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Small Classes in the Early Grades and Course Taking in High School

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Researchers examined the relationship between small-class participation in the first four years of school and course-taking patterns in high school. Using original data from Tennessee's Project STAR (Student-Teacher Achievement Ratio) with high school transcripts for 3,922 students from the STAR experiment, the hypothesis that class size is related to the amount and level of coursework taken in mathematics, science, and foreign language was tested. Results indicated that students who spent three or more years in small classes took more foreign language courses, higher-level foreign language courses, and higher-level mathematics courses than did students in full-size classes. The possibility that small-class participation would benefit students with low socioeconomic status (SES) more than high-SES students was also explored, but no evidence was found of an SES-specific effect. The results are discussed in terms of (a) using class-size policies to promote the taking of advanced courses in high school, and (b) the need to consider long-term outcomes when evaluating class-size reduction initiatives.

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The purpose of this study was to examine the relationship between small-class participation in the elementary grades and student enrollment in advanced courses during high school. Although prior studies have addressed the taking of advanced courses in high school, the present study extends prior research by examining (a) the relationship between participation in small classes during the first several years of school and taking advanced courses during high school and (b) advanced-course taking in three separate subject areas: foreign language, science, and math. Researchers used an exceptional data set for the study—a subset of data drawn from a longitudinal study of nearly 12,000 students followed from kindergarten through high school. The study addressed three questions about small classes and advanced-course taking: (1) How is participation in small classes in the first four years of school related to taking advanced courses in high school? (2) How do results differ for students who spend 1–2 years in small classes compared to students who spend 3–4 years in small classes? (3) How does small-class participation in the first four years of school affect advanced-course taking depending on socioeconomic status?

Why Is Advanced-Course Taking Important?

A decline in U.S. students' achievement scores relative to the scores of students in other countries prompted a review of education policies and practices by the National Commission on Excellence in Education (NCEE). The commission's report, A Nation at Risk (1983), attributed this decline in achievement to student course taking and low standards for completion of advanced courses. A review conducted for U.S. Secretary of Education Richard Riley (U.S. Department of

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Education, 1997) found that taking advanced courses was a precursor to high levels of academic achievement and to college attendance. Despite these connections, programs of study in the United States have been characterized as covering more topics but being less intensive than those of other countries; that is, they are "an inch deep and a mile wide" (Schmidt, McKnight, & Raizen, 1996, p. 34).

Both the number and level of high school courses are related to academic achievement. Several studies indicate that the amount of coursework taken is positively related to achievement even after student characteristics such as socioeconomic status, aptitude, and prior achievement are controlled statistically (Epstein & MacIver, 1992; Gamoran & Hannigan, 1997; Jones, Davenport, Bryson, Bekhuis, & Zwick, 1986; Lee, Croninger, & Smith, 1997; Peng, Owings, & Fetters, 1982; Rock & Pollack, 1995; Sebring, 1987; Welch, Anderson, & Harris, 1982; Williams, Atash, & Chaney, 1995). Jones (1987) also demonstrated that the relationship between mathematics performance and number of courses taken "is essentially the same for black males, black females, white males, and white females" (p.186).

There is a difference, however, between the number of courses students take in a given subject area and the difficulty level of courses in terms of content. As distinct from the amount of coursework, the level of advanced coursework, even more than grades or the type of school (public or private), is also related to student achievement (Chaney, Burgdorf, & Atash, 1997; Hallinan, 2000; Lee & Bryk, 1989; Rock & Pollack, 1995; Roth, Crans, Carter, Ariet, & Resnick, 2001; U.S. Department of Education, 1997).

