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New Evidence on College Remediation

Most American colleges and universities offer special courses for students who lack some of the reading, writing, and mathematics skills that are critical for college-level work (Roueche & Roueche, 1999). This phenomenon is known popularly as remedial education, although many educators avoid that label, preferring terms such as developmental education, skills courses, or college preparation courses. Developmental or remedial education is widespread: Our analyses indicate that about 40% of traditional undergraduates take at least one such course, and remediation is even more common among older nontraditional students (Woodham, 1998).

Remedial coursework has become a politically contentious issue in the last decade or so (Kozeracki, 2002; Soliday, 2002). Some commentators view the existence of remedial or developmental courses as evidence that many of today's college students are not academically strong enough to manage college-level work and should not have been admitted into college in the first place (Harwood, 1997; Marcus, 2000; Trombley, 1998). From this perspective, the existence of remediation suggests that some institutions have lowered their standards for admission, and have subsequently "dumbed down" courses so that unprepared students can

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make their way through college (Bennett, 1994; MacDonald, 1997, 1998, 1999; Traub, 1995). Other critics argue that students get bogged down taking multiple remedial courses, leading many to give up and drop out. Remedial education, in this view, is a hoax perpetrated upon academically weak students who will be unlikely to graduate (Deil-Amen & Rosenbaum, 2002; Rosenbaum, 2001).

In recent years, such arguments have encouraged several states to remove developmental or remedial courses from their public four-year universities and to redirect students in need of remediation into community colleges (Bettinger & Long, 2004; Kozeracki, 2002; Soliday, 2002).

The opposite view maintains that developmental education is a necessary component of higher education, one with deep historical roots. Proponents note that many promising students combine strengths in certain subject areas with weaknesses in others, which can be addressed by skills courses. Moreover, many students enter college years after graduating high school and need to rebuild certain skills. Most importantly, proponents stress that most students who take remedial/developmental coursework subsequently complete their degrees successfully (McCabe, 2000; Merisotis & Phipps, 1998).

Supporters of college remediation draw attention to the fact that students of color, students from less affluent families, and students for whom English is a second language are greatly overrepresented in remedial courses. Consequently, policies that prevent students who need remedial/developmental work from enrolling in four-year colleges could greatly reduce the likelihood that such students would ever obtain bachelor's degrees (Lavin & Weininger, 1998). Supporters of developmental education therefore construe the controversy over remediation as an attack on access to college.

Although much has been written about this controversy, there are large gaps in the empirical record. One review noted, "Research about the effectiveness of remedial education programs has typically been sporadic, underfunded, and inconclusive" (Merisotis & Phipps, 2000, p. 75). Another added, "Unfortunately, while debates for and against have been vociferous, the effectiveness of these programs has not been visible as an issue. Relatively few evaluations of remedial programs have been conducted, and many existing evaluations are useless" (Grubb, 2001, p. 1).

Exactly what constitutes "college-level work" is by no means clear. Institutions differ on this, and there are different expectations even within single institutions. Consequently, there is no objective or generally agreed upon cut-off below which college students require remediation. Each college follows its own set of practices, and this leads to the considerable variability in remediation we document below.

The recent availability of college transcript data from the National Educational Longitudinal Study (NELS:88) provides us with high-quality data describing a nationally representative cohort of students. This study provides a detailed picture of the remedial/developmental coursework that each student undertook, based on a coding of college transcripts undertaken with the advice of college and community college registrars and institutional research officers. It also includes detailed assessments of students' academic skills and coursework prior to college entry, plus measures of family background. This allows us to separate preexisting academic skills and weaknesses from the effects of taking remedial coursework during college.

The development of a statistical technique known as "the counterfactual model of causal inference" provides a superior methodological tool to separate the effects of remedial coursework from those of background variables. By applying counterfactual models to the NELS:88 transcript data, this article casts new light on the empirical facts underlying the controversy over college remediation.

This essay first documents how much remediation occurs in college and describes what kinds of students take remedial coursework. We then examine the effects of taking remedial courses on graduation rates and time to degree, including the consequences of taking many remedial courses. We explore whether some kinds of remediation are more consequential than others are, and we assess the effects of successful completion of remedial coursework on degree completion. Finally, we draw out the implications of our findings for recent policy controversies about remediation in higher education.

Previous Research

Merisotis and Phipps (1998, 2000) reviewed the controversy over remedial/developmental coursework in college, providing a historical context (see also Kozeracki, 2002; Roueche & Roueche, 1999). They noted that remedial courses have been a regular part of the curriculum at Ivy League universities and other colleges from the Colonial period to the present (cf. Breneman & Haarlow, 1998; Ignash, 1997; Payne & Lyman, 1996). The political movement against remediation that flourished in the 1990s and that led to important policy shifts was not triggered by any increase in remedial coursework on college campuses at that time, according to Merisotis and Phipps. On the contrary, the proportion of institutions offering such courses, and the proportion of students taking them, remained stable until after the new policies removed remedial coursework from many state universities.

Merisotis and Phipps (1998, 2000) summarized studies indicating that the bulk of remedial students are 20 years old or older, or returnees or delayed entrants to college. They also noted that remediation is considerably cheaper per student than regular college coursework, and in most institutions, it consumes a quite modest part of the budget. They concluded that the case for offering remediation in higher education is compelling: "[Remediation] is not an appendage with little connection to the mission of the institution but represents a core function of the higher education community that it has performed for hundreds of years" (Merisotis & Phipps, 2000, p. 79).

Clifford Adelman has studied the factors that affect college graduation rates and time to degree, and he has examined remediation in this context. His analyses of the "High School and Beyond" data set, which followed a cohort of students who graduated high school in 1982, documented that students who took remedial courses in college had markedly lower graduation rates: 39% earned bachelor's degrees, compared to 69% of students who took no remediation (Adelman, 1999, p. 74). He replicated this pattern for a later cohort, the high school class of 1992 (Adelman, 2004, p. 94). These studies indicate that students who need remedial courses are much less likely to graduate.

Less well-known than these figures on remediation and noncompletion is Adelman's finding that *college remediation ceases to predict graduation*, once a measure of secondary school academic performance and preparation is added to the model (1999, p. 75). This implies that poor high school preparation, rather than taking remedial coursework, is what reduces students' chances of graduating from college.

In analyses comparing the high school class of 1982 with the class of 1992, Adelman (2004, p. 87–94) found that the number of students taking remediation had declined somewhat over time. He also documented that students who undertake many remedial courses in college, and those whose *reading* skills require remediation, are least likely to graduate from college, but that many other students do improve their skills and complete college despite academic weak spots. He concluded:

> The bottom line . . . is that "remediation" in higher education is not some monolithic plague that can be cured by a single prescription. Determined students and faculty can overcome at least mild deficiencies in preparation. . . . But when reading is the core of the problem, the odds of success in college environments are so low that other approaches are called for. (1998, p. 11)

One lesson of Adelman's work for our current study is that researchers should test whether remediation for reading has more deleterious consequences than remedial work in other subjects, and whether

students taking multiple remedial courses decrease their likelihood of graduating. A second lesson is that research should distinguish between effects of remediation on chances of graduation and effects of remediation on time to degree.

Deil-Amen and Rosenbaum (2002) examined remediation in community colleges, locating their research in an earlier tradition that suggested that two-year institutions were places where students' educational aspirations were "cooled out." That is, many students are socialized at community college to accept a less desirable option than a bachelor's degree. Deil-Amen and Rosenbaum studied two community colleges. Both of these colleges emphasized students transferring to a four-year program and provided courses "that are intended to preserve standards and move remedial students into the college level courses that are accepted for transfer credit by senior institutions" (Deil-Amen & Rosenbaum, 2002, p. 254). Some of these courses were remedial and did not carry credit towards a degree. However, colleges obscured this fact in catalogues and in the ways they counseled students into taking the courses. "Students often go for several months, a full semester, or even a full year without knowing that their remedial courses are not counting toward a degree" (Deil-Amen & Rosenbaum, 2002, p. 260).

Deil-Amen and Rosenbaum judged these "lengthy delays" to be detrimental, concluding "This process looks a lot like the swindles that Goffman . . . described" and "the delayed recognition caused by a stigma-free approach may be contributing to students dropping out of college altogether and hence accumulating no credentials rather than a lesser degree" (2002, p. 264). They suggested that academically weak students would benefit more from taking occupational courses or the more vocational AAS degree rather than from attempting an AA degree with the goal of transferring to a four-year degree (cf. Rosenbaum, 2001).

In our analyses of the NELS:88, we will test whether remedial coursework leads students to accumulate few credits or results in delays in time to degree among two-year college students.

