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*   EFFECTS OF ABILITY GROUPING IN SECONDARY SCHOOLS IN GREAT BRITAIN   *
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EFFECTS OF ABILITY GROUPING IN SECONDARY SCHOOLS IN GREAT BRITAIN*

by

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EFFECTS OF ABILITY GROUPING IN SECONDARY SCHOOLS IN GREAT BRITAIN

ABSTRACT

The effects of the organization of schools on individual student performance have been the focus of many recent investigations. One area of inquiry that has led to mixed results and varied interpretations is research on the effects of ability grouping within schools. The present study has several advantages over previous research on this question. (a) It is based on a large, national sample. (b) It examines the effects of both school types based on ability and ability grouping within school types. (c) The analysis involves comparing students who have been separated into ability groups with those who have not been so separated. (d) The analysis and interpretation take into account the effects of ceiling and floor effects of the measures used. The results support the general hypothesis that students in high ability groups gain more and students in low ability groups gain less over a five-year period than they would be expected to gain if they had not been separated into ability groups. It is suggested that one of the reasons similarly strong effects have not been consistently observed in the United States is that we have not collected the kinds of information needed.

EFFECTS OF ABILITY GROUPING IN SECONDARY SCHOOLS IN GREAT BRITAIN

Numerous investigations have been conducted over the past two decades to determine the effects of the characteristics of schools attended on the academic performance of students. Since the "Coleman Report" (Coleman, et al., 1966) produced negative findings, little interest has been shown in such school characteristics as the nature of the physical plant or even the kinds of educational facilities (e.g., laboratories, libraries, etc). Recent literature has been more concerned with the characteristics of the student body or the internal organization of the school. Some evidence has been presented to support the belief that the general characteristics of the student body affect the academic performance of individuals (Alexander and Eckland, 1975). But the claim that the school context does not affect all students in the same way (Heyns, 1974) has also directed attention to the internal organization of the school. While the internal organization of a school is part of the overall school context experienced by students, a student's experience is quite different depending on where s/he is located in that structure.

This paper reports the findings of an investigation of the effects of school organization on students' academic achievement in Great Britain. It is concerned with the effects of what most Americans call "tracking" and the British refer to as "streaming," the segregation of students into groups defined by ability levels. While the approach taken here is consistent with that used in studies of American schools, organizational differences between the British and American school systems and methodological innovations make this investigation a more effective basis than previous studies for assessing the effects of ability grouping.

Early attempts to determine if the segregation of students into ability groups leads to performance differences which would not be observed without the segregation have produced mixed findings and differences of opinion about the proper interpretation of the findings (Esposito, 1973; Findlay and Bryan, 1975). Some have seen ability grouping as a mechanism by which schools artificially directed students toward varying levels of adult outcomes (Rosenbaum, 1976). On the other hand, not everyone thought that the outcomes which could be associated with ability grouping were sufficiently evident to warrant any concern (Jencks, et al., 1972).

While streaming has been a topic of considerable heated debate in Great Britain, there has been little systematic empirical research on its effects. Perhaps the most influential discussion of the matter is found in Lunn's (1970) investigation of streaming in primary schools, although Newbold (1977) presented evidence from a truly experimental longitudinal study conducted in a single school. One of Lunn's important emphases was on the assignment of teachers to the streamed or mixed ability groups. Many teachers in mixed ability classes objected to the assignment and were philosophically opposed to it. In fact, many actually practiced within-class differentiation in any event.

The most recent study of this issue in the United States, using the large sample and multiple measures of the High School and Beyond data set (Hotchkiss, 1984, Chapter 7), has provided additional support for the hypothesis that placement in tracks does have an effect on academic performance, net of a long list of control variables measured at an earlier point. That analysis has the same limitations as most studies conducted in the United States in that it covers only the period from tenth grade to twelfth grade, and it involves a comparison between just two groups - students in the college preparatory curriculum versus all others. However, its findings are consistent with the earlier research which has indicated significant effects of ability grouping.

Those who have believed that ability grouping does affect performance have thought that the effect is to increase the level of performance of those in the high ability groups and to lower the level of performance of those in the low ability groups in comparison to what it would have been without the separation into ability groups. The explanations offered for expecting such effects varied. Rosenbaum (1976) suggested that those in the lower tracks were discriminated against in the grading practices used and in the way school records were kept as well as being given an inadequate curriculum. Oakes (1982) also stresses the importance of the poor curriculum in the lower tracks as well as the teachers' lower expectations of the students. Alexander, et al. (1978) add to this the fact that ability level segregation places students in varying contexts differentiated by the kinds of peers with whom they associate; if such contextual effects are significant at the school level, they should be at least as significant at the learning group level. I will return to the issue of the reasons for ability group effects later in this paper, although the present study does not provide an adequate basis for testing the validity of the proposed reasons.

The theoretical stance implicit in most, if not all, studies of the effects of ability grouping is discussed by both Wohlwill (1973) and Boudon (1974), although neither dealt with this particular question. Both were concerned with the over-time effects of social settings on individual development. Wohlwill refers to a "positive feedback model" of situational effects while Boudon discusses the "exponential effect" of persisting social contexts. Both of these refer to the expectation that if two individuals are consistently exposed to different social contexts, and if those contexts can be expected to affect an individual's personal characteristics in opposite ways (e.g., one will increase academic performance, the other decrease it), over time we should expect a progressively increasing difference in the two individuals' characteristics. In the present case, therefore, we would hypothesize that students in high ability groups would gain in academic performance and those in low ability groups would lose in performance, relative to what would have occurred if they had not been placed in homogeneous ability groups.

METHEDOLOGICAL ISSUES

Three kinds of methodological critiques have been aimed at research on this problem. One of these is essentially a "friendly" criticism. It suggests that since some of the research in this area has used students' self reports of track placement, the validity of the classification is questionable. It notes that there is less than perfect agreement between such student reports and official records of track placement. Most important, it has been shown (Rosenbaum, 1980) that track defined by the official records has a stronger effect on some outcomes, such as college attendance, than does self-reported track. In effect, this criticism suggests that there is considerable measurement error in the self-reports, which weakens any possible effect they could exhibit in the analyses conducted.

A second criticism is even more basic and clearly important. Early studies of the effects of ability grouping were not always able to control for the characteristics of the individuals before they became separated into ability groups. It could thus be argued that what purported to be effects of grouping (Alexander and McDill, 1976) were actually effects of the students' characteristics prior to entering differentiated academic tracks. In effect, this criticism suggests that the analytic models used in the early research were misspecified. Some more recent analyses, controlling for pre-tracking performance (Alexander, et al., 1978), have shown that this improved specification does reduce the observed effects of ability grouping, but they also demonstrate that significant ability grouping effects remain. At the same time, not all recent research shows such residual effects (Rehberg and Rosenthal, 1978).

The third kind of critique is concerned with problems of measurement (Linn and Slinde, 1977; Reichart, 1979; Willms, 1985). The crucial tests of the hypothesis of ability group effects all involve comparing test scores at two points in time. Test reliability is never perfect, and it would be expected, therefore, that this would lead to a general negative correlation between gain scores and the initial test score due to a regression to the mean. In the present instance, such an effect would work against the hypothesized effects of ability grouping since the hypothesis calls for greater than average gains in high ability groups and smaller gains in low ability groups.

Another measurement problem which could also tend to work against the hypothesis is the possibility of floor and ceiling effects. If some students are so able that they score at or near the top of the possible range of scores on the second test, it may be that their true performance potential is not adequately measured by the test. Similarly, if the second test is not sufficiently sensitive at the lower end, low ability students' scores may understate their relative position in the distribution of students.

The problem of measurement reliability is best dealt with in such cases through the use of multiple measures, especially at the initial measurement point. The problem of floor and ceiling effects is not easily dealt with, although some ad hoc methods have been used (Coleman, et al, 1982). It is important, however, to be sensitive to the possibility of such effects and to take them into account in interpreting the results of the analysis.

In the present analysis, these matters will be dealt with in the following ways. The information regarding the students' placement in ability groups was obtained from the schools rather than the students, and thus the first criticism does not apply. Also, the analysis will include a whole range of control variables in an effort to specify the model properly and avoid attributing to ability grouping effects that are due to pre-grouping factors.

The measurement problems are handled in several different ways. First, multiple measures of performance prior to ability grouping are used, some of them taken just prior to grouping, others from an earlier point. This should increase the reliability of the early measurement. In addition, in the present analysis it is possible not only to compare students in various ability groups with each other but also to compare all of them with students who were not in ability groups. Thus, if there is a tendency toward regression to the mean, it should be found in both grouped and ungrouped students. Finally, evidence of floor and ceiling effects is carefully examined and used systematically in the interpretation of the findings.

SAMPLE AND METHOD

The present analysis of ability grouping in Great Britain has two major advantages over previous studies. First, it is based on a birth cohort whose lives have been charted from birth to early maturity and for whom there is thus information from earlier ages than is usually available for such analyses. Second, the British school system at the time these individuals were in secondary school had a greater variety of organizational arrangements than have been considered in previous studies of ability grouping. In order to put the subsequent analysis in perspective, it will be necessary to present a few introductory statements about the sample and the school system.

The data come from the National Child Development Study (NCDS) conducted by the National Children's Bureau (NCB) of London. The NCDS originated as the "Perinatal Mortality Survey," a study of "virtually every baby born in England, Scotland and Wales during the week of 3 to 9 March [1958]" (Davie, Butler and Goldstein, 1972, p. 10). Follow-up studies were conducted when the cohort was 7, 11, 16 and 23 years old. The present analysis includes data from the 7, 11 and 16 year old time points, but the majority of the measures were made when the cohort was 11 and 16 years old.