In terms of entering college, the U.S. Department of Education (1997) cites data showing that 83 percent of students who took Algebra I and geometry, and 89 percent of those who took high school chemistry went to college within two years of graduating from high school, compared to just 36 percent of those who did not take algebra or geometry and 43 percent of those who did not take chemistry. The relationships were even stronger among low-income students. Students in advanced-course pipelines (i.e., a sequence of increasingly difficult courses) are more likely to apply for college than students who are not (Atanda, 1999; Berkner & Chavez, 1997; Trusty, 2002), and they often attain higher scores on college admissions tests (ACT and the Council of the Great City Schools, 1998). Atanda (1999) found that students who took algebra or foreign language in 8th grade and completed high-level courses in those subjects in high school were more likely to apply to college than were students not consistently in the pipeline. Students who take high-level mathematics and science courses in high school are also more likely to choose mathematics and science majors in college (Trusty, 2002).

Despite the benefits, many students do not take advanced-level courses. In a classic study, Rock and Pollack (1998) examined course-taking behavior of high school students using data from the National Educational Longitudinal Survey of 1988 (NELS:88).[1] Approximately 35 percent of students who were proficient in science in 10th grade did not continue to take advanced science courses. Likewise, approximately 43 percent of students who demonstrated proficiency in mathematics in 10th grade did not continue with advanced mathematics coursework. Students who did not pursue further coursework generally did not expect to go to college. Although some schools require more course credits than others, some students opt to fill additional requirements with low-level courses rather than to advance in level (National Center for Education Statistics [NCES], 1996, 1998; Madigan, 1997; Teitelbaum, 2003). In some cases, the failure to take advanced courses is attributable to schools' limited course offerings (Finn, 1998; Oakes, Joseph, and Muir, 2002; Sebring, 1987; Teitelbaum, 2003).

The role of socioeconomic status (SES). Taking advanced courses is related to students' race/ethnicity and socioeconomic status. The U.S. Department of Education summary (1997) concluded that students from high-SES families were about twice as likely as students from low-SES families to take algebra in middle school, and geometry and chemistry in high school. Finn (1998) found that students in high-SES schools take more advanced mathematics courses compared to students in other schools, especially small rural schools. White and Asian students are more likely to take advanced courses than are Hispanic and African American students (Blank & Engler, 1992; Davenport et al., 1998; Finn, 1998; Goertz, 1989), while Hispanic and African American students are more likely to take remedial and basic mathematics courses than are White or Asian students (National Science Foundation, 1999; Rock, Ekstrom, Goertz, & Pollack, 1986).

Small Classes in the Early Grades

In the present study, researchers tested the hypothesis that attending small classes in the early grades is related to taking advanced courses in high school. The short-term benefits of small classes on student achievement has been confirmed by a plethora of nonexperimental studies (Glass & Smith, 1978; Robinson, 1990); by one large-scale, longitudinal, randomized experiment—Tennessee's STAR experiment (Achilles, 1999; Finn & Achilles, 1990; Finn, Gerber, Achilles, & Boyd-Zaharias, 2001; Word et al., 1990); and by recent local, district, and state class-size reduction (CSR) initiatives, for example, in Wisconsin (Molnar, Smith, & Zahorik, 1999; Molnar et al., 2000), North Carolina (Achilles, Harman, & Egelson, 1995; Egelson, Harman, Hood, & Achilles, 2002), and California (Bohrnstedt & Stecher, 2002). These studies also find rather consistently "that students who are economically disadvantaged or from some ethnic minorities perform better academically in smaller classes" (Robinson, 1990, p. 85).

In the STAR experiment, researchers randomly assigned students entering kindergarten to small classes (13–17), full-size classes (22–25), or full-size classes with a full-time teacher aide. These class sizes were maintained throughout the day, all year long. Students were kept in classes of the same size, with new teachers randomly assigned each year, for up to four years (through grade 3). Achievement tests were administered in the spring of each year. In all, 11,601 students participated in the STAR experiment in more than 300 classrooms in schools across the state. All students returned to full-size classes in grade 4 when the experiment ended, but collection of achievement data continued through grade 8.