Lavin and Weininger (1998) examined a recent cohort of students who enrolled in bachelor's degree programs at the City University of New York (CUNY). Consistent with prior research, they found that graduation rates were inversely related to the number of academic skills tests failed. Nonetheless, about a quarter of those who initially failed all of the tests subsequently graduated. One finding was particularly instructive. Among African American, Hispanic, and Asian bachelor's degree recipients, the number who initially failed skills tests exceeded the number who passed all of their skills tests. *Well over half of minority students who ultimately graduated initially failed academic skills tests.*

If higher education systems adopted a policy of not admitting students needing remedial coursework into four-year institutions, then the impact on minority students would be especially heavy. Lavin and Weininger's analyses also established that remedial placement is far from an academic death sentence: After taking remedial courses, many students do graduate.

Largely because of the failure to control for important selection biases, there has been little firm evidence that remediation improves a student's chances of graduation. Lavin, Alba, and Silberstein (1981) introduced controls for selection and found that remediation did make a positive contribution. After CUNY adopted a system of open admissions, it tested incoming students to determine their academic skill levels and provided remedial courses. However, many students who appeared to need remedial work were not placed in such courses, because mandatory placement was not a part of university policy at that time. So, among students who did *not* take remedial work were quite a few who were comparable to the students who were in remedial courses, in terms of high school background (high school grades, college preparatory courses taken, and percentile rank in high school graduating class) and level of need for remediation as measured by tests of reading and arithmetic skills. With these variables controlled, students who entered CUNY and were placed in remediation were compared with other low-skill students who were not placed in remedial courses.

While placement in remedial courses *per se* did nothing to enhance students' subsequent academic achievements, success in remedial courses did make a significant difference. Among students in bachelor's degree programs, those who passed at least one of their remedial courses were more likely to persist in college than were comparable low-skill nonremedial students, and they earned more credits. After 5 years, the former were slightly more likely to graduate (Lavin, Alba, & Silberstein, 1981). Among two-year college entrants, there were similar results. Students who passed at least one of their remedial courses (85% of takers were in this category) were more likely to stay in college, and were more likely to graduate or to transfer into a bachelor's degree program than were otherwise similar students who did not take remedial coursework. This suggested a positive influence of remedial courses, at least for the large majority of students who successfully complete them.

Bettinger and Long (2004) analyzed a longitudinal data set that followed 8,000 first-time freshmen enrolled in nonselective four-year public colleges in Ohio from 1998 to 2002, in order to assess the consequences of taking remedial coursework in mathematics. Their data set had extensive information on students' academic preparation and

achievement in high school, so the analyses assessed the effects of remediation after controlling for prior academic skills. Bettinger and Long found that students placed in remedial college courses in mathematics were somewhat more likely to drop out or transfer to a two-year college, compared to academically equivalent students not in remediation. Surprisingly, however, remediation did not lower the likelihood of obtaining a bachelor's degree. In addition, when Bettinger and Long distinguished students in four-year colleges who *completed* their college remedial courses, they found that those remedial students were *more likely* to complete a bachelor's degree than were otherwise equivalent students who did not complete remedial math. Thus, they concluded that success at remedial mathematics improves a student's chances of graduation. This was balanced by the fact that students who completed remedial mathematics coursework took more time to graduate than nonremedial students took.

The import of the studies by Bettinger and Long and by Lavin et al. is that completion of remedial courses may have positive consequences that are not evident when looking at all students who enroll in remedial courses. Many students do fail to complete remedial courses: Some withdraw, others take incompletes, and some drop out of college altogether (Adelman, 2004, pp. vii–viii, 84). However, those students who do complete some remedial coursework may have superior prospects of graduating. We will test that hypothesis below using the NELS:88 data.

Data and Methods

The NELS:88 Study

The National Educational Longitudinal Study, known as the NELS:88, is a project of the U.S. Department of Education's National Center on Educational Statistics. In 1988, a representative sample of the nation's eighth-grade students was assembled, and detailed baseline information was collected about their family and academic background. The Educational Testing Service developed pencil-and-paper tests of each student's skills in reading and mathematics for the NELS:88, a sort of mini-SAT. These tests were repeated in eighth, 10th, and 12th grades. Additional data were collected from parents, teachers, and the students themselves during each follow-up survey. Later, NELS:88 students who entered college provided researchers with detailed information about the institutions they attended and the degrees they obtained. The most recent survey update was undertaken in 2000.

The NELS cohort was scheduled to graduate from high school in the spring of 1992. Later that year, high school transcripts were obtained

from approximately 85% of the cohort. For those students who participated in the final survey of the NELS in 2000 and whose high school transcripts were complete, a measure of the intensity of high school curriculum was constructed. This measure along with high school GPA and class rank and score on a 12th-grade test of general learned abilities constitute the three core indicators of a student's academic achievement or preparation prior to entering postsecondary education.

More recently, the NELS:88 obtained college transcripts for those students who went to college, and coded the coursework, credits, grades, and degrees obtained. Researchers developed a taxonomy of college remedial courses in consultation with panels of registrars and institutional research officers, and this taxonomy was used in the process of coding the NELS postsecondary transcripts (Adelman, 2004). We use the NELS:88's assessments of the number and kinds of remedial courses taken. Adelman (1999, p. 7) has shown that student self-reporting about taking remedial courses, and reports by college officials of enrollment in remedial courses, both greatly understate the amount of remedial coursework undertaken, compared to the information provided by student transcripts. He has argued that the transcript studies are more reliable.

As a longitudinal panel survey, the NELS:88 experiences sample attrition and encounters issues of nonresponse bias. On occasion, the sample has been "refreshed" with additional respondents. The NCES contractor calculated different respondent weights for each combination of waves in the data collection, along with special characteristics of student records, so that, whichever subjects and topics a researcher chooses to study, the analysis will remain representative of the national 1988 cohort despite attrition and nonresponse bias. Our analyses included only respondents who participated in each of the NELS survey waves and who provided high school and college transcript data. We used a longitudinal weight provided by the NELS:88 for this combination, known as F4PHP3WT. This yields an unweighted N of 6,879 students, and a weighted N of 2,004,732, such that the weighted sample is representative of the national cohort. The case weight used in our regression models divided each person's value on F4PHP3WT by the mean value of that variable, to yield a total sample size of 6,879. Because the NELS provides several alternative weights, the findings reported below may differ slightly from other published analyses.

The resulting sample *is not* representative of the entire universe of U.S. undergraduates, for it excludes the kinds of students who enter college many years after leaving high school. The sample *is* representative of a single nationwide cohort of high school students who went on to college during the roughly 8 years following high school. That sample

includes students who entered the full range of two- and four-year, private and public, selective and nonselective colleges, students who pursued postsecondary vocational credentials, as well as associate's and bachelor's degrees.

Missing Data

We deliberately excluded persons who had no high school or college transcript data; however, this leaves in the sample individuals who are missing particular pieces of transcript information. We did not wish to impute central dependent variables—namely, the numbers and kinds of remedial courses taken, degrees obtained, and time to college graduation. Anyone missing one of those variables was excluded from the particular regression model analyzing that individual outcome. For all other variables, which included family background, high school tests, and academic intensity measures, we used a multiple imputation method, using Amelia software developed and described by King, Honaker, Joseph, and Scheve (2001). The software and the mathematical algorithm used for imputation are described at: http://gking.harvard.edu/amelia/.

Variables

The central variables in our analyses describe whether or not a student took remedial coursework during college. We utilized variables provided by the NELS:88, based on their judgment as to which courses on college transcripts were remedial courses. "Any remediation" is a dummy variable we created that is coded 1 if a student took one or more remedial courses in college, or 0 otherwise, no matter whether the student passed, failed, or withdrew from that remedial course. "Many remedial courses" is a dummy variable that takes a value of 1 if a transcript includes *three or more* remedial courses, and 0 otherwise. Those courses could be in one subject (such as three remedial reading courses) or any combination of subjects (e.g., one remedial course in reading, one in mathematics, and one in writing).

The NELS:88 classified each remedial course by its subject matter. Using those codes, we created separate dummy variables for remedial reading, for remedial math, and for what we will refer to as "remedial writing, etc." This last category contains mainly remedial courses in writing plus some courses in "comprehensive language arts." This category excludes languages courses in reading or in speech, however. If a student took any remedial courses in the respective subject, that student was given a value of 1 for that dummy variable.

Finally, using the NELS course-level transcript data, we generated dummy variables indicating students who passed all of the remedial

courses they took in each of these areas. For each course that a student takes, the NELS provides a flag indicating whether it was completed successfully. Students who passed each remedial course they took in a given subject are coded 1, and 0 otherwise.

The main outcome variables in this study are also derived from NELS:88's college transcript variables. Three are dichotomous variables: whether a student graduated with a degree, whether a student interrupted his or her college studies for a period of more than one semester; and whether or not a student earned more than 10 credits. Time to bachelor's degree (for those who did complete one) was a continuous variable, measured in years.

The NELS provided rich measures of students' academic skills and achievement during high school, which functioned primarily as control variables, as we sought to separate the effects of college remediation itself from competencies brought from high school. These included 12th-grade math and reading test levels; eighth-grade achievement test scores; middle school grades; class rank as of 12th-grade (which correlated very highly with GPA); high school curricular intensity; and highest math course taken in high school.

