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ABSTRACT

This study addresses the issue of how different school organizational patterns affect the academic learning of students of different backgrounds and abilities. Using data from the Pennsylvania Educational Quality Assessment (EQA) on approximately 8,000 sixth-grade students in elementary and middle schools, the study examines how instructional specialization, between-class ability grouping, within-class ability grouping, and grade span affect the achievement of students from low to high SES backgrounds. The study finds that elementary school settings benefit students from low social backgrounds, as does having instruction provided by a limited number of teachers. Between-class ability grouping shows benefits for high social background students in middle schools, and within-class ability grouping in elementary schools benefits low social background students in reading. (Author/PCB)

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ADDRESSING THE NEEDS OF DIFFERENT GROUPS OF EARLY ADOLESCENTS: EFFECTS OF VARYING SCHOOL AND CLASSROOM ORGANIZATIONAL PRACTICES ON STUDENTS FROM DIFFERENT SOCIAL BACKGROUNDS AND ABILITIES

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The Center

The mission of the Center for Research on Elementary and Middle Schools is to produce useful knowledge about how elementary and middle schools can foster growth in students' learning and development, to develop and evaluate practical methods for improving the effectiveness of elementary and middle schools based on existing and new research findings, and to develop and evaluate specific strategies to help schools implement effective research-based school and classroom practices.

The center conducts its research in three program areas: (1) Elementary Schools, (2) Middle Schools, and (3) School Improvement.

The Elementary School Program

This program works from a strong existing research base to develop, evaluate, and disseminate effective elementary school and classroom practices; synthesizes current knowledge; and analyzes survey and descriptive data to expand the knowledge base in effective elementary education.

The Middle School Program

This program's research links current knowledge about early adolescence as a stage of human development to school organization and classroom policies and practices for effective middle schools. The major task is to establish a research base to identify specific problem areas and promising practices in middle schools that will contribute to effective policy decisions and the development of effective school and classroom practices.

School Improvement Program

This program focuses on improving the organizational performance of schools in adopting and adapting innovations and developing school capacity for change.

This report, prepared by the Middle School program, examines the effects of middle school structures and classroom practices on the academic learning of students of different backgrounds and abilities. It is the third of three reports that (1) describe school structures and practices, (2) examine how varying structures and practices affect student outcomes in middle schools, and (3) examine how student outcomes in middle schools may vary by student background and achievement level.

Abstract

This study addresses the issue of how different school organizational patterns affect the academic learning of students of different backgrounds and abilities. Using data from the Pennsylvania Educational Quality Assessment (EQA) on approximately 8,000 sixth-grade students in elementary and middle schools, the study examines how instructional specialization, between-class ability grouping, within-class ability grouping, and grade span affect the achievement of students from low to high SES backgrounds. The study finds that elementary school settings benefit students from low social backgrounds, as does having instruction provided by a limited number of teachers. Between-class ability grouping shows benefits for high social background students in middle schools, and within-class ability grouping in elementary schools benefits low background students in reading.

Introduction

For the past sixty years or more, school administrators and education researchers have discussed the advantages and disadvantages of alternative forms of school and classroom organization for schools serving students during their middle grades (Yates, 1966). Social movements that in turn produced junior-high schools and middle schools each claimed that pre-adolescents and early adolescents should be segregated from both younger and older students and provided instruction in their own setting. But they differed in selecting the grade levels that should compose such intermediate school settings.

Educators also have tried to balance early adolescent students' developing intellectual needs and their complex psychological needs by the way they recruit and socialize teachers, the way they structure teaching responsibilities, the way they group students among different classes, and the way that teachers group students for instruction within those classes.

The major issues about school and classroom organization for the middle grades, in addition to grade span, have been (1) "instructional specialization" -- whether individual classes should be constructed by grouping students according to ability or prior achievement -- (2) "between-class ability-grouping" or "tracking" -- whether individual classes should be constructed by grouping students according to ability or prior achievement, and (3) within-class ability-grouping" -- whether teachers should divide their own class into instructional groups based on each student's current level of performance in that subject.

The issue of instructional specialization involves whether to assign teachers to teach one subject to several classes ("departmentalized") or have them teach all subjects to a single self-contained class. Mixed arrangements are also used -- for example, two teachers may each teach two academic subjects to a pair of classes. The essential dimension is how specialized the teachers' assignments are and, consequently, how many different teachers provide instruction to a typical student.

Between-class ability-grouping subsumes a variety of practices in which students are assigned to different classes and teachers on the basis of similar abilities. This includes self-contained classes that separate students of different achievement levels into different classes; block-scheduled departmentalized instruction where students of similar abilities go to different teachers' classrooms together throughout the day; and re-grouping of heterogeneous classes into more homogeneous ones for instruction in one or two particular subjects. In this paper, we refer to all forms of between-class ability-grouping as "tracking." Tracking as it is usually used to describe high school programs (i.e., separate courses and curricula for different students) is not common in the middle grades.

Within-class ability-grouping occurs when a teacher organizes instruction for one subject by forming two or three relatively stable instructional groups based on each student's achievement in that subject. The usual alternative to within-class ability-grouping is some form of whole-class instruction, although other arrangements are possible as well (Slavin, in press).

The grade span issue concerns the appropriate grade structure for schooling of students in the middle grades. One may ask whether to include middle grade students with younger students in an elementary school, or provide them with a separate setting for their instruction as in a junior high or middle school, or instead include them with older students in a combination junior-senior high school. The question may be resolved differently for each specific grade level within the middle grade years.

Background to the Research

Each of these dimensions of school and classroom organization requires schools to make choices that involve tradeoffs of mutually incompatible benefits. For example, teachers who have specialized subject-matter expertise and who teach a smaller range of content to multiple classes of students may prepare more informative and effective lessons and respond better to student questions. On the other hand, teachers linked in a more personal way to a single class of students may develop a more integrated and flexible instructional program and may respond to students' individual needs more successfully.

Dividing a school's same-age students into classes according to prior academic achievement may enable teachers to organize instruction at a more appropriate level of difficulty for more students and may allow a wider range of students to be relatively successful in their classes. However, this may result in stereotyping of classes and their students according to presumed ability and may take a toll in personal self-esteem (and hubris) by emphasizing differentiated status among students, producing unnecessarily negative expectations and ineffective teaching behavior in classes of "low ability" students, and providing more limited exposure to models of successful academic behavior for the majority of students.

Discussion and research on these topics have attempted to resolve these tradeoffs by finding "the best" alternative among those offered --for example, the "best" grade-span for middle grade students or the "best" choice between employing or not employing ability-grouping within a classroom. Few clear-cut answers have arisen.

There have been relatively few studies of the consequences of varied instructional specialization (departmentalized, mixed, or self-contained classes) for the middle grades, and there have been no in-depth reviews of such studies. Studies cited in brief reviews (Heathers, 1969; Cotton, 1982; Slavin, in press) have generally found either no difference in achievement outcomes or an advantage to self-contained classrooms. Heathers cited research indicating that upper-elementary teachers would prefer specialized teaching assignments, but suggested that the training of such teachers had not emphasized content or teaching methods in particular subject specializations.

In contrast, there have been many more studies of tracking. The research has been summarized in Slavin (1986), and two statistical metaanalyses were undertaken by Kulik and Kulik (1982; 1984). The Kuliks found differences favoring tracked classrooms at both elementary and secondary levels. But when attention is limited to studies of representative student populations, rather than just the gifted or learning disabled, differences were either very small (elementary) or non-existent (secondary). Slavin's analysis focused on a few studies with the highest quality designs and found primarily negative or negligible effect sizes in those studies.

Studies of the effects of within-class ability-grouping have been summarized by Heathers (1969) and by Slavin (1986). Most dealt with mathematics instruction, and nearly all found favorable effects of within-class ability-grouping. However, little research has examined the common practice of ability-grouping within a classroom for reading instruction.

Grade span has been a principal focus of the middle school reform movement, but the little substantive research that has compared student achievement for particular grade levels under different grade span organizations has not found significant differences. (See the review in Calhoun, 1983.)

Thus, research has generally been inconclusive regarding the outcomes of alternative organizations, perhaps because such variations are relatively difficult to detect in comparison to other major forces on student learning such as student academic abilities, socio-economic background and family support, and teachers' instructional skills. But it is plausible that differences in instructional organization may have different consequences for students of varying abilities, backgrounds, maturity, and personality, and that negligible or unstable average effects mask systematic advantages for some groups of students and disadvantages for others.