Small classes were associated with significantly higher academic performance in every school subject in every grade during the experiment (K–3) and in every subsequent grade (4–8). The lasting effects were especially pronounced for students who attended small classes for three or four years. As with Robinson's (1990) conclusion, the benefits of small classes were greater for students attending inner-city schools and students from low-income homes (Finn & Achilles, 1990; Krueger & Whitmore, 2001).

Enduring effects. In this study, we hypothesized that attending small classes in grades K–3 would affect course taking in high school. The hypothesis was based on principles of early interventions that have lasting impact, and on research showing that small classes are associated with other outcomes related to course taking.

On the basis of an analysis of early childhood programs, psychologists have identified features of early interventions that have enduring effects (Barnett, 1995; Ramey & Ramey, 1998). Interventions most likely to endure have (1) developmental timing—that is, they start early and continue; (2) program intensity—that is, many hours per week, days per week, and weeks per year of the intervention; and (3) direct provision of learning experiences, rather than relying on intermediary sources. The STAR experiment began in kindergarten; STAR was high-intensity, affecting children for the entire school day every day of the school year, for up to four consecutive years; and STAR affected the learning setting directly, affecting all student-teacher interactions in that setting. Long-term impact on students would be expected, as a function of the extent to which students participated in small classes in grades K–3.

The predicted impact has been found for outcomes related to high school course taking. Finn, Gerber, and Boyd-Zaharias (2005) demonstrated that participation in small classes in the early grades for three or more years increased the likelihood of graduating from high school, especially for students from low-income homes. Further, participation in small classes in the early grades affected students' aspirations to attend college. Combining Project STAR data with ACT and SAT test-taking data, Krueger and Whitmore (2000) found that the proportion of students who took college entrance exams was significantly higher among those who participated in small classes in the early grades (43.7 percent) than among students who attended full-size classes (40.0 percent). The difference was greater for African American students (40.2 and 31.7 percent, respectively) and for students from low-income homes (30.8 and 26.5 percent, respectively). In our study, researchers asked if the long-term impact on course taking paralleled these prior findings.

Methods

Participants

This study's sample was a subset of students who participated in the Tennessee STAR experiment in grades K–3. Although the experiment ended when students reached 4th grade, researchers continued to collect data on students through the middle and high school years. The follow-up data included high school transcripts for as many students as possible.

Gathering the transcript data was an arduous process. We used the latest information on file to identify the high school each student would most likely have attended. The first contact was with district offices. In some cases, the district office provided transcript information, but in many instances we were referred directly to the schools. Some transcript data were provided in their original form, which varied from district to district, and other data were transcribed onto summary sheets. After about two years of work, approximately 5,000 transcripts had been collected; of these, 3,922 transcripts from students in 146 high schools contained sufficient course-taking information to be used in the study.

Characteristics of the final sample for this investigation are compared to the full STAR sample in Table 1. Race/ethnicity data were collected first in multiple categories—White (76.2 percent), African American (23.3 percent), Asian (0.2 percent), Hispanic (0.1 percent), American Indian (0.1 percent), and Other (0.1 percent)—and then combined into two categories: (a) White/Asian and (b) Minority, due to the small percentages of students other than White or African American. The transcript sample was similar to the full database except that the percentages of minority students and students who received free lunch were lower than in the full STAR sample. Minority and low-SES students were more likely to drop out of high school than were White or high-SES students (McMillen, 1996; Finn, Gerber, & Boyd-Zaharias, 2005). Thus, fewer transcripts for these groups were available.