We also used as controls several indicators of student orientation towards academic work, measured during high school: the student's behavioral history in school, school engagement, self-directedness, and self-esteem. A student's higher education plans in the senior year of high school was used as another control.

Several ecological variables about the student's middle and high schools were included as controls: proportion of schoolmates who were African American or Hispanic, measured in eighth grade; proportion of school that qualified for free lunch, measured in eighth grade; whether the student attended an urban, suburban, or rural high school; and whether that school was public or private.

Finally, two NELS:88 variables indicated whether a student enrolled in a public or private college, or a two- or four-year college. Because some students move from one college to another, we coded these for the first college that a student entered after high school.

Descriptive statistics for the variables used are provided in Appendix A, both for the sample as a whole and for the subset of students who took any remediation in college.

The Counterfactual Model of Causal Inference

Researchers have known for some time about problems in conventional regression models that estimate the causal effect of one particular variable (termed a treatment variable) on an outcome while controlling

for other potentially confounding variables (Lieberson, 1985). Conventional regression models do not adequately control for selection bias: On average, subjects with one value on the treatment variable may differ on numerous background variables from those with a different value on the treatment variable. The effects of these background differences become incorporated into the estimated coefficient for the treatment variable, creating an upward or downward bias and undermining causal inference (Winship & Morgan, 1999).

Statisticians have developed a theoretical framework known as the counterfactual model of causal inference to address this problem (Heckman & Hotz, 1989; Heckman, Ichimura, Smith, & Todd, 1998; Rosenbaum & Rubin, 1983, 1985). The approach may be understood by analogy to an experimental design with random assignment of subjects into treatment and control groups. In an experiment, the random assignment of individuals to treatment and control groups assures that both groups are identical on background characteristics, so that any difference subsequently observed between the two groups on a dependent variable is attributable to the treatment alone. Something analogous is achieved in a counterfactual model by first building a model that predicts the dichotomous treatment variable. This yields a propensity score (explained below). A sample is then constructed using this propensity score, such that the treatment and control groups are close to identical on background characteristics, thus removing or drastically reducing any selection bias.

In some of the analyses reported below, the "treatment" is whether a student takes remedial coursework; in other cases, remediation serves instead as the dependent variable that we are trying to predict, while the "treatment" becomes a possible causal factor such as two-year college versus four-year college entrant. In either case, a logistic regression model is first constructed to predict the treatment. That model includes all available variables that might distinguish students who receive the treatment from those who do not (e.g., who enters a four-year rather than a two-year college). Nonlinear versions of predictors, as well as linear ones, are included in this model, and interaction terms between predictors are added. The resulting logistic regression equation predicts for each respondent the probability of that student having the treatment. This statistic is known as a propensity score, and it takes values between 0 and 1.

A second step, known as caliper matching, matches or pairs each person with a given propensity score who *did* receive the treatment (e.g., entered a four-year college) with a person who has a nearly identical propensity score (likelihood of receiving treatment), but who actually *did not* receive the treatment (did *not* enter a four-year institution). The second person in each pair functions like a member of a control group,

providing a "counterfactual" estimate of what the outcome for the treated individual would have been if that person had not received the treatment. A computer algorithm in the STATA statistical package generated matched pairs of respondents, selecting at random from those treated and untreated individuals whose propensity scores were within .01 of each other. It is possible to require an exact match on additional criteria beyond the propensity score; this may yield better standard biases (see Appendix B).

Statisticians argue that for propensity matching to approximate an experiment with random assignment, it is not necessary that the treatment group be identical to the control group on every predictor, so long as the two groups are correctly matched on the propensity for treatment (Rosenbaum & Rubin, 1983). Nevertheless, practitioners examine the balance between the treatment and control group on predictors (e.g., Harding, 2002). For each predictor, we calculated a standard bias that equals the difference between the mean value of a given predictor for the treatment group and the mean value of that predictor for the controls, divided by the standard deviation of the predictor (Rosenbaum & Rubin, 1985). Tables of standard biases for our analyses are reported in Appendix B. Although the propensity score is calculated using measured variables ("observables"), researchers have demonstrated that selection bias due to unobserved variables is also reduced by propensity-score matching (DiPrete & Engelhardt, 2000).

The last step in a counterfactual analysis employs the matched sample to compare the treatment group with the controls on a dependent or outcome variable. OLS or logistic regression may be used to estimate the effect of the treatment on the outcome for the matched sample. The resulting coefficient for the treatment dummy indicates the estimated average effect of treatment for those who receive the treatment. In our case, it might be the effect of entering a four-year college rather than a two-year college on the likelihood of taking remedial coursework; or the effect of taking remedial coursework in mathematics upon one's likelihood of college graduation, after minimizing selection bias and controlling for the effects of various background variables.

Findings

How Much Remediation Occurs in College and of What Type?

Among the traditional college students covered by the NELS:88 survey, 40% took at least one remedial course in college. Mathematics was the most common remedial subject, with 28% of students taking courses in

that area. Nine percent of all students took some remediation in reading, 18% in writing and comprehensive language arts, and 9% in some other academic area.

Remediation was much more widespread among NELS:88 students at two-year colleges than among those at four-year institutions, and remediation was also less frequent at selective colleges: 58% of NELS students at two-year colleges enrolled in a remedial course, compared to 31% of students at nonselective 4-year colleges, 14% of students at selective 4-year colleges, and only 2% of students in highly selective four-year institutions. Given the contrast between two-year colleges and four-year institutions on this issue, we decided to undertake separate analyses for the two types of institution in several sections that follow. As we shall see, the effects of remediation are very different at two- and four-year institutions.

One theme in the controversy around remediation portrays students taking many remedial courses. Our analyses show that such students exist, but they are a numerical minority among students who take remedial courses. For example, at two-year colleges, 42% of students took no remediation, 44% took between one and three courses, and only 14% enrolled in more than three remedial courses. At nonselective four-year colleges, 69% took no remediation, 26% enrolled in between one and three courses, and 5% took more than three. At selective four-year colleges, 2% of NELS:88 students took more than three remedial courses, and at highly selective four-year institutions almost no one attempted multiple remediation courses.

In terms of policy debates, we emphasize that the NELS:88 cohort represents the situation that existed *before* many states adopted new policies that moved remediation out of four-year public colleges, reducing or eliminating its presence there. Most of these students entered college in 1992. Media commentary gave the impression that large proportions of students were immersed or bogged down in remedial courses in four-year colleges. The NELS:88 data indicate, however, that students who were taking more than three remedial courses (and were allegedly bogged down) constituted at most 5% of traditional undergraduates at nonselective four-year colleges.

Who Took Remedial Coursework in College?

Conventional wisdom suggests that colleges instituted remedial courses to cope with the consequences of poorly functioning high schools, especially inner-city high schools. Adelman (1998) demonstrated that this stereotype understates the geographical diversity of students who enroll in remedial courses in college, and his point is confirmed by the

NELS:88 data. Forty percent of NELS:88 students who previously attended a rural high school took remediation in college, as did 38% of students from suburban high schools and 52% of students from urban high schools.

Although students from families in the lowest quartile of socioeconomic status (SES) were more likely to undertake remedial coursework (52% did so), nearly a quarter (24%) of the students from the highest quartile SES families also enrolled in remedial courses in college. Taking remedial or developmental courses in college is by no means limited to economically disadvantaged students.

Readers may expect that remedial coursework in college is restricted to students who leave high school having taken a less rigorous curriculum or whose academic skill levels are low. In reality, remedial/developmental education encompasses a much broader swath of students and many ability levels. The NELS tested high-school seniors on their math and reading skills before they went to college. We can classify students according to how they scored on that combined math/reading assessment in 12th grade, from the highest first quartile to the lowest-scoring fourth quartile. We find that many skilled students took some remedial coursework in college: 10% of those who scored in the top quartile on skills tests and 25% of students in the second quartile took remedial coursework.

Similarly, the NELS:88 used transcripts to classify 12th graders in terms of the academic rigor or curricular intensity of the program they took in high school. We divided this measure into quartiles, from first (most demanding) to fourth (least demanding). The NELS:88 data indicate that among students who took the most advanced curriculum in high school (the top or first quartile), 14% took some remedial coursework in college. In addition, 32% of students in the second quartile, who took fairly demanding courses in high school, enrolled in some remedial classes in college.

These numbers indicate that enrollment in remedial classes in college is *not* limited to NELS:88 students with low academic skills in 12th grade, or to students who have had a weak curricular preparation in high school. Many relatively skilled students take remedial coursework. Conversely, many of those students who left high school with low academic skills did not take remedial courses in college: 32% of students in the lowest skills test quartile took no remedial coursework. Likewise, 42% of students in the lowest quartile on high school curricular intensity avoided remedial courses in college, according to transcript data. In sum, while college remediation is correlated with weak academic skills or preparation in high school, there is only a partial overlap. Based on

the NELS:88 assessments of student academic skills, there appears to be considerable variability or arbitrariness in the assignment of students to college remediation. (Older reentry students needing remediation do not cause this pattern; such students aren't in this sample.)