The core measures are achievement tests in reading and mathematics specially administered in the schools for the NCDS when the cohort was 7, 11 and 16 years old. At age 7, the Southgate Reading Test and a Problem Arithmetic Test were administered. At age 11, a Reading Comprehension Test and an Arithmetic/Mathematics Test were administered. At age 16, the same Reading Comprehension Test as at age 11 and a Mathematics Test were administered.[1] Also, at age 11, a general ability test was administered from which verbal and non-verbal scores were derived.

The age 11 tests were administered during the last year of junior school, just prior to the students' transfer to secondary school. (This is actually a year prior to transfer to secondary school in Scotland where the change of schools occurs at age 12 rather than 11.) The measures may thus be considered indications of the students' ability and achievement levels prior to experiencing ability grouping in secondary school. The age 16 measures were administered just prior to the earliest point at which the students could leave school and thus the last point at which the full cohort could be administered tests. (Nearly two-thirds of the cohort left school at age 16.)

The vast majority of the cohort attended one of four kinds of secondary schools. After World War II, there were three kinds of British state-supported secondary schools, the grammar, technical and secondary modern schools. Grammar schools were attended by students of high ability who were deemed suitable to prepare for university attendance. Students who were gifted but who were destined for technical occupations were likely to attend technical schools. Other students, not chosen for either grammar or technical school attendance, attended secondary modern schools. By 1969 or 1970, when the cohort moved to secondary schools, a new form of school, the comprehensive school, had become predominant, and over half of the cohort attended one. It was not a selective school, but was intended to enroll a cross-section of students. Also, by that time, the technical school had almost disappeared. But both grammar and secondary modern schools still enrolled significant proportions of the students. Thus, the four major types of schools attended by the cohort were comprehensive, grammar and secondary modern schools in the state sector and private schools.[2] The analysis includes all students who attended those four types of schools and for whom full data are available.

Some, but not all, of the schools of all four types practiced ability grouping. The British differentiate between two kinds of grouping, "streaming" and "setting." Streaming refers to the separation of students by ability level for all of their classes while setting refers to separation for only particular classes, such as science or mathematics. In the analysis presented here, no distinction is made between the two. Instead, all students who were separated into ability groups of either kind for mathematics or English were classified together.[3]

The schools were asked whether each student was in an English or mathematics class grouped by ability and, if so, which group s/he was in. The reported groupings were classified into six types. In some schools, three levels of ability groups were differentiated and in others only two. It was thus possible for a student to be classified as being in a high or low group in either a two- or a three-group system or in a middle group in a three-group system. In addition, some students were in what were referred to as remedial groups. Therefore, in addition to students who were in ungrouped classes, there were those in remedial classes and those in high, medium and low levels in a three-group arrangement and those in high and low levels in a two-group arrangement.[4] (It is not at all certain that all of the students who were reported as being in a particular ability group had been in that group for the same period of time, but this variation, though regrettable, would mediate against observing the expected ability group effects.)

The analysis to be conducted is thus much more refined than has been carried out in the United States. First, it differentiates among four kinds of secondary schools which are themselves ability groups of a sort. The grammar and secondary modern schools were explicitly designed to serve different ability levels, the former being for high ability students and the latter for those not so defined. In addition, the private schools tended to serve students who were high ability, although ability was not the primary criterion of selection for attendance. Only the comprehensive schools were specifically intended to serve a cross-section of ability levels. If the effects of ability grouping are as hypothesized, we would also expect that students who attended grammar and private schools should have gained more and those who attended secondary modern schools should have gained less than comparable students who attended comprehensive schools. Also, within each of these school types, it is possible to differentiate among six kinds of ability groups rather than just two groups (usually college preparatory versus all others) as in almost all American studies. Finally, a unique feature of the present research is that, in all of the analyses, the effects of ability grouping can be assessed for the several levels and kinds of grouping in comparison with students in the same kind of school who did not experience ability grouping.

The analysis to be presented is designed to determine the extent, if any, of the effects of the separation of students into different school types and ability groups on the test performance of boys and girls in British secondary schools. The most critical analysis will use a regression model. In that analysis, the age 7 and age 11 test scores will be used as antecedent variables, the positions of the students in school types and ability groups will be used as intervening variables, and the age 16 test scores will be the dependent variables. In addition to the core test measures and the school and ability grouping categories, other measures will be included in the analysis as control variables. All but one of these measures were made prior to the students' entry into secondary school (the exception being a measure of school attendance during secondary school), and all of them were chosen because of their possible influence on the level of test performance at age 16. The additional control variables are the following:

Social Background

Social class of father's occupation (seven categories) when the child was 7 years old.

Social class of father's occupation when the child was 11 years old.

Age at which father left school.

Age at which mother left school.

Whether the child was nonwhite.

Whether the child lived with his or her natural or adoptive mother.

Whether the child lived with his or her natural or adoptive father.

Parent Influences

Whether, when the child was 11, the parents wished the child to leave school as soon as possible.

Whether, when the child was 11, the parents wished the child to seek some kind of education beyond secondary school.

School Influences

Whether the child attended a private school at age 7.

Whether the child attended a private school at age 11.

The teacher's rating of the child's reading ability at age 7.

The teacher's rating of the child's mathematics ability at age 7.

The teacher's rating of the child's use of books at age 11.

The teacher's rating of the child's mathematics ability at age 11.

Contingencies

Number of schools attended between age 5 and age 11.

Number of residential moves between birth and age 11.

The child's school attendance record at age 7.

The child's school attendance record during 1972 (when the cohort was 14 years old).

Whether the child had some kind of handicap.

A total of 9,399 individuals (4,797 boys and 4,602 girls) are included in the analysis. While there have been losses from the sample over the years, as happens in any longitudinal study, the losses have not had a strong biasing effect on the sample characteristics. A general indication of the amount of bias due to missing data is provided by Goldstein (1976, p.70) based on a detailed analysis of the data through age 16:

> Children who have previously belonged to 'disadvantaged' groups are less likely to provide any information at 16 years, and for estimates of the proportions of children with particular characteristics an upper limit for the relative bias at 16 years is about 10 percent. . . . For mental test scores at 11 years, the differences between the extreme categories of variables such as social class and family-size ratings have small biases of up to about 3 percent. . . . There is evidence in the case of mathematics attainment of a higher rate of change in attainment between 7 and 11 years for those with data at 16 compared with those without. A simple extrapolation of this difference to 16 years gives an overall bias in mathematics attainment of about 0.05 years, which would seem to be acceptably small.

FINDINGS

The results of the analyses will be presented in two parts. The first part is concerned with the levels of performance of individuals in the various groups, at both age 11 and age 16. The second part presents the results of regression analyses designed to assess the effects of ability grouping on the age 16 test scores in reading and mathematics.

Levels of Performance

Means and standard deviations of reading and mathematics test scores at age 11 and 16 were computed for boys and girls separately for each group formed by the combination of school type and ability grouping arrangements. The means and standard deviations of the full cohort, the four school types and the seven ability groups are presented in Tables 1 and 2. The full set of tables of these statistics, showing the scores of ability groups within school types, can be found in Tables A1 through A4 of the Appendix.

Several general observations can be made about these data. First, the mean levels of performance in both reading and mathematics at both ages are consistent with expectations, given the divisions of the cohort into school types and ability groups within schools. Average scores of students in comprehensive schools are most similar to the average for the full cohort - although they are slightly lower, suggesting that the top level students are "creamed" (to use a British term) by the grammar and private schools. Students in both of the latter types of schools score well above, and those in secondary modern schools score below, those in comprehensives (see Table 1).

Tables 1 and 2 about here

Similarly, the sub-group average scores follow the expected pattern. Those who were not in ability groups have average scores very similar to the full sample. (The exception is the ungrouped girls' average mathematics score, which at both 11 and 16 is clearly lower than the overall girls' average mathematics score.) Remedial students score the lowest of any sub-group at both ages, and the means for the other five types of ability groups fall in the sequence expected - even to the extent that the high and low groups in a three-group system have more extreme average scores than the high and low groups in a two-group system. In the great majority of cases, these patterns are found within school types as well as for the full sample (see Appendix Tables A1 - A4.)

It can be seen from Tables 1 and 2 that ability grouping is much more common in mathematics classes than in English. This is true for both boys and girls, three-fourths or less of either sex being grouped in English, but 91% of both sexes being grouped in mathematics. In the Appendix, Tables A1 - A4, it can be seen that grouping in English classes (Tables A1 and A2) is much more common in secondary modern and (especially) comprehensive schools than it is in either grammar or private schools. Also, in grammar and (especially) private schools, boys are more likely than girls to be grouped in English, whereas there is no sex difference in comprehensive or secondary modern schools. There are only small differences by school type or sex in the probability of being grouped in mathematics (Tables A3 and A4), although students of both sexes in comprehensive schools are the most likely to be grouped.

One important issue raised by the data in Tables 1 and 2 derives from the fact that the mean values on the reading test at age 16 are very high in some groups. In particular, for both boys and girls in both grammar and private schools, the mean age 16 reading scores are all over 30. The maximum score on the reading test was 35, so this suggests that the test was not wholly adequate to measure the potential performance of these students. The data in Tables A1 and A2 of the Appendix make this even more apparent. The mean age 16 reading scores for grammar school and private school students in all but one ability group are at least 30, and some are as high as 32. This strongly suggests that, at least for these students, the mean scores reflect a ceiling effect due to the limited nature of the test. The relatively small standard deviations of those groups with high mean scores, including even some in the comprehensive and secondary modern schools, also suggest a ceiling effect. Undoubtedly, the ceiling effect derives from the fact that the same reading test was used at age 11 and age 16. Although it was adequate to measure the full range of performances at the younger age, it was not wholly adequate at the older age.