Measures

Student data. The transcripts provided data on every course students took. Courses were combined into five main categories, used as outcome variables in the study: the total number of semesters taken in mathematics, foreign languages, and science, and the highest level reached in mathematics and in foreign language. Because science courses are not as sequential as mathematics or foreign languages, no highest-level measure was obtained in this field. Foreign language courses were distinctly sequential. They were coded 1–4, with each code corresponding to the level of the course in any foreign language (e.g., French 1, French 2, French 3, French 4). While high school mathematics courses generally have a pattern of increasing difficulty, students followed many different course sequences. To code mathematics course levels, the paradigm used by Rock and Pollack (1995) was adopted: Level 1—basic math, pre-algebra, and introduction to computers; Level 2—Algebra 1 and courses involving beginning algebra; Level 3—Algebra 2, introductory geometry, and courses involving Algebra 2 topics; Level 4—Algebra 3, advanced geometry, and other precalculus courses; Level 5—calculus. These levels were coded 1–5, respectively.

Student demographic information included gender, minority status, and free-lunch status. Students were classified as receiving free or reduced-price lunches if they had received free lunch at any time in the first four years of school (i.e., during the STAR experiment).

Despite the intention to maintain STAR experimental-group students in small classes for four years (K–3), several factors limited the number of years that some students actually spent in small classes. For one, because kindergarten was not required in Tennessee when the experiment began, some students entered participating schools in 1st grade. Second, some students moved into or out of schools participating in STAR at different points in the experiment. Thus, the experimental-group students spent between one and four years in small classes

Table 1

Comparison of the Transcript Sample with the STAR Sample

Characteristic	Full STAR Sample	Transcript Sample
Number of Students	11,601	3,922
Percent Male	52.9	48.4
Percent Minority[a]	36.9	23.6
Percent Free Lunch	55.3	48.6
Precent in Small Classes[b]	31.7	34.6

[a]Of the minority students, 98.7% were African American. The 63.1% nonminority included white students and 0.2% Asian students.

[b]For one or more years.

in grades K–3. Of the 3,922 students in the transcript sample, 10.6 percent spent one year in a small class, 6.3 percent spent two years, 5.5 percent spent three years, and 12.2 percent spent four years in small classes. The remaining 65.3 percent attended full-size classes for all four years.[2]

Several prior studies indicated that students can be meaningfully classified as spending 1–2 or 3–4 years in small classes. Finn et al. (2001) demonstrated that enduring academic achievement benefits through grade 8 depended on participation in small classes for at least three years. The likelihood of graduating from high school was also affected positively by participation in small classes for three or more years (Finn, Gerber, & Boyd-Zaharias, 2005). Thus, our study considered class size in three categories: full-size classes, 1–2 years in small classes, and 3–4 years in small classes. Two dummy codes were used to compare students who spent one or two years in small classes with students who were in regular classes, and students who spent three or four years in small classes with students who were in regular classes, respectively.

Full high school transcripts (four years) were available for 73.2 percent of the 3,922 participants in the sample. Due to the variety of transcript forms used by different districts, only three years of data (grades 9, 10, and 11, or grades 10, 11, and 12) were available for 13.7 percent of the sample, and two years (grades 11 and 12 only) were available for 13.1 percent. Transcripts with other patterns of data—for example, those that did not include grade 11 or 12—were excluded from the study. The number of years of available transcript data (2, 3, or 4) was included as a control variable in all analyses.

School data. School size (i.e., total enrollment) and school urbanicity were also examined in the study. The sample included 146 high schools with enrollments ranging from 100 to 2,425 students. School urbanicity was classified as inner-city (n = 46), urban (n = 13), suburban (n = 35), or rural (n = 52). For the analysis, two dummy codes were created to compare urban and suburban schools with inner-city schools, and rural schools with inner-city schools, respectively.

Analyses

The basic model used in the analysis was a multiple regression model for multilevel data, using the HLM5 computer software program (Raudenbush, Bryk, Cheong, & Congdon, 2000). The first level of data comprised students, nested within high schools (the second level). The dependent variables were amount of coursework taken in mathematics, science, and foreign language, and the highest level of mathematics and foreign language taken. Sample sizes for the analyses varied, depending on the pattern of missing values for the particular dependent variable, from 2,864 (highest level of foreign language) to 3,907 (highest level of mathematics).