Researchers have observed a higher proportion of students enrolled in remedial courses in two-year colleges than in four-year colleges, and they have assumed that this was due to different skill levels of the students in both types of institution. We tested this with multivariate models. We also determined whether attending a public versus a private sector college affects one's likelihood of remediation, and whether African American students are more likely to take remediation than academically equivalent Whites are, and whether lower SES students are more likely to enroll in remedial courses.

In Table 1, we present two kinds of multivariate models, one employing conventional logistic regression and the other using propensity matching to minimize selection effects. The dependent variable in this table is whether a student took *any* remedial courses during college. The top row in Table 1 examines how two-year college entrants differ from four-year college entrants in terms of their log odds of taking remediation. Thus, the "treatment" is entry to a two-year versus a four-year college, while the outcome is taking any remedial coursework in college. Because log odds estimates are not easy to interpret, we have also converted them into probabilities of taking remediation, by setting all predictors other than the treatment variable at their mean values. This allows us to report the probability that a student at a two-year college would take remedial coursework, compared to the probability that an identical student at a four-year college would take remedial courses, where this hypothetical student is average on all academic background and sociodemographic variables.

The first column in Table 1 labeled "Bivariate" reports the raw effect, with no controls. We see that 58% of NELS:88 students at two-year colleges undertook remedial coursework, compared to 26% of students entering four-year colleges. That difference is statistically highly significant.

The second column in Table 1 reports a logistic regression model in which level of entry to a two- or four-year college predicts whether a student took any remedial coursework, after statistical controls for each student's race and family SES, academic preparation, performance and skill during high school, and for the kind of school attended. With such controls, the difference in remediation attributable to entering a community college rather than a four-year college shrinks: 38% of two-year college entrants took remedial courses, compared to 27% for four-year college entrants, still a statistically significant difference.

TABLE 1

Student probability of remedial course placement, by type of college and student background.

	Bivariate	Logistic regression	Propensity matched
Treatment: Level of entry			
Logistic Coefficient	1.367***	0.529***	0.425***
Predicted probabilities for:			
Two-year college entrants	0.5824	0.3826	0.5236
Four-year college entrants	0.2622	0.2675	0.4181
	N = 6724	N = 6724	N = 3246
Treatment: Public or private college (Four-year entrants only)			
Logistic Coefficient	0.545***	0.516***	0.353***
Predicted probabilities for:			
Public college entrants	0.2940	0.1965	0.2468
Private college entrants	0.1945	0.1273	0.1871
	N = 4154	N = 4154	N = 2456
Treatment: Student race (Black vs. White)			
Logistic Coefficient	1.082***	0.697***	0.443***
Predicted probabilities for:			
White students	0.3493	0.2696	0.4731
Black students	0.6129	0.4257	0.5831
	N = 5490	N = 5490	N = 606
Treatment: Student family SES (split at median)			
Logistic Coefficient	–0.762***	–0.159	0.088
Predicted probabilities for:			
High SES students	0.3167	0.2894	0.4250
Low SES students	0.4982	0.3232	0.4037
	N = 6879	N = 6879	N = 1852

SOURCE: NELS:88

Logistic regression models control for student race; 12th-grade math and reading competency level; 8th- grade standardized achievement test scores; elementary school grades; class rank as of 12th grade; proportion of 8th grade Black or Hispanic; proportion of 8th grade qualifies for free lunch; parent's highest degree earned; family income; students' high school curricular intensity; highest math course; behavioral history; school engagement and higher education plans; self-esteem and self-directedness; urban, suburban, or rural high school; high school sector; college sector, level of entry.

The findings reported in the propensity matched column represent the effect of the treatment on matched pairs of students with equal probabilities to receive the treatment. Probabilities to receive the treatment are calculated using all of the controls utilized in the logistic regression models, as well as a series of interaction terms and multinominal terms to allow for nonlinear effects. As an additional constraint, we required that both students in the matched pairs be in the same quartile on the 12th grade achievement test.

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

The third column of Table 1 provides a propensity matched model to reduce selection bias. This model also employs all the controls utilized in the previous logistic regression.

This counterfactual model again shows a highly significant difference in the likelihood of taking remedial coursework during college when

comparing matched two-year college entrants and four-year college entrants, who are otherwise equivalent in terms of academic skills, race, and family background. On average, a two-year college entrant has an 11% higher probability of taking remediation than an otherwise equivalent four-year college entrant (.5236 minus .4181).

The logistic approach and the counterfactual or propensity models are consistent with one another, but they go against conventional wisdom that the reason that students in two-year colleges are more likely to enroll in remedial courses is that those students have weaker academic backgrounds. Two-year colleges are considerably more likely to place a student in a remedial course than four-year colleges are, *even for students with equivalent academic skills and background.*

The second panel in Table 1 reports analyses that examine whether private four-year colleges differ from public four-year colleges in remedial coursework. Since most two-year colleges are public institutions, including them in this analysis could conflate the already-documented association between two-year colleges and remediation with the relationship between public colleges and remediation. To avoid this confusion, students who enrolled in two-year colleges are excluded from this one analysis. The first bivariate column indicates that on average 29% of students in public four-year colleges took remedial courses compared to 19% of students in private four-year colleges, which is statistically highly significant. The logistic regression in the second column of the table adds controls for family background and high school skills and performance. Even after those controls, a statistically significant difference remains: On average, a student faces a 7% higher probability of taking remediation in a public four-year college than in a private one (.1965 compared to .1273). In the third column, the propensity model minimizes selection effects but continues to show a significant difference: A student in a public four-year college has a 6% higher probability of taking remedial coursework than one in a private four-year college who has an identical high school preparation, test scores, and family background.

The third panel in Table 1 examines the effect of race on a student's probability of taking remediation in college. The bivariate column indicates that on average 61% of non-Hispanic Black students took some remediation, compared to 35% of non-Hispanic White students. (Hispanic and other ethnic groups are excluded from this particular analysis.) The sociologically important question is whether this huge difference disappears after we take into account detailed information on student preparation and achievement in high school, as well as family SES and type of high school and college attended. We find that the racial difference does

not disappear, although it shrinks: The logistic regression indicates a statistically significant difference between otherwise equivalent White and Black students, a 16% difference in the probability of undertaking remedial coursework. The propensity matched model in the third column estimates a statistically significant difference of 11% between otherwise identical Black and White students on the probability of enrolling in remedial courses.

Evidently, African American students are significantly more likely to enroll in college remedial courses than are White students with the same academic skills and preparation and social background. Unfortunately, we cannot tell from the NELS:88 data to what extent these African American students are *required* to take remedial coursework, or are *advised* to take such courses, or whether they themselves *choose* to take these courses.

In the bottom panel of Table 1, we examine whether socioeconomic status itself, independent of race and other factors, is associated with taking remedial coursework. In both the logistic regression model and the propensity score model, both of which control for students' academic background and other covariates, there ceases to be a significant SES effect. Evidently, SES is not a significant determinant of taking remedial coursework, independent of high school academic background.

To summarize, *after taking account of family background and academic skills and performance in high school*, we find three separate and independent effects: Students who enter two-year colleges are more likely than equivalent students in four-year colleges to enroll in remedial courses; students who enroll in public colleges are more likely than academically equivalent students in private colleges to take remedial coursework; and African American students are significantly more likely than otherwise similar non-Hispanic White students to enroll in remedial courses.

What are the Effects of Taking Remedial Courses on Graduation Rates and Time to Degree?

Some critics of college remediation have suggested that remediation has deleterious effects on student progress, while supporters suggest that it helps students. We examined five distinct outcomes: (a) completing 10 or fewer credits; (b) an interrupted education, where a student leaves college for at least one year before completing a degree; (c) whether a student completed any degree (among two-year college entrants only); (d) whether a student completed a bachelor's degree (among four-year college entrants only); (e) time to degree (for all bachelor's degree recipients).

In Table 2, we look at the effect of taking *any remediation* (i.e., one or more remedial courses) on these outcomes. In a later section, we will determine whether students with larger amounts of developmental/remedial coursework follow the same pattern.

The first panel in Table 2 predicts whether a student completed 10 or fewer credits by year 2000; they either dropped out or they made very little progress in college. (Overall, about 9% of NELS:88 students were

TABLE 2

Effect of enrolling in one or more remedial course on student progress through higher education.