If students differ substantially from one another in academic skills by the time they reach grade six, it seems reasonable that "high-," "average-," and "low-performing" students would also systematically differ in the kinds of schools and school experiences that would maximize their learning and growth. Students who have "succeeded" in school to this point are likely to profit more than less well prepared students from having several teachers, each particularly knowledgeable in one or two subjects. Students who have been less successful in school may profit more from having a single teacher who, having responsibility for fewer students, can better know the individual needs of each. Similarly, the "high" achievers may perform better in the climate of a secondary school setting while low achievers may do best in the more personal confines of an elementary school setting.

Between-class tracking and within-class ability-grouping might most positively affect students of highest and lowest ability, because instruction in heterogeneous classroom settings is more likely to be paced to the middle of the distribution of current performance. However, any benefits for "low tracked" students of having instruction better aimed at their current level is likely to be offset by reduced self-esteem, lower teacher expectations, and other concomitants of being labelled as a "slow learning" group or class.

To the extent that the grouping of students is more comprehensive across subjects and more rigid, the negatives for students tracked into the "low" category could outweigh any positive impact of having instruction more directed to their current performance level. Because between-class grouping tends to be more systematic and inflexible, it may have a net disadvantage for the lowest ability group whereas within-class ability-grouping may not.

Homogeneous ability-grouping, however, may at least provide the the lowest ability students with more appropriately paced instruction. Those least likely to gain from homogeneous grouping instead might be students lower-than-average in achievement but who are close to the class or school average. In heterogeneous settings, they are probably not too far from the pace of the class, and the higher achieving students remain as models.

Good data about the differential advantages of instructional specialization, between-class tracking, within-class ability-grouping, and optimum grade span organizations for the middle grades is hard to find. The E.E.O. Report of 1966 (Coleman, et.al, 1966), as well as more recent research (Veldman and Sanford, 1984), have suggested strong effects of average classroom test scores on individual student achievement. That would be consistent with an advantage to low-ability students of heterogeneous class assignments and an advantage to high-ability students of between-class tracking. However, Slavin (1986) did not find differences between high- and low-ability students in the environments favorable to higher achievement. In general, in spite of the range of individual studies on these topics, we cannot yet draw definitive conclusions about the impact of alternative organizational patterns on different groups of students.

Data

In this paper, we address the issue of how different school organizational patterns affect the academic learning of students of different backgrounds and abilities. We do so with data from a statewide survey involving several hundred schools that differ substantially in their practices regarding instructional specialization, tracking, within-class ability-grouping, and grade span.

Our data set, although valuable for its breadth of outcome measures and school organizational characteristics, is limited in being a cross-sectional rather than a longitudinal study. We have no measure of student ability that pre-dates the instructional treatment or that is independent of the achievement outcome variables that we examine. Thus, rather than measuring individual student achievement in terms of academic growth, we measure it in terms of test score outcomes relative to test scores predicted from the individual's socio-economic status, race, and residential stability. Social background is so highly correlated with student achievement that it may be seen as a proxy for prior student achievement. Nevertheless, we will refer to our students, not in terms of "low," "average," or "high" ability students, but as students from a social background predictive of "low," "average," or "high" test scores.

The data are from the 330 schools in the 1986 Pennsylvania Education Quality Assessment (E.Q.A.) that contained sixth grade classes tested as part of that assessment and which responded to our own survey of school and classroom practices. (The E.Q.A. is described in McPartland, Coldiron, and Braddock, 1987.) We focus on the sixth grade because that grade experienced the broadest variation in school and classroom organizational practices of any grade for which individual test score data are available (4,6,7,9, and 11). Altogether, more than 30,000 sixth-grade students in these schools were tested; our analysis focuses on a random one-third sample of students who were given one of three alternative forms of the achievement tests, and, in particular, the roughly 8,000 students for whom school organization variables are available.

The students in our sample reflect predominantly white, non-metropolitan Pennsylvania communities apart from the large cities of Pittsburgh and Philadelphia, which did not participate in E.Q.A. Ninety-two percent of the students are white, 62% live in small towns or farming communities, and only 19% of their parents graduated from college. Only one-quarter had changed schools because of residential mobility in the past three years. Thus, in comparison to the country as a whole, this is a fairly homogeneous and stable population, which somewhat restricts our ability to detect interactions between student background characteristics and school organization effects on student achievement.

Still, there are substantial differences in background-related achievement even within this relatively homogeneous population. For this analysis, a "background index" was created from a prediction equation of socio-economic (S.E.S.) variables (father's and mother's education and books and magazines in the home), race (white vs. non-white), and residential instability (moves affecting school attendance) on individual student test scores (in reading, English, and math). Four background categories were developed by dividing the index at the mean and at one standard deviation above and below the mean. The "low" background group is composed of those students scoring lower than one standard deviation (s.d.) below the mean on this index. "low-middle" goes from -1 s.d. up to the mean. And "high-middle" and "high" are similarly defined for students whose background index was above the mean.

These four subpopulations score very differently on tests of academic achievement. Figure 1 graphs the distribution of test scores on one major achievement outcome -- a test of written English -- for the four groups of students categorized by their S.E.S./race/stability background index. For this test, and for all but one of the other measures of school achievement that we used, the test scores obtained by students at the 30th percentile among the highest scoring S.E.S./race/stability group (i.e., high S.E.S., white, non-movers) were the same scores as obtained by students at the 80th percentile among the lowest scoring S.E.S./race/stability group. Thus, only 20% of the "low" category had test scores in the range of 70% of the students in the "high" background category.

Our analysis focuses on five achievement tests -- tests in mathematics, written English, reading comprehension, science knowledge, and social studies. Each test was relatively brief -- from 16 to 20 questions -- which also limits our ability to ascribe variation in achievement outcomes to school structural variables. In order to focus on achievement that is independent of social background, residualized, standardized test score variables were created by regressing each test score on the background index. Then for each of the four student subpopulations (also based on background characteristics), residualized test scores were examined for schools with varying school and classroom organization. Because the relationship between background factors and test scores was not perfectly linear and because the schools responding to our survey of school organizational practices had scores averaging slightly higher than the mean, the variables are no longer perfectly standardized variables, but may be treated as such for ease of interpretation.

We used four measures of school and classroom organization in this analysis. As a measure of how specialized the teaching assignments were at the school, we used the principal's report of the number of different teachers which a typical sixth-grade student would have for academic subjects -- reading, English, math, science, social studies, and foreign language. Overall, only 15% of the students (in 24% of the schools) were reported to experience sixth-grade solely in a single self-contained class. Most students experienced some teaming or specialization: 23% of the students had two teachers, 27% had three, and 35% had four or more teachers for academic subjects.

Information about between-class tracking was obtained on a subject-by-subject basis for each grade level. For the sixth grade, 71% of the schools (containing 81% of the students) reported that sixth-grade students were tracked for reading or English and 48%

of the schools (enrolling 60% of the students) tracked students for math. Only 28% of the schools (with 17% of the students) did not track at all. In terms of the number of subjects for which they were tracked, 25% of the students were tracked for one subject, 40%, for two, and 17%, for three or more.

Grouping students for instruction within a classroom is sometimes a decision of teachers and sometimes a school-level decision. In our survey, principals reported the practices of "most" of the teachers for that grade level: 77% of the schools (enrolling 66% of the sixth-grade students) used reading groups for the sixth-grade and 42% used math groups. Altogether, the mean number of subjects where grouping was used was 1.4, with a standard deviation of 1.0.

Most of the schools in the Pennsylvania E.Q.A. sample that contained sixth-grade students were elementary schools. The "lowest grade" enrolled was kindergarten through third in 78% of the schools in our study. However, because intermediate (grades 4 to 6) and middle schools tend to be larger, 43% of the students were in middle or intermediate schools and only 56% were in elementary schools. Only 2 schools covered the full range from kindergarten through the 8th grade.

Data Analysis

To examine whether school and classroom organizational factors affected students from "low" and "high" background groups differently, we looked at students' mean achievements (net of the achievement predicted by their own S.E.S./race/residential stability background) for schools characterized by different patterns of organization. Then, to clarify the independent contributions of each organizational variable, we constructed linear regression models, analyzing specific organizational variables and using other organizational variables as controls.