For each dependent variable, the analysis was performed in three steps. First, a main-effects analysis was conducted to examine the relationship between small-class participation and the course-taking measure. The student-level independent variables were the two class-size dummy codes (1–2 years in small classes compared to full-size classes, and 3–4 years in small classes compared to full-size classes), gender, and free-lunch status. Years of transcript data was used as a student-level control variable. The school-level variables were school enrollment and two urbanicity contrasts (urban/suburban schools compared to inner-city schools, and rural schools compared to inner-city schools).

In a second multilevel analysis, the interactions of free-lunch status with the class-size dummy codes were added to the model to determine whether the effects on course taking were different for free-lunch and non-free-lunch students. In the third analysis, the HLM models were reduced to include just statistically significant effects, and effect size measures were estimated.

All parameters in the HLM models were treated as fixed except the school-specific intercepts, which were allowed to vary randomly. All student-level characteristics were centered on the school means. A type I error rate of $\alpha = .05$ was used to allow adequate power for detecting long-term effects that may be moderate or weak.

Effect sizes were computed to indicate the magnitude of statistically significant results. An effect size is the estimate of the difference between two means divided by the standard deviation of the particular outcome variable. Using Cohen's (1988) conventions, values near 0.20 should be interpreted as small effects and values near 0.50 as moderate effects.

Results

The numbers of courses taken by students in the sample provides context for viewing differences among the subgroups. The number of semesters of mathematics taken ranged from 0 to 14, with a mean of 5.99 (Table 2); semesters of science ranged from 0 to 13, with a mean of

Table 2

Means and Standard Deviations for Course-Taking Measures

Years in Small Classes	Semesters of Mathematics			Highest Mathematics			Semesters of Science			Semesters of Foreign Language			Highest Foreign Language		
	Free Lunch	Non-Free Lunch	All	Free Lunch	Non-Free Lunch	All	Free lunch	Non-Free Lunch	All	Free Lunch	Non-Free Lunch	All	Free Lunch	Non-Free Lunch	All
None[a]	6.02	5.99	6.00	2.92	2.99	2.95	5.52	5.43	5.47	2.44	2.50	2.47	1.90	1.89	1.90
	(1.94)	(1.98)	(1.96)	(0.93)	(0.89)	(0.91)	(2.05)	(2.04)	(2.04)	(1.85)	(1.86)	(1.85)	(0.55)	(0.51)	(0.53)
1-2 years	5.87	5.91	5.89	2.85	2.91	2.88	5.33	5.47	5.40	2.21	2.33	2.27	1.88	1.82	1.85
	(2.14)	(1.96)	(2.06)	(0.95)	(0.93)	(0.94)	(2.21)	(2.31)	(2.26)	(1.90)	(1.83)	(1.87)	(0.53)	(0.54)	(0.54)
3-4 years	6.23	5.93	6.06	3.07	3.08	3.07	5.78	5.64	5.70	2.65	2.63	2.64	1.94	1.93	1.93
	(2.00)	(2.08)	(2.05)	(0.91)	(0.93)	(0.92)	(2.07)	(2.21)	(2.15)	(1.82)	(1.84)	(1.83)	(0.53)	(0.41)	(0.47)
All	6.02	5.97	5.99	2.93	2.99	2.96	5.52	5.48	5.50	2.43	2.50	2.47	1.91	1.89	1.90
	(1.99)	(2.00)	(2.00)	(0.93)	(0.90)	(0.92)	(2.09)	(2.11)	(2.10)	(1.85)	(1.85)	(1.85)	(0.54)	(0.50)	(0.52)

Note: Standard deviations are in parentheses.

[a] Students attended full-size classes only.

5.50; and semesters of foreign language ranged from 0 to 10, with a mean of 2.47. Some students took multiple courses in a subject in a particular semester, resulting in totals greater than 8 (7.4 percent of students in mathematics, 5.4 percent in science, and 0.1 percent in foreign language).