The scores in mathematics suggest a different kind of problem, a floor effect. At age 11, for both boys and girls, the mean scores for the remedial groups are less than one-half of the full sample standard deviation above zero, and at age 16 they are still less than a full standard deviation above zero. The mathematics group means reported in Tables A3 and A4 confirm the expectation that the very low mean scores are found only in comprehensive and secondary modern schools, and thus the floor effects should be most apparent there. The group mean scores suggest that the mathematics tests at both ages were adequate to measure the upper range of potential performances, but they were less adequate in measuring the lower range.

These floor and ceiling effects mediate against the general hypothesis that guides the analysis to be presented below. The hypothesis calls for greater than average gains in high ability groups and less than average gains in low ability groups. If the high ability groups are restricted in the possible gains they can exhibit in reading, tests of the hypothesis in reading may be less adequate for them than for middle and lower groups. Similarly, if the low ability groups are restricted in the possible range of mathematics scores they could obtain, tests of the hypothesis in mathematics may be less adequate for them than for middle and upper groups.

Another matter of importance becomes apparent from an examination of the data in the Appendix (Tables A1 through A4). While the mean scores for ability groups all follow the expected order within all four school types, two differences across school types can be seen. The first is that there are essentially no remedial group students in either grammar or private schools. (There are some, but fewer than 10 boys or girls in any single instance.) Thus, the later regression analysis resulting in change coefficients for remedial students is relevant only to students in comprehensive and secondary modern schools.

Second, and even more important, it is clear that the kinds of students in what seem to be the <u>same</u> ability groups in different kinds of schools are actually very different. In numerous cases, the mean scores in reading or mathematics of students in "low" groups in grammar and private schools are actually as high or higher than the mean scores of students in "high" groups in comprehensive or secondary modern schools. That is, although students are grouped in an expected order within each school type, the select nature of the student bodies of all but the comprehensive schools leads to very different kinds of students being brought together under the same label.

While this latter fact raises questions about the labels used to identify the several ability groups, it suggests that any test of the hypothesis calling for specific patterns of effects of ability grouping that is made using such varied individuals classified into the same categories is a more stringent test of the effect of grouping than would result from using more homogeneous groups. If the hypothesized effect of ability grouping is found even when the absolute performance levels of students in the ability groups differ, it provides stronger support for the idea that it is the grouping, rather than the ability level as such, that makes the difference. We will need to examine this logic carefully after the basic analysis has been presented.

Before turning to the regression analysis, however, it will be instructive to examine the nature of the associations between age 11 and age 16 test scores. Figures 1 and 2 provide an indication of the form of those associations, although they report only a limited part of the data. Figure 1 presents reading score data for boys, and Figure 2 presents mathematics score data for girls. In both cases, the data presented are limited to those from ungrouped, remedial, and high and low groups from the three-group arrangement. The figures become unreadable if data from all seven groups are presented, and it is unnecessary to present figures for boys' mathematics and girls' reading because of their similarity to these two figures. In each figure, mean age 16 scores are plotted for each age 11 score obtained by at least 10 individuals in each of these groups. (In some cases, points are plotted based on fewer than 10 cases. When this is done, the point is marked by a circle.)[5]

The Figure 1 data are consistent with the guiding hypothesis. Since the hypothesis calls for greater than expected gains for high ability and less than expected gains for low ability groups, it suggests that at every point where two or more groups have the same age 11 test scores, the age 16 mean test scores should be in the following order: high ability group, ungrouped, low ability group, and remedial group. Although there are some cases where groups do not differ, there are no reversals of that order in the whole figure. At the same time, consistent with the previous discussion of a ceiling effect, the differences between high ability and ungrouped scores at the upper end of the range are very small. The girls' reading data are highly similar, the only difference of note being some minor cross-overs of high ability and ungrouped scores at the upper end of the range.[6]

Figure 2 parallels Figure 1, but is based on the girls' mathematics data. It is different from Figure 1 in two important ways. First, not only is there no overlap between the high ability and ungrouped scores, the margin between them is at least as large at the upper end of the range as at mid range. In fact, the high ability group has scores (made by at least 10 students) at both 11 and 16 that are far above those obtained by any of the ungrouped students. This is another indication that the mathematics tests more adequately measured the upper end of the performance continuum in this sample. Second, it is clear that there is not very much differentiation at the lower end of the continuum. The mean age 16 scores for the ungrouped, remedial and low ability groups all look very much alike in the range from 1 to 10 on the age 11 test. The age 16 mean scores for those students all range from 5.3 to 7.6, and there is little indication of a trend. It is only above the age 11 score of 10 that any tendency is seen for the age 16 scores of low ability students to fall below those of the ungrouped students. The pattern for boys' mathematics scores is very similar, although there is more differentiation at the lower end of the distribution and a greater tendency for the ungrouped and high ability group scores to converge at the upper end of the distribution.

The simple associations of age 11 and age 16 scores, partially reflected in these figures, suggest that support for the hypothesis of ability group effects may take different forms in the two subjectmatter areas. In reading, the ceiling effect should reduce the possibility of greater than expected gains in the high ability groups, and in mathematics the floor effect should reduce the possibility of less than expected gains in the low ability groups. At the same time, except perhaps for the remedial groups in mathematics, there is a suggestion of support for the hypothesis over at least part of the range of scores in both subjectmatter areas. A more comprehensive test of the hypothesis is presented in the next section.

Modeling Changes in Achievement

The core hypothesis being considered is that ability grouping tends to increase the level of performance of students in high ability groups and decrease the level of performance of students in low ability groups <u>compared with what they would have been if the students had not been segregated into ability groups.</u> The previous section uses a very simple basis for estimating the expected age 16 test scores, a single age 11 test score. Given the limited reliability of any single test, that is not a wholly adequate basis.

In order to begin to deal with the hypothesis more effectively, age 16 test scores were regressed on three prior test scores. The age 16 reading scores were regressed on the age 11 and 7 reading scores and the age 11 general ability (verbal) test score. The age 16 mathematics scores were regressed on the age 11 and 7 mathematics scores and the age 11 general ability (non-verbal) score. The three prior scores represent the best basis we have for predicting the age 16 scores and provide a more reliable basis than do the age 11 reading or mathematics scores alone.

In each regression analysis, dummy variables were used to represent either the school type or the ability group of the individual students. In analyses in which school types were included, the comprehensive school was used as the reference category. Thus, the coefficients for the other school types represent the average difference in age 16 achievement, stated in the metric of the age 16 test, due to having attended that type of school rather than a comprehensive school. Similarly, in analyses in which ability group dummy variables were used, the ungrouped students were used as the reference category. In those analyses, therefore, the coefficients of the ability groups represent the average difference in age 16 achievement, stated in the metric of the age 16 test, due to having been in a particular kind of ability group rather than having been in an ungrouped class.

The regressions were computed for the full set of possibilities - using only school types, using only ability groups, and using ability groups within school types. Because of the complexity of the results, only the coefficients for the dummy variables representing school types or ability groups are reported here. The full set of dummy variable coefficients for ability groups within school types are reported in Appendix Table A5. Table 3 presents the results from the analysis of the full samples of girls and boys. The metric dummy variable coefficients for school types and ability groups are reported as well as the adjusted R^2 of the full equation and the adjusted R^2 for the equation using only the earlier test scores as the independent variables.

Table 3 about here

The analysis of school types shows a sharp contrast between the results for reading and for mathematics. School type has essentially no effect on age 16 reading scores, net the test scores of the students at ages 7 and 11 (prior to entry into secondary school). On the other hand, school type has a very significant effect on age 16 mathematics test scores. Having attended a grammar school or a private school, rather than a comprehensive school, adds between two and three points to the average score on the age 16 mathematics test beyond what would be expected, given the students' earlier test performance. That represents between three-tenths and and one-half a standard deviation of the age 16 mathematics test scores (see Table 1) - a very considerable gain. In contrast, attending a secondary modern school rather than a comprehensive school is associated with a loss of from three-tenths to seven-tenths of a point on the age 16 mathematics score. These are especially impressive differences, given the fact that the grammar and private school students' scores were the highest overall when they entered secondary school and the secondary modern school students' scores were the lowest.

The effects of ability grouping are apparent in both reading and mathematics. The effects on reading performance are most visible for the remedial reading group. In spite of their very low average performance at age 11 (see Table 2), they lose a great deal of additional ground during secondary school. (Actually, they have not so much lost ground as failed to gain to the same degree as have comparable students in the ungrouped category - as is apparent from Figure 1.) It is not at all clear that any remediation has occurred. The remedial group coefficients are much smaller in mathematics, although the coefficient for the boys is significantly negative.

For those in the other five ability groups, there are generally significant effects of the sort called for by the core hypothesis being considered here. Those in the high ability groups score significantly higher than expected, given their earlier test performance, and those in the low ability groups score significantly lower, in comparison with comparable students who were not in ability groups. The spread created by gains in high and losses in low ability groups is greater for girls in reading and for boys in mathematics. Also, for both sexes and in both test areas, the spread is greater in the three-group than the two-group systems. The spread in the three-group systems is over four points for girls' reading scores and for boys' mathematics scores. These are about three-fifths of a standard deviation of the age 16 test scores (see Table 1), a very large effect.

The ceiling effect on the reading scores and the floor effect on mathematics scores are undoubtedly reflected in the coefficients in Table 3. In the reading score analysis of ability groups, both the remedial and the lower ability groups' negative coefficients are quite sizeable, whereas the high ability groups' positive coefficients are much smaller. This suggests that the reading score gains of the high ability groups may understate their actual gains. In the ability group analysis of mathematics, especially for girls, the opposite seems to be the case. The gains made by high ability groups are larger than the losses of the remedial or low ability groups. In fact, the loss by the boys' remedial group is smaller than the loss of the boys' two lower ability groups; similarly, the girls' remedial group shows no loss at all and the girls' low ability group coefficients are not significant in size.