Interactions between student background characteristics and school organization effects on background-controlled test scores are presented in terms of "differences of mean differences" and differences in unstandardized regression coefficients. In other words, we show how different are "highs" and "lows" in their test score differentials between, for example, tracked and non-tracked classroom assignments. Statistical interaction coefficients are not shown. Raw data better convey the actual implications of test score differences for the sample. Analysis was done at the student level because too few schools had substantial numbers of students in all four background categories, from "low" to "high," for the school sub-group means to be reliable.

Figures 2 through 5, focusing on specialization, between-class tracking, within-class ability-grouping, and grade span, respectively, present mean residualized (background-controlled) test scores for students grouped according to background characteristics. Three to five graphs make up each figure -- one for each subject-matter tested. The slopes of the lines indicate differences in test scores between students attending schools organized by different principles.

For example, Figure 2 contrasts students who obtained their academic instruction from four or more teachers ("specialized") with students who had two or three teachers ("mixed") and with those who had only a single teacher ("self-contained"). Most lines are negatively sloped, indicating higher test scores for self-contained situations. A few lines, primarily for the "high" background group, suggest a curvilinear pattern, with optimum test scores at both extremes (self-contained and specialized) and somewhat lower scores for the mixed pattern. The vertical axis is roughly in standard deviation units, so that the range from -.1 to +.1 represents one-fifth of the standard deviation of individual test scores. Differences in slopes among lines in the same graph suggest an interaction effect -- that specialization is related to test scores in different ways for different groups of students classified by their background.

Instructional Specialization

Figure 2 suggests that, especially for the basic skills subjects --mathematics, English, and reading -- sixth-grade students in the E.Q.A. sample had somewhat higher test scores when they were taught in self-contained classrooms. There are many more negatively sloped lines than positively sloped lines. However, Figure 2 suggests that the relationship between self-contained classes and higher test scores is much stronger for students from social backgrounds associated with lower test scores than it is for students from social backgrounds associated with higher test scores. (The slopes for the "high" background group are much flatter.) This is so particularly in the more verbal subject-matters -- English, reading, and social studies.

In English, a consistent negative slope -- suggesting an advantage for self-contained classes and a disadvantage for specialized instructional environments -- appeared only for the students from the background group scoring lowest on these tests. The "low-middle" group scored worse in specialized instructional environments, but did not do better in self-contained classrooms than in "mixed" situations; the "high-middle" and "high" groups scored about equally well in all variations from self-contained to specialized.

Similarly, reading test scores varied by extent of instructional specialization more for the "low" background group than for any other, and the two "high" groups' scores were least differentiated. Again, self-contained classroom settings seemed to help the students from "lower" social backgrounds much more than they did students from "higher" background groups.

The social studies results were similar, but more muted. Both the "low" and the "low-middle" groups scored about 1/8 of a standard deviation lower in schools where sixth-grade students had four teachers than where they had only one. The "high" background group did roughly the same on the social studies test in both situations.

Science achievement followed a similar trend, except that "high" and "high-middle" groups evidenced a bifurcated pattern, scoring substantially better in either specialized or self-contained situations than in "mixed" patterns, such as partial team teaching or pull-out programs.

The interaction patterns were weakest in mathematics where all groups of students did best in self-contained classrooms and least well where they received instruction from four or more teachers. "High," "middle," and "low" background students were similar in their mathematics test-taking response to varying degrees of teacher specialization.

To summarize the data in Figure 2, we calculated average test score differences between "specialized" and "self-contained" classes over the five subjects for each of the four student background groups. (See Table 1, panel A.) Students in the lowest background group scored .20 standard deviations higher in schools where only a single teacher taught them sixth-grade subjects than in schools where they had four or more teachers for those subjects. Students in the "low-middle" group scored .14 s.d. higher in the self-contained situation. However, students in the "high-middle" and "high" groups scored only .04 to .05 s.d.'s better in self-contained situations. Across school subjects, "high" and "lows" differed most in their "test score responsiveness" to teacher specialization for reading and English and they differed least for math and science (see the row in Panel 1 marked "Net Difference.")

Between- Class Tracking

Figure 3 presents similar data for the variable of homogeneous versus heterogeneous assignment of students to classes; i.e., whether or not the school "tracks" for sixth grade classes. For math and reading, the figure contrasts schools according to whether they track in the subject tested -- i.e., math test scores in schools that track for math are compared to math test scores in schools where math instruction is provided in classes of mixed student ability (irrespective of whether within-class grouping is employed). However, because only a small proportion of schools reported having homogeneous classes in English, science or social studies, we treated those subjects differently. For English test scores, the comparison is between schools that tracked for English or reading against schools that tracked for neither one. For science and social studies, neither contrasting schools according to whether they tracked for that subject nor according to how many subjects they tracked for produced consistent patterns that could be readily interpreted. Consequently, these subjects were omitted from Figure 3.

Mathematics provides the clearest example of the conditional relationship between tracking and test performance. As shown in Figure 3, the slope for the "high" background group is strongly positive -- that is, for students from more privileged backgrounds, attending a school that tracks for math is associated with substantially higher test scores than attending a school that teaches math to heterogeneous groups of students. The difference is about one-fifth of a standard deviation. For students from "low" or "low-middle" backgrounds, in contrast, there is almost no slope -- test scores are the same whether the students are in heterogeneous math classes or classes of students of similar math abilities or prior achievements. Students from "high-middle" backgrounds are in-between.

Reading also indicates differential relationships depending on student background. Only among the "low" background students are test scores negatively associated with tracking. This group may suffer from being segregated from better performing students. Other groups of students score somewhat higher on reading tests when reading classes are organized around similarly achieving students. But, neither the mean differences for particular groups of students nor the differential between "high" and "low" are especially large.

English test scores could be affected by tracking in reading as well as by tracking in English itself. In data not shown here, we found that tracking for English was associated with higher English test scores for the "low" and "high" background groups but not for the "middle" groups. However, for the middle groups higher English scores were associated with tracking for reading, so when both types of tracking are considered (as in Figure 3), slightly positive slopes appear for all groups. A pattern of differential value according to student background category is not apparent in this figure, but does appear later when we examine sixth graders in elementary schools separately from the others.

Combining the test score differences (between tracking and not tracking) for the five tests (including science and social studies), tracking shows no pattern of advantages for either the "high" or "low" background students -- neither group scores appreciably different under either situation.

However, if we consider only mathematics and reading, the subjects for which tracking is most common, tracking seems to have a much more positive association with test scores for "high" background students than for "low" background students. And the "low-middle" and "high-middle" groups have intermediate results. The right-most column of Table 1, panel B, shows that the average "test score advantage" for homogeneous grouping in reading and mathematics is -.04 s.d. units (i.e., a disadvantage) for the "low" group, +.02 for the "low-middle," +.07 for the "high-middle," and +.11 for the "highs." The difference between "highs" and "lows" for tracking in reading and math is nearly identical to the difference between "highs" and "lows" for self-contained vs. specialized instructional organization -- roughly .15 s.d.'s. However, students in the "low" background category are advantaged by self-contained classes roughly twice as much as the "highs" are advantaged by tracked classes (.20 vs. .11). If reading and math tests only are considered for specialization, the test-score value of self-contained classes for the lows (.28) is even greater.

Within-Class Ability Grouping

Figure 4 focuses on the practice of ability-grouping within classes -- a classroom organizational issue. We focus primarily on mathematics and reading because within-class ability-grouping for sixth-grade English, science and social studies is even less frequent than between-class tracking in these subjects. English test scores are again shown, but the contrast, as with tracking, is between schools that do ability-grouping in either English or reading. Overall, both the size of the "effects" for particular student subgroups and the differentials of effects among them are somewhat smaller for within-class grouping than for tracking or specialization. Also, the patterns vary more sharply from subject to subject.

For mathematics, ability-grouping is only slightly positively associated with test scores for "high" background students and even less associated with test scores for any of the other groups. On the other hand, within-class ability grouping in reading is most positively associated with test scores for "low" background students, and it is negatively associated with test scores only for "high" background students. The pattern for the English achievement test is similar to that for the rea ng test, but is of smaller magnitude.

Grade Span

Slightly more than half of the sixth-graders in the sample attended schools that we classed as elementary schools (enrolling students from K-6, 1-6, 2-6, or 3-6). Most of the rest attended middle schools enrolling students through grade 8.