In terms of the levels recommended by the NCEE (1983), 76.7 percent of students completed three years or more of mathematics coursework, 67.3 percent completed three years or more of science, and 50.2 percent completed two years or more of foreign languages. Further, 7.1 percent completed a course at the highest level of mathematics (i.e., calculus), and 0.8 percent completed a fourth-level foreign language course.

Table 2 also gives the means and standard deviations for students who attended small or regular-size classes in grades K–3. The means for students in regular-size classes were slightly higher than the means for students who spent 1–2 years in small classes on every course-taking measure. This may be due to the fact that students who attended small classes for one, or possibly two, years were more transient than others. In contrast, the regular-size class group included the whole range of transience, including none.[3]

The means for students who spent 3–4 years in small classes were higher than those for students in regular-size classes on every course-taking measure. The means showed slightly greater benefits of small-class participation for 3–4 years for low-SES students than for high-SES students on every measure except highest level of foreign language. The regression analysis was used to determine whether these differences were significant.

The multilevel analysis (Table 3) indicated no significant differences between low- and high-SES groups on any course-taking measure. There were significant urbanicity differences, however. Students in urban and suburban schools took more semesters of mathematics, science, and foreign language than did students in inner-city schools. Students in rural schools took more semesters of mathematics and science than did students in

Table 3
HLM Results for Five Course-Taking Measures

Independent Variable	Outcome Variables: Semesters of Mathematics	Highest Mathematics	Semesters of Science	Semesters of Foreign Language	Highest Foreign Language
School Level					
Enrollment	-.33x10-4	.24x10-3**	-.76x10-4	.29x10-3	.18x10-4
Urbanicity					
Urban/Suburban–Inner City	1.97***	-0.13	1.70***	.60**	-0.1
Rural–Inner City	1.74***	-.21**	1.72***	0.02	-.13*
Student Level					
Years of Data	1.44***	.70***	1.10***	1.30***	.38***
Years in Small Classes					
1 or 2–none	0.04	-0.05	0.1	-.17*	-0.02
3 or 4–none	-0.05	.14***	0.07	.17*	.06*
Free Lunch Status (yes–no)	0.03	-0.04	0.05	-0.03	0.01
Free Lunch x Years in Small Classes[a]					
1 or 2–none	0.03	0.02	-0.14	0.09	0.05
3 or 4–none	0.2	0.06	0.03	0.06	-0.01

[a] Interactions were tested in a separate HLM analysis, controlling for main effects.
*p<.05 **p<.01 ***p<.001

inner-city schools. Students in inner-city schools went further in the course sequences in mathematics and foreign language than did students in rural schools. This may be due in part to limited advanced-course offerings in rural areas (Finn, 1998). In general, demographic differences in course-taking patterns were reflected more in between-school variability than among students within schools.

Small Classes and Course Taking

The multilevel analysis indicated no significant differences on the course-taking measures between students in small classes for 1–2 years and students in regular-size classes, with one exception. Students in small classes for 1–2 years actually took fewer foreign language courses (M = 2.27, SD = 1.87) than did their counterparts in full-size classes (M = 2.47, SD = 1.85).

Significant differences were found for students who spent 3–4 years in small classes. These students took more foreign language courses (M = 2.64, SD = 1.83) than did their counterparts in full-size classes (M = 2.47, SD = 1.85) and also took higher-level courses in foreign language (M = 1.93, SD = 0.47) than did students in full-size classes (M = 1.90, SD = 0.53). The effects were small but reliable; the effect size for semesters of language study was 0.10σ, and for highest level taken was 0.12σ. The finding of significance for both measures is attributable in part to the relationship between them: additional courses of foreign language study are usually courses at a higher level. The correlation between semesters of foreign language and highest foreign language course was substantial (r = .46).