The school type coefficients for mathematics suggest that, compared with those in comprehensive schools, students in grammar and private schools gained more than students in secondary modern schools lost. However, the mean age 16 mathematics test score for secondary modern students is only one and one-half standard deviations above zero (see Table 1), and it is thus likely that the test did not fully represent the range of possible performances at the lower end. In spite of these limitations, however, the results in Table 3 are consistent with the general hypothesis, with the exception of the reading scores across school types.

Before accepting these results as definitive, it is important to raise the further question of other possible sources of the observed changes over the five-year period. As indicated earlier, four sets of variables, all antecedent to the age 16 testing, were considered. They were measures of the family background of the student, the student's parent's wishes for his or her educational attainment, additional measures of earlier school influences, and several contingent factors that might be expected to affect academic performance. These four sets of variables were included individually and in combination in the regression analyses to control for possible additional influences, not directly relevant to the effects of ability grouping.

As before, these analyses were conducted for the full sample with school type represented by dummy variables, with ability groups represented by dummy variables, and within school types with ability groups represented by dummy variables. The dummy variable coefficients from the analyses within school types are presented in Appendix Table A6.

Table 4 presents the dummy variable coefficients for school types and ability groups from the analysis of the full samples of girls and boys using all of the control variables in a form parallel to Table 3. A comparison between the two sets of coefficients indicates that, although the control variables have added somewhat to the explanation of variance in age 16 test scores, and although the sizes of the coefficients for school types and ability groups have generally been reduced somewhat, the form of the results is essentially the same as without the controls.

Table 4 about here

School type continues to have little effect on the level of performance in reading, although there is an interesting reversal in the signs of the boys' coefficients for grammar and secondary modern schools. Boys who attend grammar schools fall below their expected level of performance, and those who attend secondary modern schools rise above their expected level. The direction of these effects was the same in Table 3, but the coefficients were not statistically significant until the control variables were introduced. I have no ready explanation for this result.[7] Those who attend grammar or private schools gain significantly in mathematics performance beyond what would be expected from their earlier test scores and all of the other antecedent conditions considered. While the size of the gain has been reduced over that reported in Table 3, it still represents a gain of between one-fifth and one-third of a standard deviation in the age 16 mathematics test scores.

The results for ability groups continue to be more significant than are those for school types. The remedial reading group is still the most disadvantaged of all, falling from three-fifths to nearly three-fourths of a standard deviation below their expected performance, given the full set of antecedent variables. There is no disadvantage for the remedial groups in mathematics, however, the girls actually performing somewhat better than expected. Undoubtedly these results reflect the floor effect on the mathematics analysis.[8] Among the other ability groups, there are still sizeable differences between the coefficients for the high and low groups. As before, the high-low spread is greater for the three-group comparison, and the spread is greater for girls in reading and for boys in mathematics. The three-group spread in reading for girls and in mathematics for boys are both in excess of one-half a standard deviation. Finally, it remains true that the negative coefficients for low ability groups are larger than the positive coefficients for high ability groups in reading, and the reverse is true for mathematics coefficients. Which, again, is consistent with the expected ceiling and floor effects discussed earlier.

Although these results for ability grouping are highly significant and have withstood the introduction of a large number of other possible sources of influence, they are not wholly consistent across school types. (The full set of dummy variable coefficients is presented in the Appendix Table A6.) Several variations across school types are noteworthy:

(1) There are very few individuals in remedial groups in either grammar or private schools. Thus, the strong effect on reading scores of remedial group segregation applies only to comprehensive and secondary modern schools, and it tends to be stronger in the former than the latter.

(2) Very few of the individual ability group coefficients are statistically significant in the grammar or private school type analyses. Also, although most of the coefficients follow the expected pattern, there are a number of reversals from the general pattern in the order of the coefficient sizes and signs. The reversals are more common for mathematics in grammar schools

and for reading in private schools.

(3) Overall, therefore, the expected pattern of increased gains for high ability groups and decreased gains for low ability groups is found most clearly and consistently in comprehensive and secondary modern schools.

The weaker results within grammar and private schools are not surprising, given the small ability group sample sizes and the compact distributions of the age 16 mean scores of the ability groups in those two school types (see Tables A1 through A4). Neither of these school types has any sizeable number of remedial students, and the private schools have very few low ability group students of any kind. In addition, the range of mean scores of the ability groups they do have is usually very narrow. Only the mathematics group means in private schools have a range anywhere near the ranges in comprehensive and secondary modern schools. And it is precisely in the private school mathematics analysis where the hypothesized pattern is most clearly found. What is more surprising than the generally weaker results in these school types is the fact that the grammar school reading score analyses are consistent with the hypothesized pattern, given the very narrow range of ability group mean scores (a maximum of 3.8 points difference between high and low ability group means) and the very small low ability group sample sizes.

Discussion

The evidence presented leaves little doubt that separation of students into ability groups has an effect on achievement test performance in both reading and mathematics. The regression analyses graphically demonstrate the effects of ability grouping, even when a great many other sources of possible influence are controlled. Students in remedial classes lose a great deal of ground (at least in reading). Students in low ability groups lose ground, and those in high ability groups increase their average performance level beyond that exhibited by comparable students in ungrouped school settings. The losses by low ability students, combined with the gains by high ability students, make the overall effect of ability grouping very striking. The pattern is so clear that it is even possible to differentiate between the effects of a two-group and a three-group system, the latter producing a greater high-low spread in test-score gains.

While there is evidence of the effects of ability grouping in all four school types, it is much clearer in comprehensive and secondary modern schools than in either grammar or private schools (Appendix Tables A5 and A6). Yet, where there is any sizeable differentiation in scores across ability groups, the hypothesis receives support even in those highly selective schools.

It is also noteworthy that there is a significant overall gain in mathematics performance associated with attending a grammar or private school (Table 4). The contrast between grammar and secondary modern student outcomes in mathematics parallels the contrast between high and low ability groups. Since students are chosen to attend these two types of state supported schools on much the same basis as students are chosen for high and low ability groups within schools, this contrast also tends to support the major hypothesis of the research. However, the reading score analysis does not indicate the same kind of contrast between grammar and secondary modern school outcomes.

The weakest support for the hypothesis of differential gains in high and low ability groups is found in the mathematics analysis for girls. In Table 4 it is seen that for that analysis the two low ability groups have positive coefficients and the remedial group has a significant positive coefficient. If that pattern were found for both boys and girls, it might be attributed to a floor effect in the mathematics test score analyses. But the boys' mathematics results are much more clearly in keeping with the hypothesis.

The data in Table A6 indicate that the overall mathematics results for the girls are most clearly repeated in the comprehensive schools, although both there and in the secondary modern schools only the two high ability group coefficients are statistically significant. It was noted earlier that the mean mathematics scores for girls who were not in ability groups were lower, relative to the full sample means, than was the case for either boys' mathematics scores or the reading scores for either sex. As Table A4 reports, the ungrouped girls in both comprehensive and secondary modern schools have mean scores that are less than one and one-half standard deviations above zero. There is very little difference between the mean scores of the ungrouped girls and girls in either low ability group or the remedial group. (This bunching of the remedial, low and ungrouped girls is also reflected in Figure 2, although Figure 2 is based on the full sample of girls.) The weaker results for girls' mathematics scores may thus be due to the peculiarities of the distributions of girls in the various groups.[9]

The more persistent difference found in these analyses is between the results for reading and for mathematics. If only the regression analyses were considered, it would be possible to speculate that those differences resulted from differences associated with the subjectmatter itself. Instead, it has been possible to relate the differences across subjectmatter to the characteristics of the tests used and to explain the relative sizes of the coefficients for high and low (or remedial) groups in terms of floor and ceiling effects. Similarly, the weakness of the support for the hypothesis within grammar and private schools can be explained in terms of the very narrow range of mean scores of students in the various ability groups.

What is indicated by these results is that ability grouping does indeed increase the gains of students in high ability groups and reduce the gains of students in low ability groups. These effects are strong wherever the characteristics of the tests and the groups of students involved permit them to occur. They are weakest (sometimes missing) where either the mean scores of the groups of students are unusually homogeneous or the tests do not permit sufficient differentiation among them. While the results of this analysis suggest that the measures used were less than ideal for the purposes at hand, they also serve to emphasize the importance of examining the distributional characteristics of the test scores rather than just the results of the multivariate analyses. And, in spite of the limitations of the measures used here, the results are sufficiently clear to lend strong support to the hypothesis that guided the research.

The present research has the advantage over any previously conducted on this problem of having a more refined set of ability groups to be included in the analysis. It thus has been possible not only to compare high and low ability groups, but to do so within both a two-group and a three-group arrangement. In addition, of course, the presence of the remedial category broadened the basis of comparison even more. As called for by the hypothesis, the remedial group suffered the greatest setback, and the spread of differential gains was greater in the three-group than in the two-group arrangement.

These comparisons were made clearer by the fact that, for all analyses, there was a category of ungrouped students which served as a reference point in making these comparisons. Since the division of students into ability groups was based on a different range of levels in different kinds of schools, it was also possible to observe (as in Figures 1 and 2) the contrasts across groups at the same test score levels. The fact that differential gains occurred in the various groups, even when the initial scores were held constant, is especially striking. The nature of the British school system also made it possible both to use school types as analogues of ability groups and to examine the effects of ability grouping within these different school types.

While the evidence presented here does strongly support the hypothesis that ability grouping differentially affects performances of high and low ability groups, it does not provide an explanation of that effect. At least four explanations appear to be reasonable: (a) Students in high ability groups are provided with a different program than those in low ability groups, and they are thus provided with the means to gain more in the tested subjectmatter. This difference might include a more demanding set of lessons, more homework, etc. (b) The teachers assigned to high ability groups are both more competent and more highly motivated to improve the level of performance of their students. Whatever the curriculum, they do a better job of teaching it. (c) Students respond to their peers as well as to their teachers and the curriculum. Thus, if a given student is surrounded by high (or low) ability peers, his or her performance will be affected by them. (d) Scores on the tests used in such studies actually measure both the level of a student's current knowledge and also his or her growth potential. The reason high ability group students gain more than low ability group students is that they have a greater ability to do so. Of course, these explanations are not mutually exclusive. They could all have some validity. The present study is not an adequate basis for assessing the validity of any of them.

