. B. (1975) Birth order and intellectual development, *Psychological Review*, 82, pp. 74–88.