Figure 5 suggests that the interaction effect of student background and grade span on test scores is stronger than for any of the other organizational variables. (The summary row in Table 1, Panel D marked "High - Low" confirms this, containing larger values than the summary rows for the other panels.)

For all five achievement tests, "low" background sixth-grade students in elementary school settings score much better than "low" background sixth-grade students in middle school settings. "Low-middle" students also do better, but the differential is only half as great as for the "lows." "High-middle" students do consistently very slightly better in elementary school settings. And "high" background students do consistently better in NON-elementary settings. (See Table 1, panel D.)

The advantages of the elementary school setting for "low" background students are clearest for reading and mathematics. They score between one-fifth and one-fourth a standard deviation higher on tests in such settings than they do in middle schools. They also do much better in science in elementary settings. In contrast, "high" background students score somewhat better in middle school settings on all five tests, but no one subject gives them a substantial advantage in middle schools.

Further Specification of Relationships

Independent Grade Span Effects

Of course, elementary schools and middle schools differ from one another on a whole range of instructional practices, and in particular, they differ from one another with respect to the frequency of instructional specialization, between-class tracking, and within-class ability-grouping. The correlation between the lowest grade level in the school and the number of teachers who teach a typical sixth-grade student is +.49. Sixth-grade students in elementary schools average 2.4 teachers whereas sixth-grade students in middle and intermediate schools average 3.8. The correlation between the lowest grade level in the school and the number of subjects tracked in the sixth grade is +.27. Two-thirds of the middle schools track for math compared to 42% of the elementary schools. Elementary schools are also more likely to group sixth-grade students within a classroom by ability for instruction in reading and mathematics.

Thus, in some ways, grade span merely reflects the associations we have already presented in discussing instructional specialization, tracking, and ability-grouping. But grade span may also influence student achievement independently of affecting these school and classroom organizational practices. Middle schools are typically larger than elementary schools, and because they encompass fewer grade levels, they typically have several times the number of students in any one grade level that elementary schools do. The staffs of elementary schools and middle schools are recruited and trained differently. There may be different expectations for performance. And, apropos our interest in interaction effects, teacher expectations and behavior may be more differentiated by student background or ability in one setting (middle school?) than the other, or teachers may be more attuned to individual differences in one setting (elementary?) than the other. Differentiated expectations or responses may affect some groups (low and perhaps high ability students) more than it affects others. Thus, grade span is an interesting variable in its own right, apart from how it might influence tracking, grouping, or specialization practices.

To analyze the effects of grade span that are independent of specialization, tracking, and within-class ability-grouping, we computed regression coefficients for predictions of background-controlled test scores in each subject from grade span, holding constant the other three organizational variables. These are shown in Table 2, Panel B, along with regression coefficients from the simple linear model of test score on grade span (Panel A, giving identical numbers as in Table 1, Panel D), and a third set of regressions that hold enrollment per grade level constant as well (Panel C) and thus rule out size as an explanation of the effects of grade span.

In only one subject -- English -- do the control variables diminish the importance of grade span on test scores or the differential effect of grade span for high background and low background students. For mathematics, reading, science, and social studies, elementary schools continue to show strong benefits primarily for the students from the lowest social background category. For other categories of students, the effects are small except that science achievement by high background students in elementary schools remains about one-tenth of a standard deviation below their achievement in middle schools.

Overall, combining all five subjects, the low background students do nearly one-fifth of a standard deviation better in elementary schools, even when specialization, tracking, ability-grouping, and enrollment per grade level are held constant. For none of the other background groups does grade span seem to have an impact on average test scores.

Specialization Effects in Elementary Schools and in Middle Schools

So far, we have treated the variable "instructional specialization" as if it meant the same thing in elementary and middle schools. But full departmentalization is much more common in middle school sixth grades than in elementary schools, and self-contained classes are more frequent in elementary schools than in middle schools. So the range of variation, and therefore the meaning, of "instructional specialization" is different at the two levels.

In Table 3, we present data from three sets of multiple regression equations predicting background-controlled test scores in five subjects from instructional specialization. The first panel (A) indicates the predicted standardized test score differential between self-contained and fully departmentalized organizations for all sixth-grade students in the sample. These data are equivalent to the data in Table 1, Panel A, except that they come from a linear model, "straightening out" the observed values given in Table 1. The second and third panels present the same kind of data, but for elementary and middle schools separately.

The relationship between specialization and student achievement is still generally negative for both types of schools, as it was when all sixth-grade students were considered together. However, the differential effects for "high" vs. "low" students that appeared in Table 1 do not remain when students in elementary schools are considered separately.

The overall analysis of "high minus low" differentials in Table 1 had suggested that "low" background students are more disadvantaged than "highs" by having multiple teachers (note the positive signs for "Net Difference [High - Low]" in Panel A). However, the signs of the differentials in Panel B for the elementary school subsample tend to be slightly negative, suggesting no such relationship. In elementary schools, specialization appears to reduce test scores in reading, English, and math for ALL groups of students, and the "lows" as much as the "highs" seem advantaged by specialization for science and social studies test outcomes.

On the other hand, in middle schools, where the usual alternative is between a flexible team or semi-departmentalized approach and full instructional specialization, the "low" and the "low-middle" background students do much better in the less specialized structure whereas the higher background groups do not. In the linear model used for Table 3, self-contained classes give low and low-middle background students a one-sixth s.d. advantage over fully departmentalized classes on the average test score, but there is no notable pattern for students from higher than average backgrounds.

Tracking Effects Controlling on Other Tests and Gradespan

Having test score data on multiple subjects and knowing for which subjects a school made class assignments according to student ability enables us to undertake some further analyses with subsets of schools in our sample. We can "hold constant" a school's tracking practices on one subject and examine test score differences between schools according to whether they tracked in another subject. The most common tracking patterns in our sample (enabling the largest N for comparisons) are schools that tracked in reading and mathematics, those that tracked in reading alone, and those that tracked in neither. Consequently, we can compare mathematics test scores for students in schools that tracked for both reading and math with mathematics test scores in schools that tracked for reading but NOT for math. Similarly, we can compare reading scores and English scores in schools that tracked for reading only with reading and English scores in schools that did not track for either reading or math. Furthermore, by controlling on the "opposite" test score (reading and English when looking at math scores, and math when looking at reading and English scores), we control on general ability differences between the two groups of schools. (This approach was suggested by Robert Slavin.)

Our initial analysis (Figure 2; and Table 1, Panel B) had shown tracking to be related to higher mathematics test scores for high background students, and to be generally more advantageous for high background students than for "lows." In this subsample of schools, and controlling on reading and English test scores as well, a similar finding emerges. High background students scored roughly .14 s.d. higher on their math test if they were in a school that assigned students to math classes homogeneously by ability. No strong differences emerged for the other background groups, and the differential between high and low and between high and low-middle was about .17 to .18 standard deviations.

Table 4 also shows what happens to these data when we split the sample further into elementary and middle schools. For elementary schools, tracking for math is associated with lower math test scores for the lowest background group (although not statistically significant), and the advantage to the high background group is no longer apparent. Although the high-low difference is even larger, the overall advantage of tracking in elementary schools appears to be smaller than in the combined elementary-middle school sample.

In contrast, among sixth graders in middle schools, math achievement for all groups except the low-middle is superior in schools where assignments to math classes are made by between-class tracking. The high-low differential is smaller because the low background students appear to benefit from tracked math classes as well, although not to the same degree as the highest background group.

When we compare the schools that tracked for reading only with those that did not track for either, we find that tracking for reading seems to have some benefits for English test performance, particularly for the lowest background group, but it has little effect on reading test performance. The English results are more dramatic among elementary schools because they suggest that tracking for reading may lower English test scores among the highest background group as well as raise test scores for the lowest group. The high-low differential is nearly one-third of a standard deviation unit, favoring the "lows." At the middle school level, tracking for reading is related to higher English test scores for all groups, but most particularly for BOTH the "highs" and the "lows." However, the sample size for both extreme background categories was too small (roughly 80 students) for either regression coefficient to be statistically significant.

Discussion

Sixth-grade students experience school under a variety of organizational structures, from highly tracked, highly departmentalized middle schools to self-contained, heterogeneous elementary school classrooms. Research about the impact of alternative organizational structures has not been clear and consistent. Partly, this may be because an organizational feature may have offsetting advantages and disadvantages for different groups of students. In particular, we suggested that instructional specialization and middle school environments may assist learning by high ability students but may hinder learning by low ability students and that between-class ability grouping may help high ability students but not help low- or low-average ability students (for different reasons). In any event, the divergent impact of organizational arrangements requires school administrators to recognize that each choice may have costs and benefits for different clientele.