	Bivariate	Logistic regression	Propensity matched
Outcome: Student earned 10 or fewer credits			
Logistic Coefficient	0.456***	–0.634***	–0.593***
Predicted probabilities for:			
Remedial students	0.1120	0.0183	0.0838
Nonremedial students	0.0740	0.0339	0.1420
	N = 6879	N = 6879	N = 3292
Outcome: Student left college for at least one year before receiving first degree			
Logistic Coefficient	0.666***	–0.101	–0.096
Predicted probabilities for:			
Remedial students	0.4248	0.2535	0.3948
Nonremedial students	0.2751	0.2732	0.4179
	N = 6879	N = 6879	N = 3292
Outcome: Student earned a college degree (two-year college entrants only)			
Logistic Coefficient	–0.328***	0.105	0.179
Predicted probabilities for:			
Remedial students	0.2842	0.2882	0.3404
Nonremedial students	0.3553	0.2672	0.3105
	N = 2661	N = 2661	N = 1670
Outcome: Student earned a college degree (four-year college entrants only)			
Logistic Coefficient	–1.159***	–0.316***	–0.288***
Predicted probabilities for:			
Remedial students	0.5211	0.7367	0.5685
Nonremedial students	0.7761	0.7933	0.6373
	N = 4173	N = 4173	N = 1623
Outcome: Years to Bachelor's degree			
OLS Coefficient	0.633***	0.150***	0.211***
Predicted time to degree for:			
Remedial students	5.070	5.100	4.970
Nonremedial students	4.437	4.950	4.759
	N = 3413	N = 3413	N = 1226

SOURCE: NELS:88

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

in this situation.) The first column in Table 2 reports that 11% of remedial students make little progress, compared to about 7% of students who do not enroll in remediation. At first impression, this statistically significant effect suggests that remedial coursework might drastically curtail progress towards the degree; however, there are no controls in this bivariate model. In the second column, in a logistical regression model that includes controls for student academic background in high school, plus sociodemographic controls, *the effect of remediation reverses*: Fewer students with remedial coursework earned 10 or fewer credits, compared to academically and socially similar students with no remedial coursework. This effect is statistically significant but small in magnitude (under 2%). In the third column, a propensity matched analysis also indicates that after one controls for academic preparation, a student's family background, and other covariates, taking one or more remedial courses is significantly associated with a *lower* probability of earning few credits, about a 6% lower probability.

The second panel in Table 2 describes a phenomenon that is especially common among students from less affluent families: leaving college for a substantial time before returning and completing a degree. Although there is a bivariate association between remediation and an interrupted college education, this disappears in both multivariate models that control for academic and family background. After controls, there is no statistically significant difference between students who took and did not take remedial courses, in terms of taking time out from college.

The third panel in Table 2 looks solely at entrants to two-year colleges and examines whether taking remedial education affects their chances of completing a degree (an associate degree or higher, since some students transfer to bachelor's programs rather than completing an associate's degree.) The bivariate analysis indicates that on average, students who took remediation at a two-year college had significantly lower graduation rates than students at the same kind of institution who did not take remedial coursework. However, after we add controls for family background and academic performance in high school, this effect is reduced to nonsignificance, in both logistic and propensity models. We interpret this as meaning that taking one or more remedial courses in a two-year college does not, in itself, lower a student's chances of graduation. Causal factors that do reduce one's chances of graduating include low family SES, poor high school preparation, and being Black, but not college remediation *per se*.

The fourth panel of Table 2 looks solely at entrants to four-year colleges and examines whether taking remediation affects the probability of graduation with a bachelor's degree. Here the picture is different. In the

models that control for high school preparation and family background, including selection effects, taking remedial courses is associated with a significantly lower likelihood of degree completion. In the logistic regression, remedial students have a 6% lower probability of graduating, and in the propensity model, remedial students have a 7% lower probability of completing a degree. Unlike the situation for two-year college entrants, among students in four-year colleges there *is* a statistically significant negative effect of taking remedial coursework on graduation.

The last panel in Table 2 assesses the effects of taking any remedial coursework on time to degree, for the subpopulation of NELS:88 students who completed a bachelor's degree within 8.5 years of leaving high school. Here we find that there is a statistically significant delay associated with taking remedial coursework, after we controlled for other characteristics. However, the magnitude of this effect is quite modest: On average, students with remediation took around 0.2 years longer to graduate, which is between 2 and 3 months extra.

Taken as a whole, these models suggest that taking some remedial or developmental coursework has no negative effects on two-year college entrants' likelihood of gaining a degree but does lower the average chances that a four-year college entrant will graduate by about 6% to 7%, after controlling for academic preparation and high school skills and family background. Nevertheless, in the NELS:88 population, over half of four-year college students who took remedial courses did graduate from college within about 8 years of leaving high school. Thus, taking remediation in a four-year college modestly lowers one's odds of graduating but does not prevent most students completing a bachelor's degree. Taking remedial coursework also slightly increases time to a bachelor's degree. One should also note that so far there is no evidence in any of the multivariate models that remediation on average improves students' chances of graduation in either two- or four-year institutions. However, we shall return to this issue below.

What are the Effects of Taking MANY Remedial Courses on Graduation Rates and Time to Degree?

We noted earlier that taking many remedial courses is atypical. However, several critics of remediation focus on this group, arguing that they especially are harmed by remediation. We therefore examined the effect of enrolling in *three or more* remedial courses on the same range of outcomes. The results of these analyses are presented in Table 3.

In the top panel, one sees that taking many remedial courses has an unclear relationship to earning 10 or fewer credits. Only in the logistic regression model was there a statistically significant effect: a slightly

TABLE 3
Effect of enrolling in three or more remedial courses on student progress through higher education.

	Bivariate	Logistic regression	Propensity matched
Outcome: Student earned 10 or fewer credits			
Logistic Coefficient	0.179	–0.933***	–0.908
Predicted probabilities for:			
Multiple remedial students	0.1025	0.0119	0.0968
Other students	0.0871	0.0298	0.2099
	N = 6979	N = 6979	N = 1580
Outcome: Student left college for at least one year before receiving first degree			
Logistic Coefficient	0.784***	–0.024	–0.151
Predicted probabilities for:			
Multiple remedial students	0.4943	0.2617	0.4752
Other students	0.3085	0.2664	0.5130
	N = 6979	N = 6979	N = 1580
Outcome: Student earned a college degree (two-year college entrants only)			
Logistic Coefficient	–0.351**	0.006	0.212
Predicted probabilities for:			
Multiple remedial students	0.2586	0.2802	0.2348
Other students	0.3312	0.2790	0.2751
	N = 2706	N = 2706	N = 1092
Outcome: Student earned a college degree (four-year college entrants only)			
Logistic Coefficient	–1.721***	–0.594***	–0.616***
Predicted probabilities for:			
Multiple remedial students	0.3357	0.6705	0.3358
Other students	0.7385	0.7855	0.4834
	N = 4173	N = 4173	N = 488
Outcome: Years to Bachelor's degree			
OLS Coefficient	0.889***	0.164**	0.334***
Predicted time to degree for:			
Multiple remedial students	5.422	5.151	5.418
Other students	4.533	4.987	5.084
	N = 3413	N = 3413	N = 316

SOURCE: NELS:88
* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

lower likelihood of earning few credits. In the propensity model, this effect was not statistically significant.

The multivariate models in the second panel in Table 3 suggest that there was no significant influence of taking multiple remedial courses on leaving college for a year prior to graduation. Nor was there a discernable effect of taking multiple remedial courses on the likelihood of graduating for two-year college entrants, as the third panel shows.

Therefore, for two-year college entrants, even students who take three or more remedial courses are not disadvantaged relative to academically equivalent students who took less or no remediation.

Research by Deil-Amen and Rosenbaum (2002) has given the impression that taking multiple remedial courses is itself a serious barrier to graduation from two-year college. When we controlled for students' academic preparation and abilities leaving high school for a two-year college, we found that taking multiple remedial coursework in a two-year college does not in itself disadvantage these students. Deil-Amen and Rosenbaum did not distinguish between the effects of having a weak high school academic preparation and the effects of taking multiple remedial courses in college. Our analyses suggest that the problem is the former, not the latter. Taking several remedial courses (characterized as being "bogged down" in remedial coursework) does not reduce chances of graduation.

By contrast, for entrants to four-year colleges, the analyses reported in Table 3 suggest that there was a statistically significant disadvantage for students who took three or more remedial courses: Their graduation rates were between 12% and 15% lower than those of students with comparable skills and backgrounds who took fewer or no remedial courses. However, while taking many remedial courses clearly lowers graduation chances for students in bachelor's degree programs, *about one in three students who took many remedial courses nevertheless completed their degree within eight years or so*, overcoming disadvantages in high school preparation and in social background.

Among students who obtained a bachelor's degree, we also observed that remediation increased time to degree. For students who took three or more remedial courses in a four-year college, time to degree increased on average between .164 and .334 years, depending on the model. This is a statistically significant but substantively modest delay. In sum, unlike the case for two-year colleges, students in four-year colleges who take many remedial courses are at a disadvantage in earning a degree, over and above any disadvantage stemming from their high school skills and background.

Are Some Types of Remedial Coursework More Consequential than Others Are?