The greatest effect of small-class participation for at least three years was found with respect to the highest mathematics course taken. Students who spent 3–4 years in small classes took higher-level coursework (M = 3.07, SD = 0.92) than did students in full-size classes (M = 2.95, SD = 0.91). Again, the difference was small but reliable; the effect size was 0.17σ.

In contrast to foreign language, this effect did not appear to be significant for the number of semesters of mathematics taken. Students who spent at least three years in small classes took courses of increasing difficulty, while students in regular-size classes took a similar number of courses but did not move to an advanced level. Unlike the correlation in foreign languages, the correlation between the number of mathematics courses taken and highest level taken was weak (r = .15). This may reflect that students can fulfill graduation requirements by taking several courses within the same level (Teitelbaum, 2003).

With respect to semesters of science courses, students in small classes for 1–2 years did not take significantly more (or fewer) courses than did students in regular-size classes. Likewise, although the means favored small classes, students in small classes for 3–4 years did not take significantly more science courses than did students in regular-size classes.

Although previous research has shown that small-class participation benefits low-SES students more than high-SES students in terms of high school graduation rates (Finn, Gerber, & Boyd-Zaharias, 2005) and taking college entrance exams (Krueger & Whitmore, 2000), in this study there was no significant interaction between socioeconomic status and class size. Small-class participation affected the high school course-taking patterns of low- and high-SES students similarly. Both groups benefited from 3–4 years of small-class participation in terms of foreign language course taking and the most advanced mathematics course taken.

Discussion

Our study examined relationships between student participation in small classes in the first four years of school (K–3) and course-taking patterns in high school with respect to mathematics, science, and foreign language. We examined the impact of class size on the amount of coursework taken by students in these three subject areas and on the highest level of coursework that students took.

Previous research indicated that small-class participation effects persist through high school and beyond. In this study, we hypothesized that small-class participation would also have a positive effect on course taking. Indeed, small-class participation had a significant relationship to the amount of foreign language taken and to the highest levels of foreign language and math taken. Although effect sizes were small, the finding of an impact on behavior 6 to 9 years after the small-class intervention is noteworthy.

The findings for both subjects have important implications for educators. Students who take advanced mathematics courses—not just more mathematics courses—achieve more in mathematics throughout high school than those who do not take advanced mathematics courses (Rock & Pollack, 1995). And students who take advanced mathematics courses are more likely to go to college (Atanda, 1999; U.S. Department of Education,

1997) and to choose mathematics-related majors in college (Trusty, 2002), compared to those who do not take advanced courses.

Nevertheless, prior research shows that students proficient in mathematics early in high school do not always continue to advanced levels (Chaney, Burgdorf, & Atash, 1997; Rock & Pollack, 1998). In our study, most students completed basic mathematics courses (96.1 percent completed Algebra I or an equivalent course). The proportions of students who completed courses beyond Algebra 2 diminished with increasing course difficulty (17.3 percent took advanced coursework other than calculus, and 7.1 percent took calculus).[4]

Proficiency in languages other than English remains an important educational goal. The U.S. population continues to become increasingly multicultural and multilingual. The number of population members born outside the country increased by more than 50 percent between 1990 and 2000 (U.S. Census Bureau, 2003). Multiple languages are becoming a fact of life in American communities even as policymakers and educators debate the pros and cons of bilingual education (e.g., Lewis, 2005; Rumberger & Gandara, 2004). Also, as nations become increasingly interactive, it is in the national interest to collaborate on scholarly endeavors (Kellsey & Knievel, 2004; Kohl, 2004), economic development (Bruthiaux, 2002), and even national security (Flintoff, 2002; Paquette, 2000).

Despite their importance, few American students study foreign languages, and fewer study languages in depth. In the year 2000, only 43.8 percent of high school students nationwide were enrolled in a foreign language course (Draper & Hicks, 2002). Of those who do take foreign language courses, about half never advance beyond low-level courses, and very few (about 5.0 percent) take advanced placement courses (NCES, 2003a; NCES, 2003b). Indeed, our study found that only 0.8 percent of all students in the sample took four or more years of foreign language coursework.