Our data support the importance of considering the differential payoff of alternative arrangements for different groups of students. Although student sub-populations were measured in terms of their social background, corresponding results may apply to sub-populations defined by prior achievement or ability.

In particular, elementary school settings are shown to be particularly advantageous for students from low social backgrounds and not helpful or harmful to others. This is so beyond specific characteristics of elementary schools such as their greater use of self-contained classroom instruction, their less frequent use of tracking, and their smaller enrollment per grade level.

Second, having each student instructed by a limited number of teachers -- perhaps only one or two -- appears to be a benefit or at least not be detrimental for learning in most subjects for most groups of students. This effect was present in both elementary and middle school settings. In middle school settings, having fewer teachers is most clearly associated with greater achievement (in English, reading, science, and social studies) for students from low and low-middle social backgrounds.

Third, forming mathematics classes according to homogeneous ability groups, on average, seems to benefit high background students much more than "lows," and appears to be worthwhile primarily where sixth graders are taught in middle school environments. In contrast, between-class ability grouping in reading results in higher English achievement (though not higher reading achievement), and is particularly advantageous for low background students (but not for high background students) when situated in elementary school settings.

Finally, the only support for within-class ability-grouping in these data relates to the performance of low background students on reading tests. Their scores are higher where ability-grouping for reading or English occurred. Although not shown here, this advantage appears most convincingly in elementary school settings, but not in middle schools.

The fact that different organizational arrangements have benefits for some students and costs for others does not mean that school administrators cannot act decisively in favor of arrangements that best meet certain educational goals. To the extent that current arrangements produce greater differentials in achievement among students than is socially warranted, decisions that benefit students performing below grade-level, even at some cost to other students, may have net social value. Alternatively, it may be possible to structure different organizational arrangements within the same school for different groups of students. For example, providing high ability students with separate mathematics instruction in a middle school setting can be accomplished even though most students remain in a self-contained instructional setting. At an extreme, one might even contemplate having sixth grade classes in an elementary-middle feeder system located at both the middle school and one or more of its feeder elementary schools, and have substantial fractions of students located at both places. It is far too early, though, to make such choices based on available data and analyses.

Even our analysis of these data requires substantial elaboration to provide practical information. A more precise examination of "instructional specialization" would treat the intermediate degree of specialization (i.e., where each student has two or three teachers) as a unique category rather than as an intermediate point along a linear scale. Tracking should be examined in schools with many classes at the same grade level separately from instances where there are only two or three, and separately in departmentalized systems from self-contained or team-teaching environments. Within-class ability-grouping should be examined separately in both tracked and non-tracked settings.

This survey of Pennsylvania sixth-graders and their schools is limited partly because of the homogeneous nature of the population and partly because it lacks truly longitudinal achievement data. However, the survey data provide a base for more rigorous analyses of the impact of the school and classroom organization on academic performance of different groups of middle-grade students by means of controlled field experiments.

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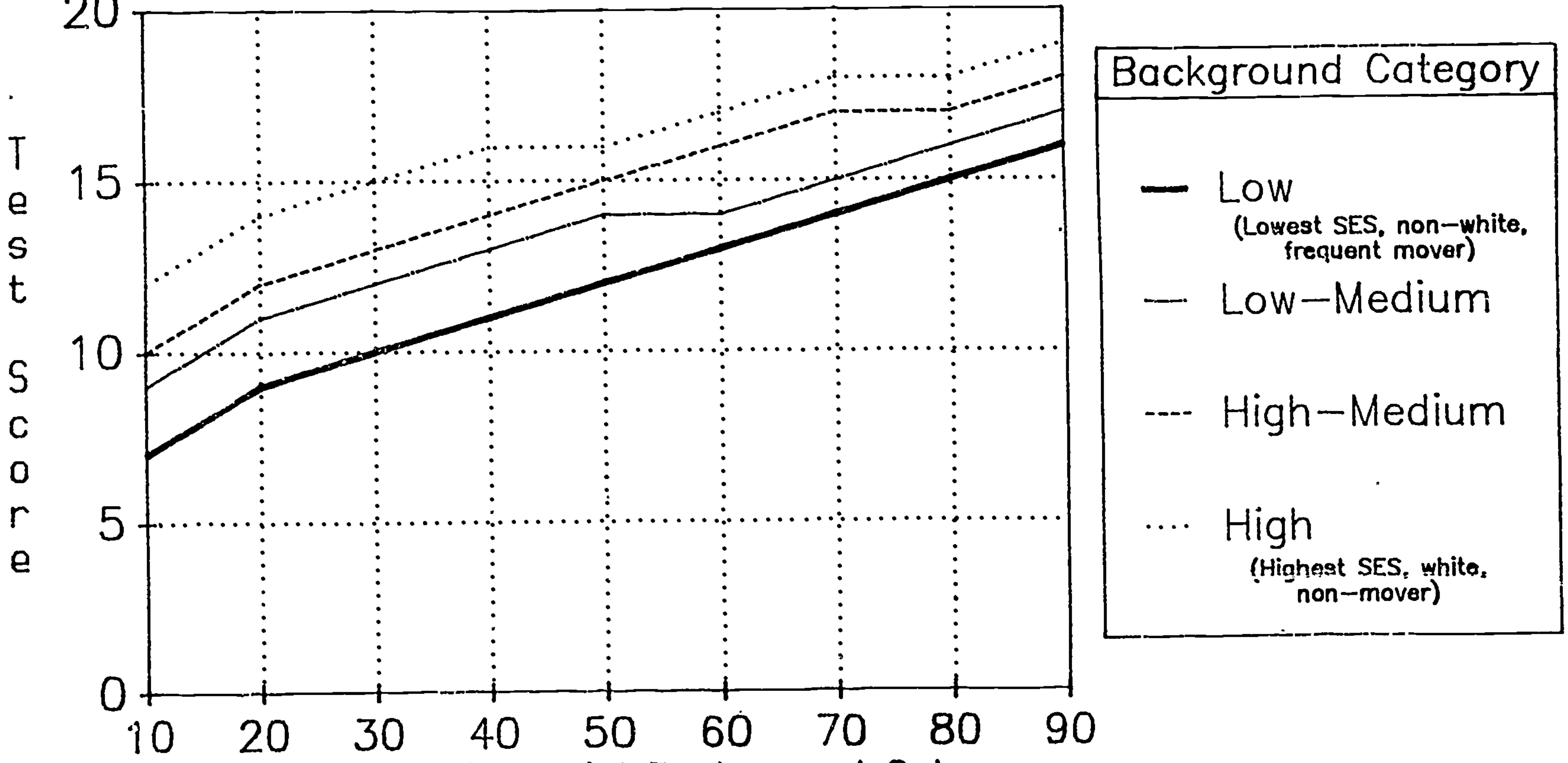
Fig. 1: Written English Test Score Distribution by Social Background Category*



*Category formed from predicted test score index –– regression model that includes mother's education, father's education, race, number of books and magazines in the house, and frequency of moves in past 3 years. Categories formed by cutting index at −1 standard deviation, mean, and +1 s.d.