Adelman (1999) argued that, on average, students who take remedial reading courses are less likely to graduate, whereas those taking remedial mathematics had a better chance of graduation. His analyses were based on simple (uncontrolled) percentages, however, and did not control for students' academic background. One might interpret them as

saying that the kinds of students who need remediation in reading tend to come into college with the weakest academic skills and therefore have the lowest rates of graduation. We will ask a quite different question: *after controlling for student academic skills prior to college*, does remedial coursework itself improve or worsen a student's chance of graduation? To pose the question this way, we must separate a student's academic background from whether the student took remedial courses in college. Where we follow Adelman is his insight that it is important to examine whether remediation in math, reading, and writing differ in their consequences.

Table 4 looks individually at the effects of remedial coursework in reading, math, and writing, solely for entrants to four-year colleges. The outcome of interest is whether a student graduates with a degree within 8.5 years of leaving high school. The logistic models examine the effect of taking a particular type of remedial coursework in college, after controlling for a student's family background and high school preparation and skills. In the top panel, we observe a significant *negative effect* on graduation of taking one or more remedial *reading* courses, after controlling for a student's academic and social background. On average, students who took remedial coursework in reading at a four-year college had between a 7% (logistic model) and 11% (propensity model) lower probability of completing a degree than otherwise identical students who did not enroll in remedial reading. This supports Adelman's thesis insofar as reading remediation creates a disadvantage in terms of graduation. However, our analyses also show that 40% of four-year entrants who took remediation in reading nevertheless graduated with a degree. That does not fit Adelman's belief that, "when reading is the core of the problem, the odds of success in college environments are so low that other approaches are called for" (1998, p. 11).

The findings for remedial mathematics coursework were less clear. In the logistic model in Table 4, students who took two or more remedial math classes had on average a 5% lower probability of graduation than students with one or no remedial courses in math had. The propensity model showed an effect in the same direction, but it was not statistically significant. A cautious interpretation would be that taking remedial coursework in mathematics might have no effect on graduation or possibly a weak negative effect on graduation.

The bottom panel in Table 4 reports that taking remedial courses in writing had no significant effect on graduation, for four-year college students, after controlling for academic background. Both multivariate models are consistent on this.

TABLE 4
Effects of different types of remediation on senior-college student graduation rates.

	Bivariate	Logistic regression	Propensity matched
Treatment: Any reading remediation			
Logistic Coefficient	–1.374***	–0.355**	–0.446**
Predicted probabilities for:			
Remedial students	0.4037	0.7164	0.4087
Nonremedial students	0.7279	0.7826	0.5190
	N = 4173	N = 4173	N = 429
Treatment: Two or more math remedial courses			
Logistic Coefficient	–1.416***	–0.260*	–0.464
Predicted probabilities for:			
Remedial students	0.3965	0.7351	0.3343
Nonremedial students	0.7301	0.7825	0.4439
	N = 4173	N = 4173	N = 488
Treatment: passed all writing remediation etc			
Logistic Coefficient	–0.920***	–0.039	–0.109
Predicted probabilities for:			
Remedial students	0.5225	0.7740	0.5236
Nonremedial students	0.7330	0.7807	0.5508
	N = 4173	N = 4173	N = 870

SOURCE: NELS:88
* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

Overall, then, among entrants to four-year colleges, remediation in reading had a clear negative effect on graduation prospects, remedial mathematics had no effect or possibly a weak negative effect, and remedial writing had no significant impact on graduation.

Interestingly, the pattern for remediation in two-year colleges was quite different. Those results are reported in Table 5. In the top panel, we find that entrants to two-year colleges who took reading remediation were about 11% *more likely* to earn a degree (associate's or bachelor's) within 8 years of high school than academically equivalent students who did not take reading remediation, according to the propensity model. There was a similar trend in the logistic model, but it did not attain statistical significance. This is the first evidence, albeit weak, that remedial coursework might have a positive impact on students' chances of graduating from college.

In the second panel of Table 5, we note findings for mathematics remediation in two-year colleges. In both the logistic regression analysis

TABLE 5
Effects of different types of remediation on two-year college student graduation rates..

	Bivariate	Logistic regression	Propensity matched
Treatment: Any reading remediation			
Logistic Coefficient	0.040	0.147	0.529*
Predicted probabilities for:			
Remedial students	0.3213	0.3154	0.3348
Nonremedial students	0.3128	0.2751	0.2287
	N = 2706	N = 2706	N = 690
Treatment: Two or more math remedial courses			
Logistic Coefficient	–0.591***	–0.177*	–0.157*
Predicted probabilities for:			
Remedial students	0.2191	0.2514	0.2378
Nonremedial students	0.3362	0.2861	0.2674
	N = 2706	N = 2706	N = 1092
Treatment: passed all writing remediation etc			
Logistic Coefficient	0.023	0.278**	0.368**
Predicted probabilities for:			
Remedial students	0.3175	0.3213	0.3193
Nonremedial students	0.3126	0.2640	0.2449
	N = 2706	N = 2706	N = 1220

SOURCE: NELS:88
* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

and the propensity matched model, we observe a small but statistically significant *negative effect* of taking two or more remedial math courses on graduation rates. Students who take two or more remedial mathematics courses in a two-year college have about a 3% lower likelihood of graduating with a degree, net of high school preparation.

In the bottom panel of Table 5, we see that students who took writing remediation in a two-year college were *more likely* to graduate with a degree (either associate's or bachelor's) than students of equivalent high school skills and social background who did not take remedial writing. Both multivariate models are statistically significant and show the same effect. The difference—a positive effect of remedial or developmental coursework—was 6% in the logistic model and 7% in the propensity model.

Overall, then, Table 5 suggests that for two-year college entrants, after one has controlled for high school preparation and academic skills prior to entering college, taking remedial coursework in writing and perhaps also in reading improves the chances that a student will graduate with a degree. However, remedial coursework in mathematics is associated with slightly lower graduation rates.

The Effect of Successful Completion of Remedial Coursework

In our analyses so far, we have examined whether students who enrolled in remedial coursework were more or less likely to complete a degree. However, substantial numbers of students withdraw from remedial courses, and others do not attend class since there is often no penalty for doing so in non-credit courses. Some scholars argue that in order to assess whether remedial courses improve student skills and enhance chances of graduation, one ought to focus on those students who complete remedial coursework rather than on all who enroll (cf. Bettinger & Long, 2004; Lavin, Alba, & Silberstein, 1981). Most students pass *all* the remedial courses they enroll in writing (68%) and in reading (71%). However, only 30% pass all their remedial math courses: Apparently, the majority of those taking remedial math need more than one attempt before passing.

For each subject area, we decided to contrast those students who successfully completed all their remedial courses in that area with students who did not ever enroll in remedial coursework in that subject, controlling for skills and coursework intensity during high school and for sociodemographic background. In this comparison, we excluded students who took remedial coursework in a given area but either failed a course or withdrew. This provides a different perspective on whether remedial coursework helps: It asks whether students who successfully completed remedial work in an area (reading, writing, or mathematics) had better or worse outcomes than equivalent students who did not undertake remedial coursework at all.

Table 6 reports on these multivariate models, all of which predict graduating with a degree. For remedial courses in reading, we found that two-year college students who passed remedial reading were *more likely to graduate* than were academically and otherwise equivalent students who did *not* take remedial reading. The positive effect was a 11% higher graduation rate in the conventional logistic model, and 8% in the propensity matched model.

This positive influence of remediation was also evident for remedial writing in two-year colleges. Students who passed remedial writing courses were 13% more likely to graduate in both models. There was also an apparent benefit to taking remedial mathematics in the conventional logistic regression model (11%), but that effect was not apparent in the propensity matched model.

Overall, however, there is evidence among two-year college entrants that students who passed remedial courses had better educational outcomes than did similar students who never took remedial courses. This positive picture of remedial coursework, however, did not carry over to

TABLE 6

Graduation rates and remedial success: Graduate rates for students who passed all remediation, compared to those who did not take remediation.