Class-size reduction in the early grades may encourage students to take more advanced coursework in both foreign language and mathematics. The National Research Council (2002) noted that experiences in the early grades hold important implications for later attainments in subjects that are hierarchical in nature. Likewise, this study found that the roots of some course-taking decisions lie in school experiences beginning in grades K–3. Education leaders concerned with student achievement in secondary school may want to consider policies that result in small class sizes in these early grades.

In our study, the greatest course-taking benefits accrued to students who spent three or more years in small classes in grades K–3. Previous research has shown that students who spend several years in small classes realize other long-term benefits (Finn, Gerber, & Boyd-Zaharias, 2005; Krueger & Whitmore, 2000; Nye, Hedges, & Konstantopoulos, 1999). Our findings are also consistent with known features of educational interventions that have enduring effects: program duration is high on the list (Ramey & Ramey, 1998). The impact of some short-term programs, including Head Start programs, tends to fade when students leave the program and enter nonintensive classes in subsequent years (Garber, 1988; Horacek, Ramey, Campbell, Hoffman, & Fletcher, 1987; Ramey & Ramey, 1998; Reynolds, 1994). Educational leaders should create policies to keep students in small classes for multiple consecutive years and, together with teachers, structure small-class experiences in ways that research has shown are effective (see Achilles, 2005; Egelson, Harman, Hood, & Achilles, 2002).

Our study adds to the evidence that small classes have long-term benefits (see Finn, Gerber, & Boyd-Zaharias, 2005; Krueger & Whitmore, 2000). It suggests that the full impact of class-size reduction programs cannot be known until students reach high school. Debates about the efficacy of class-size initiatives (e.g., current debates in California and elsewhere) can be completely resolved only when all the data are in.

Strengths and Limitations of the Study

This study benefited by being based on a large sample of students followed longitudinally for up to 13 years, and from a well-defined and carefully monitored intervention in the early grades. The findings are strengthened by their similarity to other long-term results from the full STAR database (Finn, Gerber, Achilles, & Boyd-Zaharias, 2001; Nye, Hedges, & Konstantopoulos, 1999; Krueger & Whitmore, 2000).

Two limitations should also be noted. First, the 3,922 transcripts in our sample (out of 11,601 possible) were from schools that cooperated with the research team and were based on students with complete records. Thus, the sample may be biased in ways not portrayed in Table 1.

Second, although STAR researchers collected achievement and behavior data beyond grade 3, little information was obtained about students' day-to-day experiences in the ensuing years. This study, linking class size in the early grades to courses taken in high school, lacks solid data to document how these connections occurred. This is the most pressing issue in need of further research. By identifying the variables that mediate the links between small-class experiences in the early grades and indicators of success later in life (e.g., grades, graduating from high school, taking advanced courses), educators would be better able to capitalize upon the advantages of class-size reduction. Future research should be undertaken (a) to explain why small classes are effective in the short run, and (b) to examine the events that intervene between the early grades and later academic outcomes.

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Endnotes

1. The NELS study began in 1988, when students were in 8th grade. The transcripts were collected in 1992, when most students had completed high school.
2. These percentages are close to the percentages for 3rd grade, the final year of the experiment. In that year, 65.5 percent had attended full-size classes for four years, and 10.2 percent, 6.0 percent, 5.7 percent, and 12.6 percent had attended small classes for one, two, three, and four years, respectively.
3. Finn, Gerber, and Boyd-Zaharias (2005) reported transience rates of students who participated in STAR. Among students who were assigned to small classes for one or two years, 74.9 percent had moved out of a participating school before the experiment ended. This figure compared to 52.0 percent among students in regular-size classes.
4. Figures are not given in tables. Results are based only on students with four years of data (n = 2,872).