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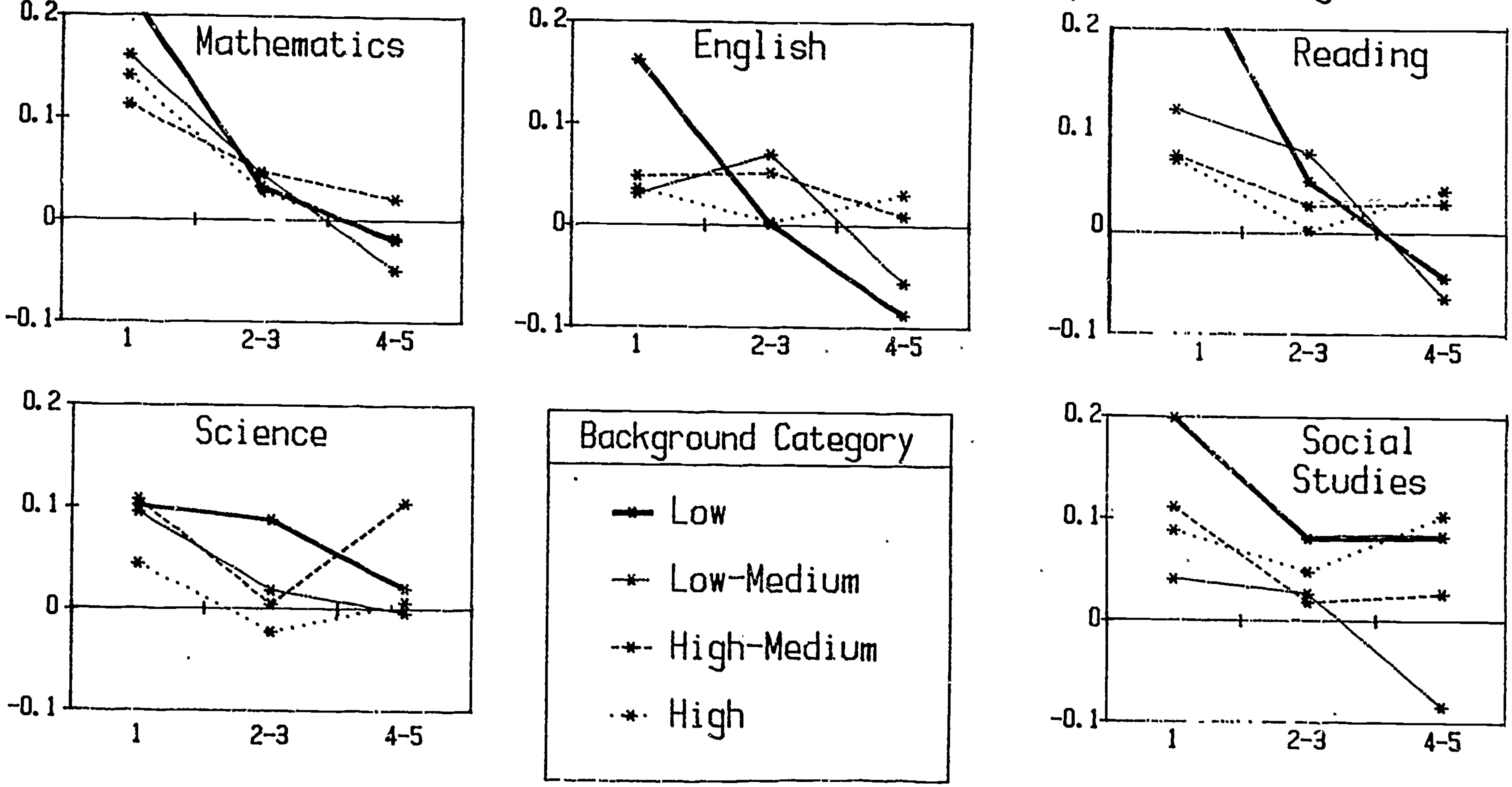
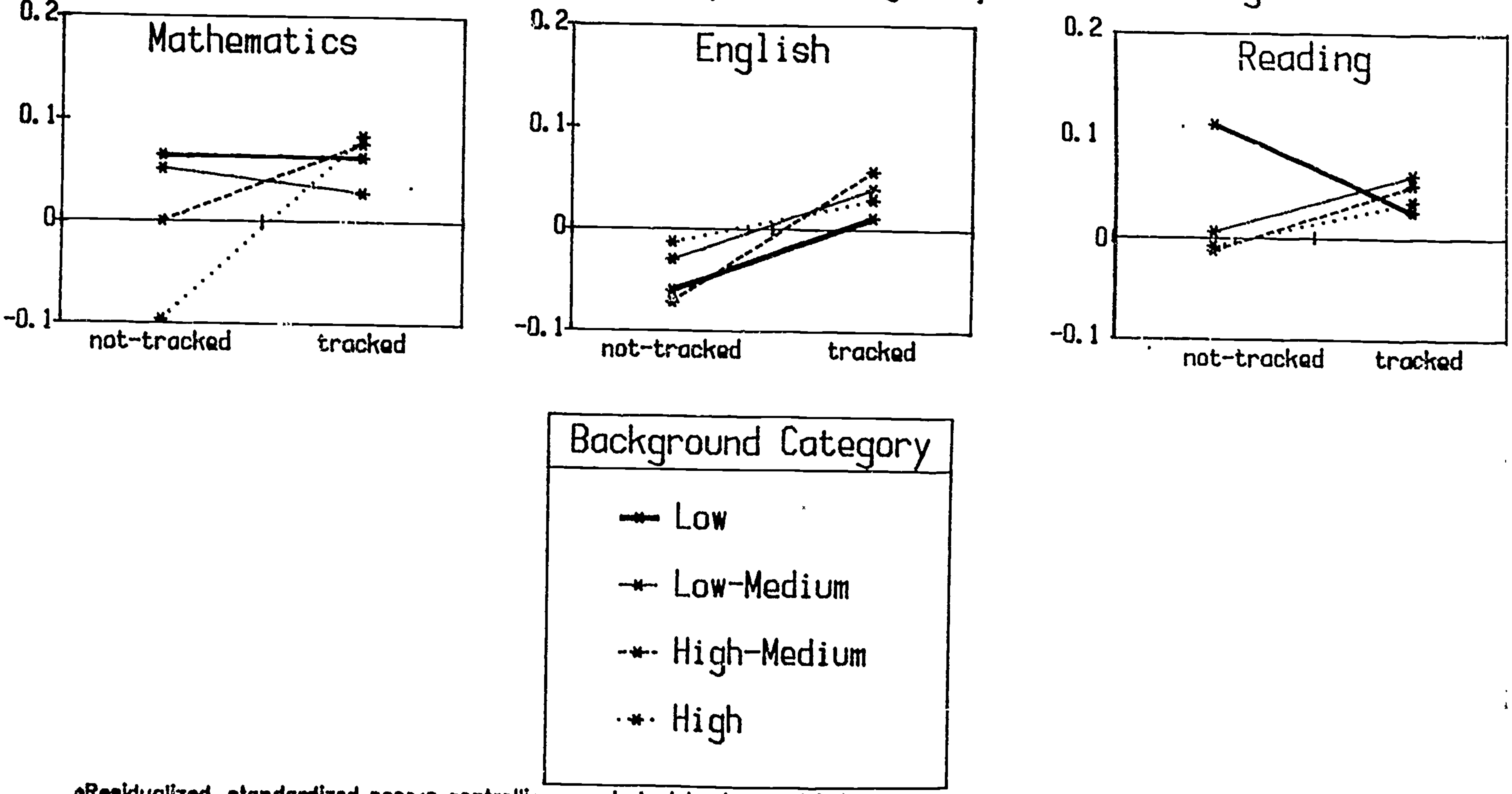
Fig. 2: Grade 6 Test Scores* by Teacher Specialization** by Student Background