	Bivariate	Logistic regression	Propensity matched
Two-year College Entrants Only			
Treatment: passed all reading remediation			
Logistic Coefficient	0.490**	0.477***	0.415**
Predicted graduation rates for:			
Successful remedial students	0.4261	0.3884	0.3388
Nonremedial students	0.3125	0.2827	0.2528
	N = 2508	N = 2508	N = 464
Treatment: passed all math remediation			
Logistic Coefficient	–0.157	0.490***	–0.030
Predicted graduation rates for:			
Successful remedial students	0.3297	0.3973	0.3404
Nonremedial students	0.3651	0.2876	0.3472
	N = 2009	N = 2009	N = 1160
Treatment: passed all writing remediation etc.			
Logistic Coefficient	0.473***	0.591***	0.600***
Predicted graduation rates for:			
Successful remedial students	0.4228	0.4140	0.3908
Nonremedial students	0.3134	0.2812	0.2605
	N = 2407	N = 2407	N = 770
Four-year College Entrants			
Treatment: passed all reading remediation			
Logistic Coefficient	–1.241***	–0.337	–0.271
Predicted graduation rates for:			
Successful remedial students	0.4360	0.7236	0.5551
Nonremedial students	0.7278	0.7857	0.4877
	N = 4070	N = 4070	N = 328
Treatment: passed all math remediation			
Logistic Coefficient	–0.864***	–0.089	–0.066
Predicted graduation rates for:			
Successful remedial students	0.5723	0.7938	0.6066
Nonremedial students	0.7604	0.8079	0.6222
	N = 3833	N = 3833	N = 652
Treatment: passed all writing remediation etc			
Logistic Coefficient	–0.664***	0.270	0.038
Predicted graduation rates for:			
Successful remedial students	0.7327	0.8284	0.5840
Nonremedial students	0.5853	0.7866	0.5931
	N = 4013	N = 4013	N = 582

SOURCE: NELS:88

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

four-year colleges (the bottom of Table 6). Instead, we observe that those students in four-year colleges who completed remedial reading courses graduated at about the same ratio as similar students who did not take remedial reading (a 7% difference). For remedial writing, the analyses were mixed, with the conventional model indicating a 4% disadvantage, while the propensity model indicated no significant difference between those who passed remedial writing and those who did not take it. Finally, there appeared to be no significant difference between students who completed remedial math and students who never took remediation in mathematics.

In sum, there was evidence that students who successfully completed remedial coursework in two-year colleges gained from that coursework. There was no such positive evidence about remediation in four-year colleges.

Conclusion and Discussion

Our analyses show that remedial coursework was widespread among undergraduates in the high school class of 1992, but did not dominate their college years. Most took only one or two such courses, and most passed those courses successfully, usually in the first year of college.

The common-sense impression that remedial coursework is taken by students with poor high school preparation or very weak academic skills is inaccurate. Our analyses show that many college students with limited academic skills do not take remedial coursework, while substantial numbers of students with strong high school backgrounds nevertheless take remedial courses. Nor is remedial coursework the preserve of the economically disadvantaged: Large proportions of students who graduated from suburban and rural high schools take remedial coursework in college, as do many students from high SES families. These empirical findings contrast with public debates that portray remediation as a preserve of a small group of academic incompetents who have no hope of success in higher education.

Critics have accused public colleges and universities of abandoning their commitment to academic standards, of granting diplomas to undeserving students. Implicit is the claim these colleges have done so to accommodate academically unprepared minority students. The NELS:88 data show that public colleges are more likely to require remedial coursework than private institutions, for equivalently skilled students. In this sense, public institutions appear to have created higher hurdles than their private sector equivalents have created. After controlling for high school preparation and academic skills, we found that a student is also less likely to graduate from a public than from a private university. In addition, Black students are more likely to take remediation than similarly

prepared White students are. This is the opposite of the "soft bigotry of low expectations" that critics have claimed operates in public education.

Critics of developmental education suggest that students who need remediation will not be able to graduate. The NELS:88 shows that 28% of remedial students in two-year colleges graduate within 8.5 years (compared to 43% of nonremedial students) and that 52% of remedial students in four-year colleges finish bachelor's degrees (compared to 78% of students without remedial coursework). Looked at another way, 50% of African American bachelor program graduates and 34% of Hispanic bachelor program graduates in the NELS:88 survey graduated after taking remedial coursework. If those students were deemed unsuited for college and denied entry to four-year institutions, a large proportion of the minority graduates in the high school class of 1992 would never have received degrees. (These graduation numbers would be considerably larger if the NELS survey followed students beyond 8.5 years from high school. From our analyses of the NLSY, we find that about a quarter of students who ultimately get a bachelor's degree take longer than that to graduate. So graduation rates measured 8.5 years after high school provide an overly pessimistic picture of the prospects of weaker students.)

Our analyses were able to distinguish the effects of a poor high school academic preparation from the effects of taking remedial coursework in college, and we found that most of the gap in graduation rates has little to do with taking remedial classes in college. Instead, that gap reflects preexisting skill differences carried over from high school. In two-year colleges, we found that taking remedial classes was *not* associated at all with lower chances of academic success, even for students who took three or more remedial courses. Contra Deil-Amen and Rosenbaum's (2002) thesis, in multivariate analyses two-year college students who took remedial courses were somewhat less likely to drop out in the short run, and were no less likely to graduate than were nonremedial students with similar academic backgrounds. In addition, two-year college students who successfully passed remedial courses were more likely to graduate than equivalent students who never took remediation were, suggesting that developmental courses did help those students who completed them. These apparent benefits from taking remediation should not obscure the fact that overall graduation rates in two-year colleges are quite low. Nor should we overlook our finding that taking remediation caused a modest delay in time to degree for two-year college students.

The situation was different among entrants to four-year colleges. At four-year institutions, taking some remedial courses did modestly lower student chances of graduation, even after we took prior academic preparation and skills into account. Student chances of graduation were

reduced between 6% and 7%. This should be a matter of concern, but this is not the same as saying that students in four-year colleges who take remediation are unable to graduate. On the contrary, in four-year colleges, the graduation rate for students who took remedial coursework was about two thirds of the graduation rate of students who took no remediation. As was the case for two-year college students, these lower graduation rates faced by students in four-year colleges predominantly reflected skill problems students brought from high school, rather than a negative consequence of taking remedial courses. Nevertheless, taking remedial coursework in reading at a four-year college had a clear negative effect on graduation, even after we controlled for academic skills and background. This did not occur for remedial writing courses. The effect of remedial math courses was ambiguous.

The majority of colleges in the United States are unselective: They admit almost every high school graduate who applies and can pay tuition. Many schools combine open access with requirements that weaker students take remedial or college prep courses in academic areas in which they have problems. Thus, remedial education acts as a gatekeeper and a quality control in higher education, though this function is rarely acknowledged. Students who can successfully pass these courses continue into regular college-level courses. Students who can't make it through remediation either drop out or are academically terminated. Ironically, when colleges require that their students demonstrate proficiency in basic skills by passing remedial courses, they are criticized for wasting the time of the students who fail to overcome these hurdles. At the same time, the provision of remedial courses is perceived by the public as indicating a lack of standards rather than as a mechanism for setting a basic skills standard.

Whether it is desirable for society to offer educational opportunity to students who have a one-in-four chance of graduating from a two-year college, or to students who have a 50% likelihood of graduating from a four-year college, is a complex question. Those students who do earn the degree against the odds enjoy considerably higher incomes. Even those who enter college but don't complete a degree benefit economically, compared to high school graduates. How does one balance the clear benefits of admissions policies for those who succeed against the costs of those who fail? This controversy is also about public finances: How is taxpayers' money best used? Not least, the question touches on issues of inequality and social justice: If children of poor and minority families disproportionately leave high school with poor academic skills, should social policy encourage colleges to redress those skill problems, or should failure at the high school level be irreversible? Currently, college remediation functions partly as a second-chance policy and partly as a form of institutional quality control.

APPENDIX 1

Descriptive statistics of variables used in the analysis

	NELS source		Mean	Standard deviation	Range	Number of cases
Remediation variables						
R took any remediation	REMCRSE		0.403	0.491	0–1	6879
R took three or more remedial courses	REMCRSE		0.145	0.352	0–1	6879
R took any remedial reading courses	REMREAD		0.092	0.290	0–1	6879
R took two or more remedial math courses	REMMATH		0.119	0.324	0–1	6879
R took any remedial writing or comprehensive language courses	REMFLAG, CRSECODE		0.179	0.383	0–1	6879
R passed all reading remediation	REMFLAG, PASSFLAG		0.067	0.250	0–1	6690
R passed all math remediation	REMFLAG, PASSFLAG		0.193	0.395	0–1	5899
R passed all writing remediation	REMFLAG, PASSFLAG		0.117	0.321	0–1	6485
Outcome variables						
R earned 10 or fewer credits	TCREDB	All	0.089	0.485	0–1	6879
		Remedial	0.112	0.315	0–1	2275
R left college for at least one year before receiving first degree	CONTIN	All	0.335	0.472	0–1	6879
		Remedial	0.425	0.494	0–1	2275
R earned a college degree (community college entrants only)	CONSDEG, REFSELCT	All	0.314	0.464	0–1	3033
		Remedial	0.284	0.451	0–1	1766
R earned a college degree (senior college entrants only)	CONSDEG, REFSELCT	All	0.709	0.454	0–1	3846
		Remedial	0.521	0.500	0–1	1008
Years to Bachelor's degree	BACHTME	All	4.581	1.078	2.58–9.42	3059
		Remedial	5.070	1.122	2.66–9.42	696
Background covariates						
White male (dummy)	SEX, RACE	All	0.370	0.483	0–1	6879
		Remedial	0.334	0.472	0–1	2275
Black male (dummy)	SEX, RACE	All	0.041	0.198	0–1	6879
		Remedial	0.075	0.263	0–1	2275

APPENDIX 1 (*Continued*)