However, the kinds of results displayed in Figures 1 and 2 at least cast serious doubt on the validity of the fourth explanation. In those figures we see that, to the extent the characteristics of the tests used permit adequate measurement and the group assignment practices provide a basis for comparison, there is a consistent tendency for students at all ability levels to gain more if they are assigned to a high ability group and to gain less if they are assigned to a low ability group. If the baseline test scores measured potential as well as performance, this would not be so. The first three suggested explanations would thus seem to be a stronger basis on which to plan further research on this problem. They clearly call for information about teachers, curriculum and the composition of the several ability groups within schools, information not available for this analysis.

But does the present analysis have relevance to the American case? This may be a more debatable question. It can be argued, certainly, that the British division between grammar and secondary modern schools has no counterpart in this country and thus it is pointless to emphasize that contrast for our purposes. At the same time, it is important to remember that all of the findings of differences across ability groups are strongly upheld within the British comprehensive schools, which are as close as one can come in Great Britain to a counterpart of the American high school.

Thus, a more appropriate question may be: Does the fact that the British schools report such an elaborate set of streams, compared with the crude dichotomy between college preparatory and other curricula used in analyses of the American case, preclude any relevance of the present analysis for our purposes? I would argue the opposite. Actually, the present analysis should alert us to the possibility that we have yet to conduct a wholly satisfactory analysis of the American system of tracking.

It is at least worth considering the possibility that, if we were to administer a questionnaire to American schools comparable to the one used in the NCDS, we might find that many (most?) American schools also track English and mathematics classes in a wide variety of ways similar to those reported by the British school officials. By depending on a global curriculum classification, we not only combine curricula which are undoubtedly different from each other (e.g., general and vocational), but we also obscure any variation that may exist within any of these tracks. If nothing else, it leads us to assume that all students in the academic track are at the same level in both English and mathematics. It seems unlikely that that is generally the case in the United States, and the frequencies in various ability groups in the present analysis make it clear it is not the case in Great Britain. Thus, the present analysis may serve as a warning that the studies of American school organization thus far may have been overly crude and may not have attended to important differentiations that actually exist within our schools.

FOOTNOTES

1. To measure reading skills, at age 7, the children took the Southgate reading test (Southgate, 1962) which is a standardized test of word recognition (choosing the correct word to correspond to a picture or to the word read aloud by the teacher). At age 11, a 35-item Reading Comprehension Test designed by the National Foundation for Educational Research (NFER) was administered. The test was designed to be parallel with the Watts-Vernon test of reading comprehension. It is a sentence-completion test in which the student chooses the correct word from several (usually five) provided. The same test was administered at age 16. Three different arithmetic/mathematics tests were used, one for each age level. The first two were designed by NFER to be appropriate for children of these ages. The 7 year test consisted of only ten problems, graded according to difficulty. The test for the 11 year olds had 40 items and combined both problem and mechanical items. The 16 year test, designed at the University of Manchester, also combined problem and mechanical items and had 31 items. Only the Southgate reading test has been published. However, the other tests have all been subjected to intensive analysis by the NCB staff and have been found to have desirable psychometric characteristics. Goldstein and Fogelman (1974), Fogelman and Goldstein (1976) and Fogelman (1983, pp. 36-42) provide evidence of both high levels of reliability and external validity of these scales when used in longitudinal analysis.

2. It is worth noting that the Scottish school system is different in many ways from the English and Welsh systems, and it might be questioned whether a single combined analysis is warranted. Many more Scottish children attended comprehensive schools (more than 90% in this sample, compared with less than

60% of the English and Welsh children) although they were about equally likely as the English and Welsh children to be separated into ability groups. Separate analyses were conducted for the Scots and for the English and Welsh combined to determine if there were significant differences in the patterns of effects. Although there were some differences and there were many fewer significant Scottish effects, even the small Scottish samples (fewer than 600 boys or girls) exhibited the same general patterns of effects of ability grouping as reported here for the full samples.

3. Ideally, this differentiation would be made because it is reasonable to expect that separating students into streams would have a greater effect than separating them into sets because of the greater visibility and comprehensiveness of the division. Unfortunately, it was not feasible to use that differentiation in this analysis because the requisite information was not reliably recorded. It is worth noting, however, that more than 70% of both boys and girls were in ability groups in both English and mathematics, and the great majority of those were in the same level ability group in both subjects. (Only about 15% were in an ability group in one subject and not in the other, the great majority of those being in an ability group in mathematics but not in English.) It is not necessarily the case, of course, that even students who were in the same level ability group in both subjects were in fully streamed situations, and I have chosen to conduct the analysis separately in the two subject areas rather than make that assumption.

4. The classification scheme used to construct the data set was actually even more complex than this suggests. The schools were asked to describe their system of separation of students into groups. The NCB personnel then devised a coding system to reflect the common patterns within the responses. The

arrangements reported were very numerous, some schools having more than three sets or streams. The coding system used thirds where possible, sometimes combining two or more sets or streams into an upper, middle or lower third. Sometimes, however, only two levels could be differentiated. Also, some schools used internal standards to define the levels while others separated students according to which national examinations they were preparing for. The coding used often differentiated between levels of examinations such as: (a) O-level (or in Scotland O-grade) classes, CSE classes, and non-examination classes (England and Wales only), or (b) O-level and CSE classes, and CSE plus non-examination (or in Scotland non-examination) classes. About two-fifths of students in ability groups were in groups formed by internal standards, and about three-fifths were in groups formed by national examination standards. In both cases, of course, it was also possible for there to be remedial classes. Preliminary analyses used all of these groups (five based on internal standards, five based on national examination standards, and remedial - eleven in all), but that meant that many of the groups were very small. The magnitude and ordering of the coefficients in the regression analyses were fully parallel for the two forms of grouping, and it was decided to collapse the two sets of groups into those used here. The results presented here are fully consistent with those using the greater number of groups, and they are much more reliable.

5. Figures 1 and 2 appear to be very different because of the different kinds of tests used to measure reading and mathematics. Because the same test of reading was used at ages 11 and 16, all groups' average age 16 scores are higher than their age 11 scores, and the trend lines for all groups in Figure 1 are above the diagonal. However, since two different mathematics tests were used, and the age 16 test was much more difficult than the age 11 test, the

diagonal has a different meaning in Figure 2 than in Figure 1. All of the groups except the remedial group produce trend lines that cross the diagonal (this is true for the boys' scores also), an indication of the different levels of difficulty of the tests at the two ages.

6. The fact that students in very different ability groups had the same age 11 test scores is due to two factors. The most important one, as noted earlier, is the fact that within different school types, the definitions of "high" and "low" differ. In addition, however, it is true that, even within the same school type, students with the same age 11 test scores are found in different ability groups. To assess the possible significance of factors other than test performance in the assignment to ability groups, all of the antecedent variables used in the regression analysis to be presented were included in a logit analysis predicting high ability group assignment in comprehensive schools. The only variables having a significant effect on the probability of high ability group assignment for both boys and girls were prior test scores and teachers' ratings of the students' abilities. For boys, parent educational goals for the boy were also significant. However, for both sexes, in the case of both test scores and teachers' ratings, measures from both age 11 and age 7 were significant predictors of ability group assignment. This makes it clear why the single age 11 test score is not a very precise indicator of ability group placement, even within a single school type.

7. The unusual school effects for boys' reading may also have resulted from the ceiling effect on reading scores. If the ceiling effect prevented the grammar and private school students from exhibiting the gains they were capable of but permitted the secondary modern boys to do so, the kind of effect indicated in Table 4 could be produced. However, if that is the basis for these results, it is not clear why the results for the girls are so different.

8. This outcome will be considered again later in the paper.

9. The difference between the sexes noted here may in some way be related to the frequently cited (Douglas, et al, 1968; Grant and Eiden, 1982) tendency for girls to lose ground in mathematics performance during adolescence, but there is insufficient evidence available here to justify further speculation on that possibility.

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TABLE 1

FREQUENCIES, MEANS AND STANDARD DEVIATIONS OF TEST SCORES AT 11 AND 16, BY SCHOOL TYPES

		AGE 11		AGE 16	
	N	Mean	SD	Mean	SD
Boys Reading					
Total	4,797	16.41	6.36	25.88	6.88
Comprehensive	2,927	15.59	6.08	25.08	6.85
Grammar	518	22.42	4.58	31.37	3.23
Secondary Modern	1,070	14.20	5.41	24.02	6.89
Private	279	22.42	5.29	31.25	3.71
Girls Reading					
Total	4,602	16.46	5.94	25.65	6.50
Comprehensive	2,746	15.63	5.71	24.76	6.50
Grammar	609	21.77	4.15	31.09	2.81
Secondary Modern	986	14.18	5.06	23.54	6.32
Private	261	21.46	5.06	30.39	3.92
Boys Mathematics					
Total	4,768	17.72	10.46	13.77	7.19
Comprehensive	2,911	16.31	9.89	12.71	6.80
Grammar	513	29.37	6.08	21.46	5.36
Secondary Modern	1,071	13.48	8.41	11.07	5.41
Private	273	27.58	8.82	21.18	5.92
Girls Mathematics					
Total	4,572	17.18	10.01	12.35	6.65
Comprehensive	2,743	15.72	9.38	11.31	6.04
Grammar	600	27.68	6.54	19.75	5.05
Secondary Modern	976	12.77	8.08	9.31	4.88
Private	253	25.23	8.89	17.89	6.59