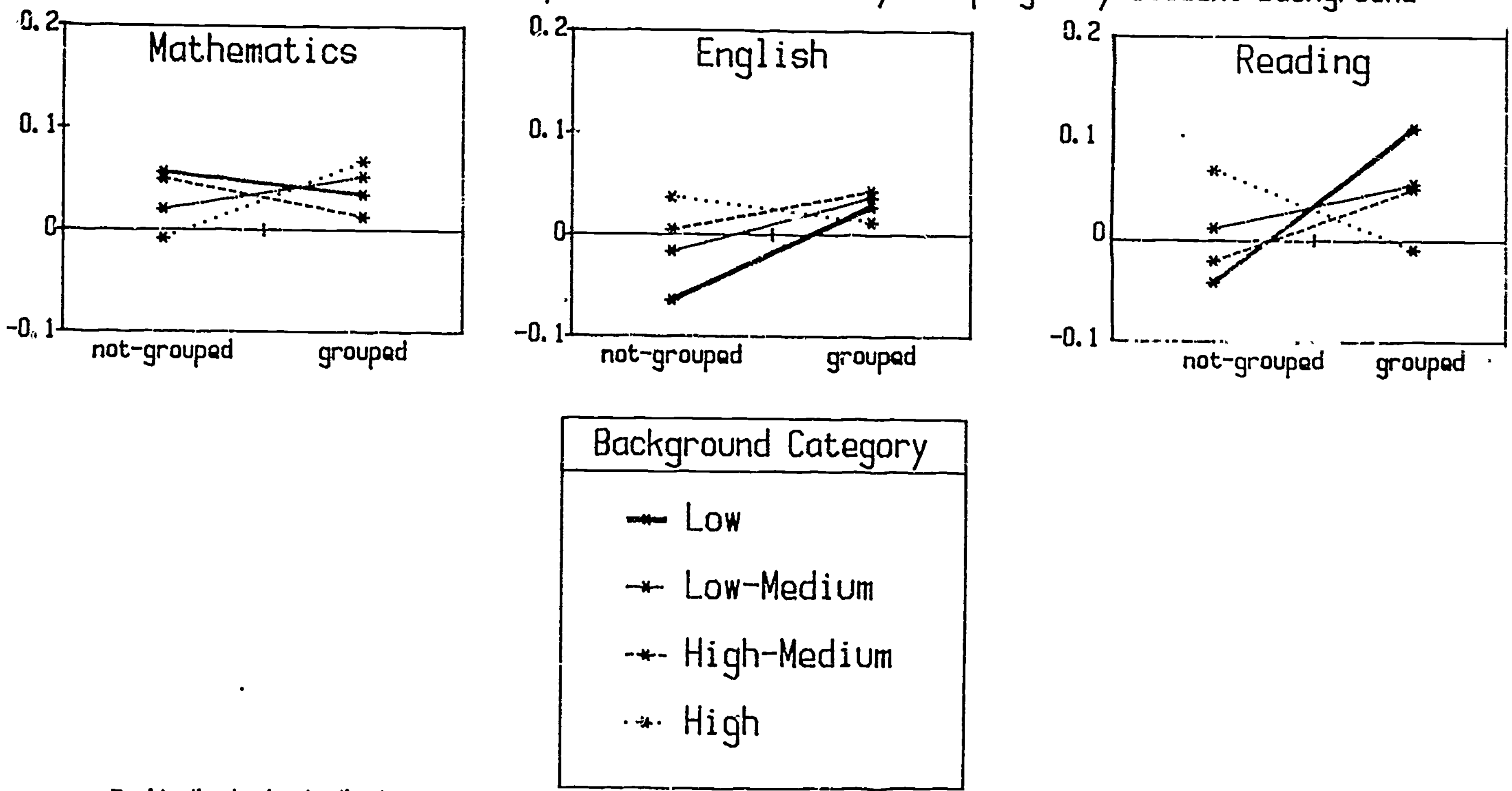
*Residualized, standardized scores controlling on student background index.
**Number of teachers for typical sixth grade student at that school.

Fig. 3: Grade 6 Test Scores* by Tracking** by Student Background



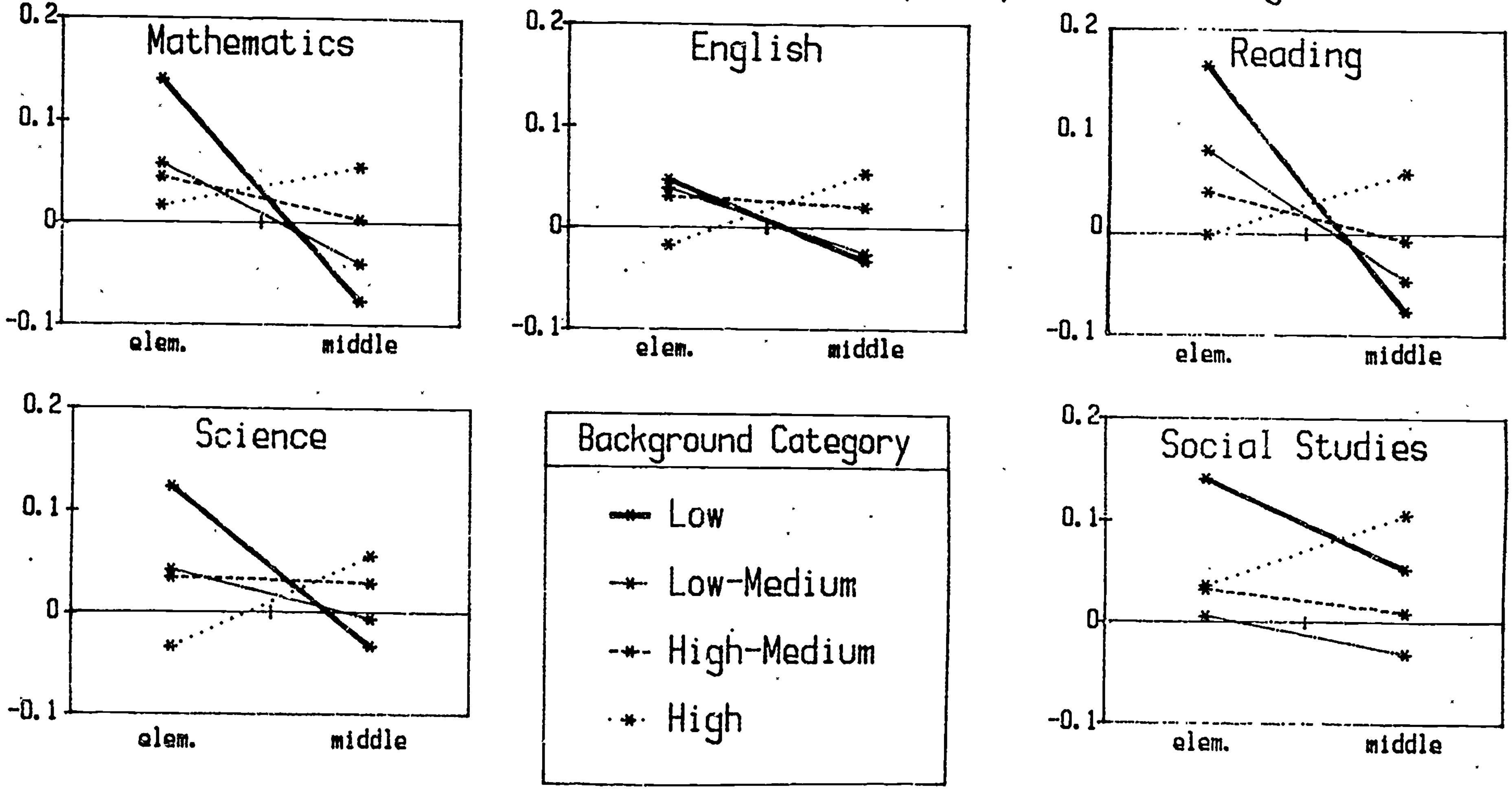
*Residualized, standardized scores controlling on student background index.
**Whether classes are organized by student ability or achievement. Math —— whether tracked for math. Reading —— whether tracked for reading. English —— whether tracked for English or reading.

Fig 4: Grade 6 Test Scores* by Within-Class Ability Grouping** by Student Background



*Residualized, standardized scores controlling on student background index.
**Whether most sixth grade teachers at the school group by ability for instruction. Math –– whether grouped for math. Reading –– whether grouped for reading. English –– whether grouped for English or reading.

Fig. 5: Grade 6 Test Scores* by Grade Span by Student Background



*Residualized, standardized scores controlling on student background index.

Table 1: Differences in Mean Test Scores (Standard Deviation Units) by Student Background Category Under Varying Organizational Conditions (1)

Panel A: Specialized Instruction (each student has 4+ teachers) vs. Self-Contained Classes (each student has 1 teacher)

+ favors specialization.
- favors self-contained classes.

Student Background(2)	Test Subject: Mathematics	English	Reading	Science	Social Studies	(Mean)
Low	-.24	-.25	-.33	-.08	-.12	-.20
Low-Middle	-.21	-.09	-.18	-.10	-.12	-.14
High-Middle	-.09	-.04	-.05	-.00	-.08	-.05
High	-.16	-.00	-.03	-.04	+.02	-.04
Net Difference (High - Low)	+.08	+.25	+.30	+.04	+.14	+.16

+ indicates highs do relatively better than lows under specialized instruction.

Panel B: Tracking in That Subject vs. Heterogeneous Class Assignments

+ favors tracking.
- favors heterogeneous class assignments.

Student Background	Test Subject: Math	English*	Reading	Science	Social Studies	(Mean)	(Mean: Math, Reading)
Low	-.00	+.07	-.08	-.02	+.16	+.03	-.04
Low-Middle	-.02	+.07	+.06	-.16	-.10	-.02	+.02
High-Middle	+.08	+.13	+.06	-.08	-.02	+.07	+.07
High	+.18	+.04	+.04	-.09	-.05	+.02	+.11
Net Difference (High - Low)	+.13	-.03	+.12	-.07	-.21	-.01	+.15

+ indicates highs do relatively better than lows under tracking.
- indicates lows do relatively better than highs under tracking.

* Difference between tracking in English and/or reading and tracking in neither.

Panel C: Within-Class Ability Grouping vs. Teachers Not Grouping for Instruction

+ favors within-class ability-grouping.
- favors instruction to whole class or heterogeneous groups.

Student Background	Test Subject: Math	English*	Reading	Science**	Social Studies**	(Mean)	(Mean: Math, Reading)
Low	-.02	+.09	+.15			+.07	+.06
Low-Middle	+.03	+.05	+.04			+.04	+.04
High-Middle	-.04	+.04	+.07			+.01	+.02
High	+.07	-.02	-.08			.01	.00
Net Difference (High - Low)	+.09	-.11	-.23			-.08	-.06

+ indicates highs do relatively better than lows under ability-grouping.
- indicates lows do relatively better than highs under ability-grouping.

* Difference between tracking in English and/or reading and tracking in neither.
** Science and social studies not included because of infrequency of grouping.

Panel D: Grade Span: Elementary School vs. Middle (starting grade 4+)

+ favors elementary schools.
- favors middle/intermediate schools.

Student Background	Test Subject: Mathematics	English	Reading	Science	Social Studies	(Mean)
Low	+.22	+.08	+.24	+.16	+.09	+.16
Low-Middle	+.10	+.06	+.13	+.05	+.04	+.08
High-Middle	+.04	+.01	+.05	+.01	+.02	+.02
High	-.04	-.07	-.06	-.09	-.07	-.07
Net Difference (High - Low)	-.26	-.15	-.30	-.25	-.16	-.23

- indicates lows do relatively better than highs in elementary school setting.

(1) Test scores are standardized residuals from prediction equation of raw test score on S.E.S. (father's & mother's education, books & magazines in home, race, and frequency of residential moves in previous three years. (Prediction equation called "student background index.")

(2) Categories based on student background index (see note (1)).
"Low" = score below 1 standard deviation (s.d.) below mean (N=1271).
"Low-middle" = (-1, 0) s.d. (N=3418) "High-middle" = (0, +1) s.d. (N=3178)
"High" = (+1, +4) s.d. (N=1244)

Table 2: Effect of School Grade Span on Standardized, Background-Controlled Test Scores, by Student Background, With Varying Controls and Conditions

Table entries are unstandardized regression coefficients, representing difference in predicted test scores between middle or intermediate school structure (beginning at grade level 4 or more) and elementary school structure (beginning at grade level less than 4 and ending no higher than grade 6).

Positive coefficient indicates advantage of elementary structure; negative coefficient indicates advantage of middle or intermediate structure.

Controls and Student Background	Test Subject: Mathematics	English	Reading	Science	Social Studies	(Mean)
Panel A: Control: Background only						
Low	+.22*	+.08	+.24*	+.16*	+.09x	+.16
Low-Middle	+.10*	+.06	+.13*	+.05	+.04	+.08
High-Middle	+.04	+.01	+.05	+.01	+.02	+.03
High	-.04	-.07	-.06	-.09x	-.07	-.07
Net Difference (High - Low)	-.26	-.15	-.30	-.25	-.16	-.23
Negative differences indicate that lows do better than highs in elementary.						
Panel B: Control: As above plus Specialization, Tracking, Ability-Grouping						
Low	+.25*	+.03	+.18x	+.23*	+.15x	+.17
Low-Middle	+.04	+.03	+.07	+.00	-.03	+.02
High-Middle	+.06	+.01	+.06	+.06	+.02	+.04
High	-.07	-.08	-.04	-.11x	-.05	-.07
Net Difference (High - Low)	-.32	-.11	-.22	-.34	-.21	-.24
Negative differences indicate that lows do better than highs in elementary.						
Panel C: Control: As above plus Enrollment per Grade Level						
Low	+.30*	+.01	+.23*	+.25*	+.14	+.19
Low-Middle	+.05	+.06	-.08	-.04	+.00	+.00
High-Middle	+.12*	+.04	+.04	+.06	+.03	+.05
High	+.01	-.03	-.02	-.09	-.01	-.03
Net Difference (High - Low)	-.29	-.04	-.25	-.34	-.15	-.22
Negative differences indicate that lows do better than highs in elementary.						

x regression coefficient nearly significant: $p < .15$
* regression coefficient statistically significant: $p < .05$

Table 3: Effect of Instructional Specialization on Standardized, Background-Controlled Test Score, by Student Background, by Grade Span

Table entries are 3 times unstandardized regression coefficient, representing difference in predicted test scores between "1 teacher per student" and "4 teachers per student," or between self-contained and specialized instructional organization.

Positive coefficient indicates advantage of specialization; negative coefficient indicates advantage of self-contained classes.

Grade Span and Student Background	Test Subject: Mathematics	English	Reading	Science	Social Studies	(Mean)
Panel A: All Schools						
Low	-.14x	-.18*	-.22*	-.08	-.06	-.14
Low-Middle	-.16*	-.12*	-.19*	-.07	-.12*	-.13
High-Middle	-.03	-.02	+.02	+.08	-.01	+.01
High	-.10x	-.01	+.02	+.03	+.06	+.00
Net Difference (High - Low)	+.04	+.19	+.24	+.11	+.12	+.14
Positive differences indicate lows do better than highs in self-contained.						
Panel B: Elementary						
Low	-.06	-.09	-.03	+.09	+.15	+.01
Low-Middle	-.24*	-.10x	-.15*	+.03	-.12x	-.12
High-Middle	-.07	-.07	-.04	+.08	-.12x	-.04
High	-.19x	-.06	-.03	-.00	+.02	-.06
Net Difference (High - Low)	-.13	+.03	-.05	-.09	-.13	-.07
Negative differences indicate lows do better than highs in specialized.						
Panel C: Middle						
Low	+.02	-.30*	-.22x	-.14	-.20	-.17
Low-Middle	-.10	-.17*	-.21*	-.20*	-.16*	-.17
High-Middle	-.02	-.02	+.15x	+.09	+.10	+.06
High	-.10	-.04	+.04	-.02	+.05	-.01
Net Difference (High - Low)	-.12	+.26	+.26	+.12	+.25	+.15
Positive differences indicate lows do better than highs in self-contained.						

x regression coefficient nearly significant: $p < .15$
* regression coefficient statistically significant: $p < .05$

Table 4: Effect of Between-Class Ability-Grouping (Tracking) on Standardized, Background-Controlled Test Scores, by Student Background by Grade Span, Controlling on Tracking in Other Subject and Other Test Score

Table entries are unstandardized regression coefficients, representing difference in predicted test scores between tracked or not-tracked in that subject holding constant tracking in other subject and controlling on test scores in other subject.

Positive coefficient indicates advantage of tracking; negative coefficient indicates advantage of heterogeneous assignment to classes.

Controls, Grade Span, Student Background	Test Subject: Mathematics	English	Reading	(Mean)
Condition:	All Track for Reading	None Track for Mathematics		
Control:	Reading, English Tests	Math Test	Math Test	
Grade Span: All				
Low	-.04	+.15x	-.05	+.02
Low-Middle	-.03	+.05	-.06	-.01
High-Middle	+.03	+.08	-.01	+.04
High	+.14*	-.03	+.00	+.04
Net Difference (High - Low)	+.18	-.18	+.05	+.02
Grade Span: Elementary				
Low	-.14	+.17x	+.07	+.03
Low-Middle	-.04	+.04	-.02	-.01
High-Middle	-.03	+.06	+.02	+.02
High	+.07	-.14x	-.01	-.03
Net Difference (High - Low)	+.21	-.31	-.08	-.06
Grade Span: Middle, Other (1)				
Low	+.17	+.21	-.11	+.09
Low-Middle	-.03	+.12	-.18x	-.03
High-Middle	+.13*	+.09	-.10	+.11
High	+.29*	+.33x	+.04	+.22
Net Difference (High - Low)	+.12	+.12	+.15	+.13

x regression coefficient nearly significant: $p < .15$
* regression coefficient statistically significant: $p < 05$

(1) Sample size for English and reading columns for Middle/Other settings: Low Background N=86. High Background N=80. All others above 200.