TABLE 2

FREQUENCIES, MEANS AND STANDARD DEVIATIONS OF TEST SCORES AT 11 AND 16, BY ABILITY GROUPS

		AGE 11		AGE 16	
	N	Mean	SD	Mean	SD
Boys Reading					
Not Grouped	1,007	17.19	6.63	26.48	6.72
Remedial	153	8.47	3.92	13.76	6.23
3-Groups - High	1,213	20.67	5.09	30.45	3.73
- Mid	1,285	15.07	5.02	25.34	5.37
- Low	510	11.39	5.17	19.72	7.17
2-Groups - High	316	18.65	5.35	28.89	4.47
- Low	310	12.70	5.08	21.40	6.23
Girls Reading					
Not Grouped	1,149	17.47	6.04	26.62	6.25
Remedial	103	8.14	3.94	13.81	5.97
3-Groups - High	1,281	19.84	4.83	29.54	3.86
- Mid	1,138	14.75	4.66	24.38	5.08
- Low	355	10.53	4.68	17.60	6.30
2-Groups - High	336	17.63	5.04	27.50	4.75
- Low	240	12.42	4.54	20.76	6.28
Boys Mathematics					
Not Grouped	421	17.86	10.59	13.42	7.26
Remedial	149	4.44	4.56	5.87	3.16
3-Groups - High	1,337	26.24	8.04	20.08	5.85
- Mid	1,535	15.61	8.35	12.04	5.43
- Low	657	9.19	7.55	7.92	4.30
2-Groups - High	343	21.97	8.29	16.54	6.01
- Low	326	11.37	7.79	8.95	4.91
Girls Mathematics					
Not Grouped	417	15.35	9.49	10.59	6.15
Remedial	118	4.61	3.89	6.07	3.20
3-Groups - High	1,254	25.19	8.12	17.97	6.20
- Mid	1,573	15.63	8.19	10.70	4.93
- Low	560	9.09	7.52	7.72	4.64
2-Groups - High	343	20.77	8.22	14.78	6.02
- Low	307	10.50	7.34	8.43	4.38

TABLE 3

SCHOOL TYPE AND ABILITY GROUP COEFFICIENTS IN REGRESSION ANALYSIS OF AGE 16 TEST SCORES

	Boys Reading	Girls Reading	Boys Math	Girls Math
School Type				
Grammar	-.243*	.397[a]	2.178[d]	3.099[d]
Secondary Modern	.270*	-.005*	-.309*	-.706[d]
Private	.110*	.450*	2.707[d]	2.367[d]
Adjusted R^2	.655	.679	.640	.607
R^2 Without Types	.654	.679	.628	.579
Ability Group				
Remedial	-5.659[d]	-4.523[d]	-1.072[b]	.538*
3-Group - High	.975[d]	.781[d]	2.741[d]	3.010[d]
- Mid	.461[c]	-.173*	-.523[b]	-.156*
- Lo	-2.022[d]	-3.241[d]	-1.507[d]	-.105*
2-Group - High	.890[c]	.482[a]	1.031[c]	1.653[d]
- Low	-1.405[d]	-1.744[d]	-1.563[d]	-.071*
Adjusted R^2	.685	.705	.660	.610
R^2 Without Groups	.654	.679	.628	.579

* = non-significant
a = .05
b = .01
c = .001
d = .0001

Note: See text for list of other variables included in the analysis.

TABLE 4

SCHOOL TYPE AND ABILITY GROUP COEFFICIENTS IN
REGRESSION ANALYSIS OF AGE 16 TEST SCORES WITH ADDITIONAL CONTROLS

	Boys Reading	Girls Reading	Boys Math	Girls Math
School Type				
Grammar	-.622[b]	-.007*	1.786[d]	2.536[d]
Secondary Modern	.362[a]	.088*	-.236*	-.541[b]
Private	-.265*	.170*	1.784[d]	1.617[d]
Adjusted R^2	.672	.700	.656	.632
R^2 Without Types	.671	.700	.650	.616
Ability Group				
Remedial	-5.066[d]	-3.643[d]	-.716*	1.115[a]
3-Group - High	.908[d]	.827[d]	2.344[d]	2.631[d]
- Mid	.538[b]	.020*	-.570[b]	-.166*
- Low	-1.755[d]	-2.669[d]	-1.222[d]	.146*
2-Group - High	.714[b]	.510[a]	.721[a]	1.561[d]
- Low	-1.279[d]	-1.459[d]	-1.256[d]	.310*
Adjusted R^2	.694	.719	.674	.640
R^2 Without Groups	.671	.700	.650	.616

* = non-significant
a = .05
b = .01
c = .001
d = .0001

Note: See text for list of other variables included in the analysis.

TABLE A1

BOY'S FREQUENCIES, MEANS AND STANDARD DEVIATIONS OF AGE 11 AND 16 READING SCORES, BY ABILITY GROUP WITHIN SCHOOL TYPES

		AGE 11		AGE 16	
	N	Mean	SD	Mean	SD
TOTAL	4,797	16.41	6.36	25.88	6.88
Comprehensive	2,927	15.59	6.08	25.08	6.85
Not Grouped	435	15.03	6.20	24.42	6.87
Remedial	107	8.70	3.76	13.69	5.74
3-Group - High	748	20.34	4.98	30.25	3.78
- Mid	868	14.69	4.87	25.01	5.27
- Low	340	11.16	4.83	19.09	6.56
2-Group - High	199	18.00	5.06	28.54	4.38
- Low	230	12.21	4.56	20.97	5.83
Grammar	518	22.42	4.58	31.37	3.23
Not Grouped	224	22.25	4.35	31.03	3.68
Remedial	*	*	*	*	*
3-Group - High	177	23.12	4.72	32.03	2.51
- Mid	39	21.31	4.32	31.21	2.82
- Low	27	19.81	4.21	30.00	2.70
2-Group - High	38	23.63	5.00	32.18	2.60
- Low	13	21.23	4.28	29.23	4.78
Secondary Modern	1,070	14.20	5.41	24.02	6.89
Not Grouped	244	13.95	5.06	24.07	6.29
Remedial	45	7.82	4.24	13.62	7.13
3-Group - High	163	17.53	4.29	28.66	4.32
- Mid	360	15.01	4.81	25.21	5.41
- Low	132	9.86	4.41	18.35	7.15
2-Group - High	61	17.41	4.74	27.56	4.64
- Low	65	12.55	5.48	21.06	6.68
Private	279	22.42	5.29	31.25	3.71
Not Grouped	104	22.89	5.76	30.99	4.63
Remedial	*	*	*	*	*
3-Group - High	125	23.36	4.44	31.78	2.61
- Mid	18	21.39	4.67	30.78	2.46
- Low	11	16.27	4.22	30.36	4.06
2-Group - High	18	19.56	5.66	30.22	4.80
- Low	*	*	*	*	*

*Means and standard deviations are not computed if the category frequency is less than 10.

TABLE A2

GIRL'S FREQUENCIES, MEANS AND STANDARD DEVIATIONS OF AGE 11 AND 16 READING SCORES, BY ABILITY GROUP WITHIN SCHOOL TYPES

		AGE 11		AGE 16	
	N	Mean	SD	Mean	SD
TOTAL	4,602	16.46	5.94	25.65	6.50
Comprehensive	2,746	15.63	5.71	24.76	6.50
Not Grouped	433	14.77	5.32	23.80	6.35
Remedial	70	7.89	3.86	13.03	5.78
3-Group - High	893	19.47	4.85	29.21	4.00
- Mid	744	14.31	4.41	23.98	4.91
- Low	239	10.45	4.39	17.30	5.78
2-Group - High	209	17.08	5.20	26.74	5.08
- Low	158	11.85	3.85	19.77	5.38
Grammar	609	21.77	4.15	31.09	2.81
Not Grouped	321	22.07	4.09	31.29	2.62
Remedial	*	*	*	*	*
3-Group - High	171	22.42	3.82	31.67	2.20
- Mid	52	19.79	4.85	29.37	4.01
- Low	12	17.75	4.49	27.83	4.57
2-Group - High	28	21.75	3.89	31.07	2.43
- Low	25	19.64	2.58	29.80	2.68
Secondary Modern	986	14.18	5.06	23.54	6.32
Not Grouped	236	13.58	4.34	23.00	5.45
Remedial	31	8.06	3.18	14.81	5.54
3-Group - High	160	18.01	4.31	28.31	3.84
- Mid	322	14.60	4.50	24.20	5.16
- Low	96	9.46	4.16	16.36	6.03
2-Group - High	86	16.97	4.12	27.64	3.93
- Low	55	10.47	3.74	19.09	6.22
Private	261	21.46	5.06	30.39	3.92
Not Grouped	159	21.36	5.03	30.21	4.12
Remedial	*	*	*	*	*
3-Group - High	57	22.93	4.49	31.74	2.31
- Mid	20	20.65	4.42	29.50	2.93
- Low	*	*	*	*	*
2-Group - High	13	22.08	4.23	31.08	2.36
- Low	*	*	*	*	*

*Means and standard deviations are not computed if the category frequency is less than 10.

TABLE A3

BOY'S FREQUENCIES, MEANS AND STANDARD DEVIATIONS OF AGE 11 AND 16 MATHEMATICS SCORES, BY ABILITY GROUP WITHIN SCHOOL TYPES

		AGE 11		AGE 16	
	N	Mean	SD	Mean	SD
TOTAL	4,768	17.72	10.46	13.77	7.19
Comprehensive	2,911	16.31	9.89	12.71	6.80
Not Grouped	165	14.88	9.23	10.88	5.65
Remedial	111	4.22	3.55	5.59	2.99
3-Group - High	764	25.37	7.93	19.53	5.80
- Mid	997	14.67	7.74	11.35	4.93
- Low	428	8.63	6.58	7.38	3.61
2-Group - High	200	21.19	7.80	15.66	5.93
- Low	246	10.59	6.71	8.39	4.07
Grammar	513	29.37	6.08	21.46	5.36
Not Grouped	83	29.83	5.33	21.80	5.42
Remedial	*	*	*	*	*
3-Group - High	229	30.86	5.64	22.93	4.82
- Mid	103	27.08	6.70	19.57	5.82
- Low	26	24.42	6.70	18.35	4.44
2-Group - High	52	29.71	5.05	20.33	5.40
- Low	19	27.58	5.42	19.95	4.27
Secondary Modern	1,071	13.48	8.41	11.07	5.41
Not Grouped	144	12.68	8.24	10.04	4.97
Remedial	36	3.89	4.20	6.08	2.35
3-Group - High	186	20.42	7.06	16.18	5.24
- Mid	396	14.23	7.44	11.07	4.32
- Low	183	6.93	5.40	6.96	2.89
2-Group - High	70	18.13	7.45	15.46	5.18
- Low	56	8.96	6.02	7.80	4.00
Private	273	27.58	8.82	21.18	5.92
Not Grouped	29	26.31	8.02	20.59	5.79
Remedial	*	*	*	*	*
3-Group - High	158	30.58	6.77	23.20	4.52
- Mid	39	23.54	9.25	19.79	5.66
- Low	20	21.95	10.63	14.75	5.31
2-Group - High	21	22.95	10.03	19.14	6.62
- Low	*	*	*	*	*

*Means and standard deviations are not computed if the category frequency is less than 10.

TABLE A4

GIRL'S FREQUENCIES, MEANS AND STANDARD DEVIATIONS OF AGE 11 AND 16 MATHEMATICS SCORES, BY ABILITY GROUP WITHIN SCHOOL TYPES

		AGE 11		AGE 16	
	N	Mean	SD	Mean	SD
TOTAL	4,572	17.18	10.01	12.35	6.65
Comprehensive	2,743	15.72	9.38	11.31	6.04
Not Grouped	176	13.04	8.63	8.86	5.26
Remedial	81	4.69	3.73	6.27	3.25
3-Group - High	709	23.71	7.99	16.81	6.01
- Mid	1,003	14.53	7.62	9.99	4.22
- Low	356	8.00	6.00	7.09	3.54
2-Group - High	212	20.22	7.55	14.10	5.71
- Low	206	9.33	5.86	7.35	3.27
Grammar	600	27.68	6.54	19.75	5.05
Not Grouped	57	27.09	6.14	18.98	5.10
Remedial	*	*	*	*	*
3-Group - High	299	29.55	6.11	21.60	4.42
- Mid	141	25.35	6.26	16.99	5.09
- Low	37	24.95	6.37	17.46	4.73
2-Group - High	39	28.10	6.14	20.49	4.52
- Low	27	23.56	7.49	17.30	3.44
Secondary Modern	976	12.77	8.08	9.31	4.88
Not Grouped	138	11.59	7.19	8.25	4.08
Remedial	34	3.97	3.36	5.41	3.03
3-Group - High	142	19.58	7.43	13.03	5.24
- Mid	374	13.91	7.37	9.57	4.50
- Low	152	6.80	5.01	6.16	3.28
2-Group - High	69	17.14	8.09	12.64	5.10
- Low	67	8.00	5.19	7.81	3.38
Private	253	25.23	8.89	17.89	6.59
Not Grouped	46	20.93	8.27	13.80	5.52
Remedial	*	*	*	*	*
3-Group - High	104	30.48	6.20	22.24	5.07
- Mid	55	22.65	7.61	15.40	5.08
- Low	15	19.27	10.24	14.47	5.67
2-Group - High	23	24.30	9.21	17.74	7.09
- Low	*	*	*	*	*

*Means and standard deviations are not computed if the category frequency is less than 10.

TABLE A5

EFFECTS OF ABILITY GROUP ASSIGNMENT ON AGE 16 TEST PERFORMANCE
IN REGRESSION ANALYSIS WITHIN SCHOOL TYPE,
CONTROLLING EARLIER TEST PERFORMANCE

		GROUPS						
		Remedial	3 High	3 Mid	3 Low	2 High	2 Low	Adjusted R^2
Comprehensive								
Reading	- Boys	-5.875d	1.256[d]	.621[c]	-2.148[d]	1.272[c]	-1.273[d]	.676
	- Girls	-5.028[d]	1.174[d]	.193*	-3.215[d]	.624[a]	-1.747[d]	.694
Math	- Boys	-1.314[b]	3.963[d]	-.130*	-1.531[d]	1.576[d]	-1.352[c]	.632
	- Girls	.673*	3.774d	.299*	.081*	2.367[d]	-.172*	.565
Grammar								
Reading	- Boys	-	.759[a]	.303*	-.448*	.644*	-1.423*	.221
	- Girls	-	.257*	-1.114[b]	-1.735[b]	-.175*	-.615*	.400
Math	- Boys	-2.415*	.508*	-.663*	.012*	-1.386*	-.646*	.298
	- Girls	-	1.472[b]	-1.345[a]	-1.079*	.882*	-.286*	.428
Secondary Modern								
Reading	- Boys	-4.291[d]	.805*	.170*	-1.992[d]	.055*	-1.503[b]	.641
	- Girls	-3.119[d]	1.340[b]	.187*	-3.177[d]	1.610[b]	-1.775[b]	.600
Math	- Boys	-.900*	3.276[d]	.170*	-1.391[c]	3.228[d]	-1.438[a]	.522
	- Girls	-.658*	2.243[d]	.492*	-.915[a]	2.565[d]	.199*	.352
Private								
Reading	- Boys	-	.445*	.639*	2.734[b]	-.054*	4.089*	.493
	- Girls	-1.414*	.789*	-.681*	.098*	.399*	2.478*	.633
Math	- Boys	-2.695*	.893*	.690*	-3.195[c]	-.477*	-8.310[d]	.629
	- Girls	-1.225*	4.001[d]	.500*	-.029*	.969*	-2.063*	.583

* = Non-significant
[a] = .05
[b] = .01
[c] = .001
[d] = .0001

Note: See text for list of other variables included in the analysis.

TABLE A6

EFFECTS OF ABILITY GROUP ASSIGNMENT ON AGE 16 TEST PERFORMANCE IN REGRESSION ANALYSIS WITHIN SCHOOL TYPE, CONTROLLING EARLIER TEST PERFORMANCE AND OTHER VARIABLES

		GROUPS						
		Remedial	3 High	3 Mid	3 Low	2 High	2 Low	Adjusted R
Comprehensive								
Reading	- Boys	-5.097[d]	1.087[b]	.629[b]	-1.851[d]	.934[b]	-1.280[d]	.688
	- Girls	-4.048[d]	1.005[d]	.268*	-2.447[d]	.479*	-1.416[d]	.708
Math	- Boys	-.813*	3.616[d]	-.137*	-1.222[b]	1.354[c]	-.925[a]	.645
	- Girls	1.222[a]	3.143[d]	.083*	.286*	2.034[d]	.086*	.591
Grammar								
Reading	- Boys	-	.827[a]	.661*	-.408*	.376*	-1.020*	.220
	- Girls	-	.387*	-.772[a]	-1.438[a]	-.041*	-.686*	.416
Math	- Boys	1.533*	.125*	-.761*	-.733*	-1.916[a]	-.513*	.341
	- Girls	-	1.185[a]	-1.429[a]	-.893*	.653*	.217*	.455
Secondary Modern								
Reading	- Boys	-3.818[d]	.639*	.062*	-1.849[c]	.091*	-1.212[a]	.658
	- Girls	-2.183[a]	1.293[b]	.240*	-3.149[d]	1.439[c]	-1.729[a]	.618
Math	- Boys	-1.106*	2.999[d]	.109*	-1.218[a]	2.851[d]	-1.474[a]	.511
	- Girls	-.407*	2.273[d]	.452*	-.801*	2.593[d]	.365*	.371
Private								
Reading	- Boys	-	.464*	.548*	2.535[a]	-.024*	6.914[a]	.524
	- Girls	1.217*	.927*	-.482*	-.564*	-.008*	3.102*	.608
Math	- Boys	-1.456*	.459	.117*	-4.043[b]	-2.061*	-8.448[d]	.616
	- Girls	-2.264*	3.342[b]	.431*	-.582*	.091*	-1.804*	.595

* = Non-significant
[a] = .05
[b] = .01
[c] = .001
[d] = .0001

Note: See text for list of other variables included in the analysis.

Figure 1. Boys' Average Age 16 Reading Scores by Age 11 Reading Scores

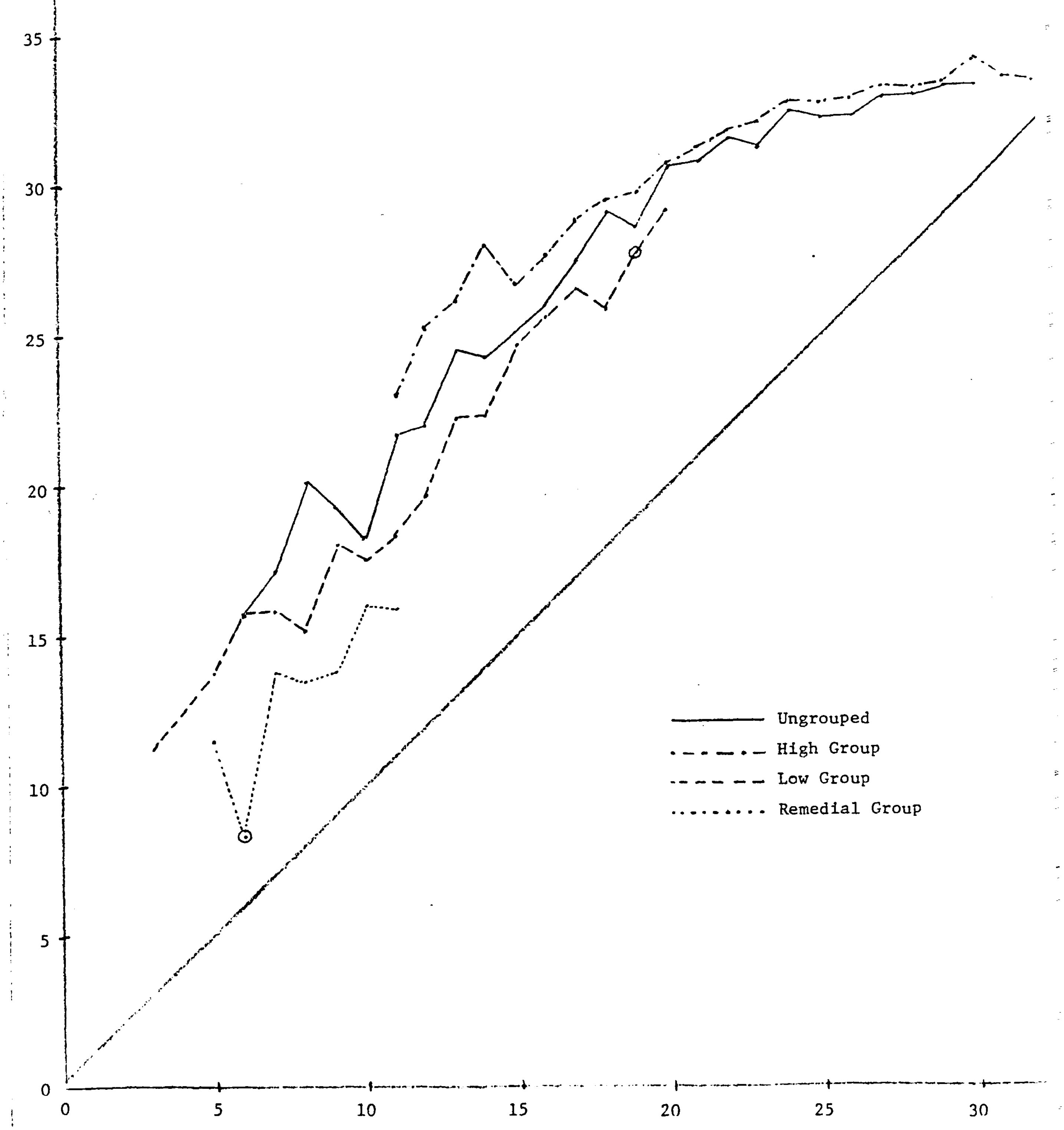
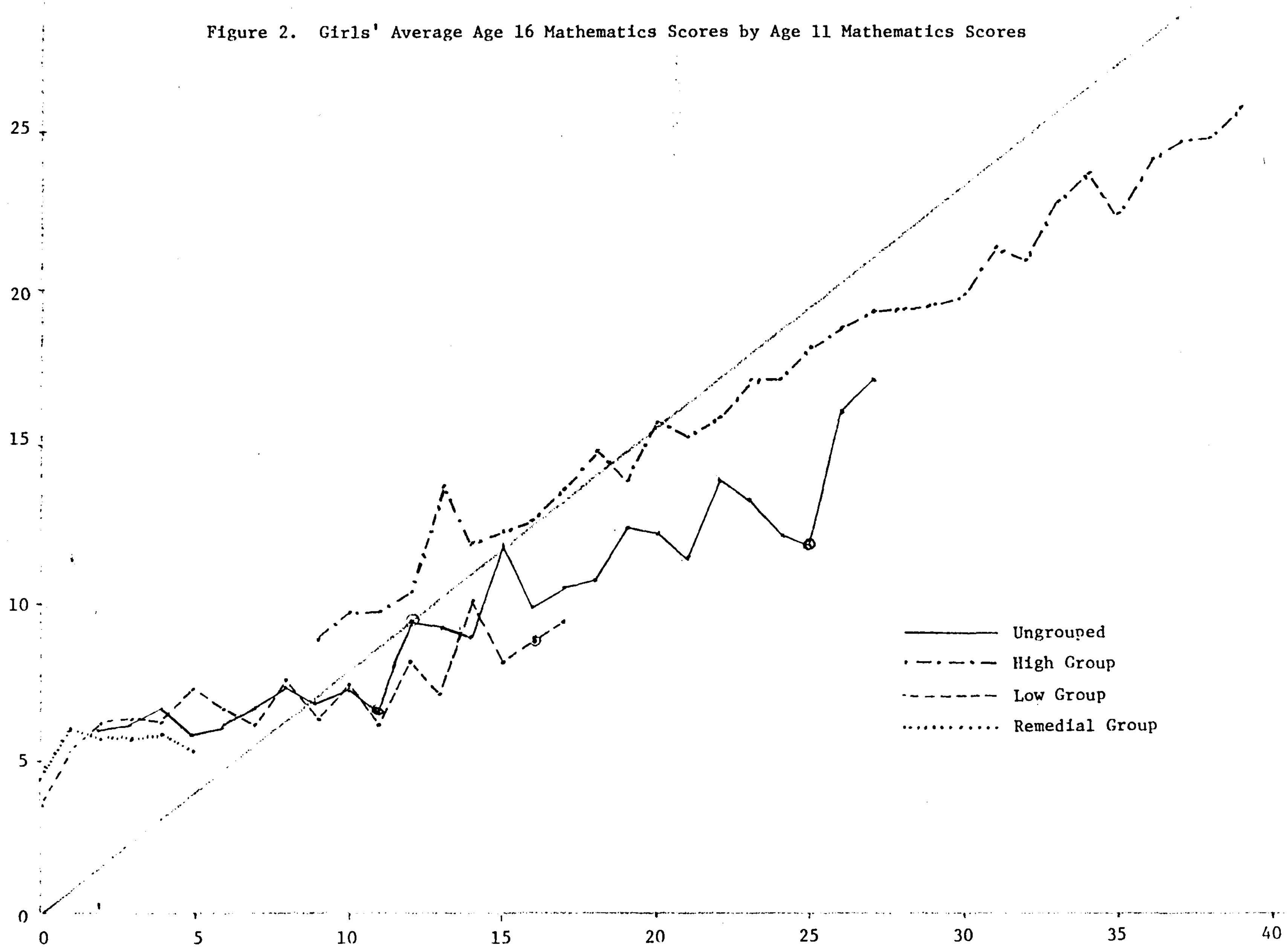


Figure 2. Girls' Average Age 16 Mathematics Scores by Age 11 Mathematics Scores



National Child Development Study User Support Group Working Paper Series

This Working Paper is one of a number, available from the National Child Development Study User Support Group, which report on the background to the Study and the research that has been based on the information collected over the years. Other Working Papers in the series are listed below.

No.	Title	Author(s)	Date
1.	The National Child Development Study: an introduction to the origins of the Study and the methods of data collection	P. Shepherd	October 1985
2.	Publications arising from the National Child Development Study	NCDS User Support Group and Librarian, National Children's Bureau	October 1985
3.	After School: the education and training experiences of the 1958 cohort	K. Fogelman	October 1985
4.	A Longitudinal Study of Alcohol Consumption Amongst Young Adults In Britain: I Alcohol consumption and associated factors in young adults in Britain	C. Power	December 1985
5.	A Longitudinal Study of Alcohol Consumption Amongst Young Adults In Britain: II A national longitudinal study of Alcohol consumption between the ages of 16 and 23	M. Ghodsian and C. Power	December 1985
6.	A Longitudinal Study of Alcohol Consumption Amongst Young Adults In Britain: III Childhood and adolescent characteristics associated with drinking behaviour in early adulthood	M. Ghodsian	December 1985
7.	Report on the longitudinal exploitation of the National Child Development Study in areas of interest to DHSS	Mildred Blaxter	April 1986

N A T I O N A L   C H I L D   D E V E L O P M E N T   S T U D Y

The National Child Development Study (NCDS) is a continuing longitudinal study which is seeking to follow the lives of all those living in Great Britain who were born between 3 and 9 March, 1958.

It has its origins in the Perinatal Mortality Survey (PMS). This was sponsored by the National Birthday Trust Fund and designed to examine the social and obstetric factors associated with the early death or abnormality among the 17,000 children born in England, Scotland and Wales in that one week.

To date there have been four attempts to trace all members of the birth cohort in order to monitor their physical, educational and social development. These were carried out by the National Children's Bureau in 1965 (when they were aged 7), in 1969 (when they were aged 11), in 1974 (when they were aged 16) and in 1981 (when they were aged 23). In addition, in 1978, details of public examination entry and performance were obtained from the schools, sixth-form colleges and FE colleges.

For the birth survey information was obtained from the mother and from medical records by the midwife. For the purposes of the first three NCDS surveys, information was obtained from parents (who were interviewed by health visitors), head teachers and class teachers (who completed questionnaires), the schools health service (who carried out medical examinations) and the subjects themselves (who completed tests of ability and, latterly, questionnaires). In addition the birth cohort was augmented by including immigrants born in the relevant week in the target sample for NCDS1-3.

The 1981 survey differs in that information was obtained from the subject (who was interviewed by a professional survey research interviewer) and from the 1971 and 1981 Censuses (from which variables describing area of residence were taken). Similarly, during the collection of exam data in 1978 information was obtained (by post) only from the schools attended at the time of the third follow-up in 1974 (and from sixth-form and FE colleges, when these were identified by schools). On these last two occasions case no attempt was made to include new immigrants in the survey.

All NCDS data from the surveys identified above are held by the ESRC Data Archive at the University of Essex and are available for secondary analysis by researchers in universities and elsewhere. The Archive also holds a number of NCDS-related files (for example, of data collected in the course of a special study of handicapped school-leavers, at age 18; and the data from the 5% feasibility study, conducted at age 20, which preceded the 1981 follow-up), which are similarly available for secondary analysis.

Further details about the National Child Development Study can be obtained from the NCDS User Support Group.