Descriptive statistics of variables used in the analysis

	NELS source		Mean	Standard deviation	Range	Number of cases
Black female (dummy)	SEX, RACE	All	0.055	0.228	0–1	6879
		Remedial	0.071	0.257	0–1	2275
Hispanic male (dummy)	SEX, RACE	All	0.048	0.213	0–1	6879
		Remedial	0.071	0.256	0–1	2275
Hispanic female (dummy)	SEX, RACE	All	0.048	0.215	0–1	6879
		Remedial	0.075	0.264	0–1	2275
Asian male (dummy)	SEX, RACE	All	0.021	0.141	0–1	6879
		Remedial	0.016	0.125	0–1	2275
Asian female (dummy)	SEX, RACE	All	0.021	0.145	0–1	6879
		Remedial	0.017	0.127	0–1	2275
Other male (dummy)	SEX, RACE	All	0.007	0.081	0–1	6879
		Remedial	0.012	0.107	0–1	2275
Other female (dummy)	SEX, RACE	All	0.008	0.086	0–1	6879
		Remedial	0.013	0.113	0–1	2275
12th grade test score (percentile)	SRTSTPCT	All	59.465	25.972	0–100	6879
		Remedial	44.732	22.623	0–100	2275
8th grade behavior problems scale	BYS55a-BYS55f	All	0.206	0.327	0–2	6879
		Remedial	0.270	0.374	0–2	2275
8th grade standardized test composite	BY2XCOMP	All	53.819	9.619	31–76	6879
		Remedial	48.469	7.785	31–76	2275
High school class rank percentile	CLSSRANK	All	0.591	0.266	0–1	6879
		Remedial	0.478	0.245	0–1	2275
Percent minority students in school (8th grade)	G8MINOR	All	2.718	2.070	0–7	6879
		Remedial	3.212	2.220	0–7	2275
Percent free or reduced lunch students in school (8th grade)	G8LUNCH	All	2.906	2.014	0–7	6879
		Remedial	3.327	2.098	0–7	2275

APPENDIX 1 (*Continued*)

Descriptive statistics of variables used in the analysis

	NELS source		Mean	Standard deviation	Range	Number of cases
Parents' highest education level	BYPARED	All	3.344	1.232	1–6	6879
		Remedial	3.038	1.184	1–6	2275
Yearly family income	BYFAMINC	All	10.298	2.217	1–16	6879
		Remedial	9.819	2.338	1–16	2275
Completed "New Basics" curriculum (dummy)	F2RNWB3A	All	0.393	0.488	0–1	6879
		Remedial	0.252	0.434	0–1	2275
Completed pre-calculus course (dummy)	HIGHMATH	All	0.251	0.433	0–1	6879
		Remedial	0.063	0.243	0–1	2275
High school academic intensity top quartile	ACCURHSQ	All	0.251	0.434	0–1	6879
		Remedial	0.094	0.292	0–1	2275
High school academic intensity 2nd quartile	ACCURHSQ	All	0.256	0.437	0–1	6879
		Remedial	0.232	0.422	0–1	2275
High school academic intensity 3rd quartile	ACCURHSQ	All	0.202	0.402	0–1	6879
		Remedial	0.275	0.446	0–1	2275
Urban high school (dummy)	PHSURBAN	All	0.281	0.449	0–1	6879
		Remedial	0.303	0.461	0–1	2275
Suburban high school (dummy)	PHSURBAN	All	0.431	0.495	0–1	6879
		Remedial	0.405	0.491	0–1	2275
Public high school (dummy)	HSTYPE	All	0.890	0.313	0–1	6879
		Remedial	0.918	0.274	0–1	2275
Came to class unprepared	BYS78A-BYS78C	All	0.524	0.871	0–3	6879
		Remedial	0.665	0.980	0–3	2275
Bored in class	BYS69A, BYS70A, BYS71A, BYS72A, BYS73	All	2.220	0.550	1–4	6879
		Remedial	2.236	0.551	1–4	2275

APPENDIX 1 (*Continued*)

Descriptive statistics of variables used in the analysis

	NELS source		Mean	Standard deviation	Range	Number of cases
Retained in grade (before 8th grade)	BYS74	All	0.097	0.294	0–1	6879
		Remedial	0.143	0.347	0–1	2275
Time spent on homework	BYHOMEWK	All	4.220	1.477	1–8	6879
		Remedial	4.019	1.411	1–8	2275
Grades composite (8th grade)	BYGRADS	All	3.105	0.679	0.5–4	6879
		Remedial	2.834	0.649	0.5–4	2275
College degree plans (dummy, 8th grade)	BYPSEPLN	All	0.783	0.412	0–1	6879
		Remedial	0.701	0.458	0–1	2275
Parents educational plans (8th grade)	BYS48A-BYS48B	All	4.917	1.317	0–6	6879
		Remedial	4.741	1.421	0–6	2275
Age first enrolled in college	REFDATE	All	18.923	1.386	14–27	6879
		Remedial	19.046	1.431	14–27	2275
Locus of control (standardized, 8th grade)	BYLOCUS2	All	0.118	0.579	-2.3–1.3	6879
		Remedial	-0.003	0.590	-2.3–1.3	2275
Self-concept (standardized, 8th grade)	BYCNCPT2	All	0.067	0.635	-2.9–1.4	6879
		Remedial	0.015	0.617	-2.9–1.4	2275
First PSE is two-year	REFSELCT	All	0.441	0.497	0–1	6879
		Remedial	0.637	0.481	0–1	2275
First PSE is selective four-year	REFSELCT	All	0.142	0.349	0–1	6879
		Remedial	0.041	0.198	0–1	2275
First PSE is public	LEVLCONT	All	0.756	0.430	0–1	6879
		Remedial	0.859	0.348	0–1	2275
First PSE is for-profit	LEVLCONT	All	0.053	0.224	0–1	6879
		Remedial	0.046	0.210	0–1	2275

APPENDIX B

Summary of standard biases, comparing unmatched and matched samples.

The columns indicate how much the treatment and control groups differ on predictors. E.g., in the unmatched sample, the treatment and control groups differed by more than 0.5 of an s.d. on 12 predictor variables, and between .25 and .5 s.d. on 11 predictors. In the matched sample, biases of this magnitude disappeared.

1. Predictors of remedial course assignment (Tables 2–3)

	Treatment: Level of Entry		Treatment: Public vs. Private		Treatment: Race (Black v. White)		Treatment: Family SES	
	Unmatched sample	Matched sample	Unmatched sample	Matched sample	Unmatched sample	Matched sample	Unmatched sample	Matched sample
Standard Bias of Predictors:								
>0.50	12	—	1	—	7	—	9	—
0.25–0.50	11	—	12	—	8	—	8	—
0.15–0.25	4	—	9	—	7	2	11	1
0.10–0.15	4	2	4	2	4	3	3	1
0.05–0.10	2	12	5	9	2	7	5	8
<0.05	5	24	9	29	2	18	1	27
Standard bias of propensity score	–1.398	–0.001	–0.934	–0.001	–1.831	0.000	–2.566	–0.001

2. Effects of remediation (Tables 4–5)

	Treatment: 1+ remedial courses		Treatment: 3+ remedial courses		Treatment: Reading remediation		Treatment: Math remediation		Treatment: Writing Remediation	
	Unmatched sample	Matched sample	Unmatched sample	Matched sample	Unmatched sample	Matched sample	Unmatched sample	Matched sample	Unmatched sample	Matched sample
Standard bias of predictors:										
>0.50	13	—	16	—	16	—	14	—	7	—
0.25–0.50	12	—	13	—	11	—	15	—	14	—
0.15–0.25	10	—	6	—	7	—	6	1	8	—

APPENDIX B (*Continued*)

Summary of standard biases, comparing unmatched and matched samples.

2. Effects of remediation (Tables 4–5)

	Treatment: 1+ remedial courses		Treatment: 3+ remedial courses		Treatment: Reading remediation		Treatment: Math remediation		Treatment: Writing Remediation	
	Unmatched sample	Matched sample	Unmatched sample	Matched sample	Unmatched sample	Matched sample	Unmatched sample	Matched sample	Unmatched sample	Matched sample
0.10–0.15	—	—	—	6	1	7	1	5	1	8
0.05–0.10	4	17	2	14	4	12	4	14	2	10
<0.05	3	25	5	22	4	24	3	23	6	20
Standard bias of propensity score	-1.393	-0.001	-1.375	-0.000	-1.190	-0.000	-1.281	-0.000	-1.103	-0.000

3. Effects of successful remediation (Table 6)

	Treatment: Passed reading remediation		Treatment: Passed math remediation		Treatment: Passed writing remediation	
	Unmatched sample	Matched sample	Unmatched sample	Matched sample	Unmatched sample	Matched sample
Standard bias of predictors:						
>0.50	7	—	8	—	6	—
0.25–0.50	12	—	11	—	12	—
0.15–0.25	8	—	9	—	7	—
0.10–0.15	4	1	2	1	3	3
0.05–0.10	3	15	7	9	5	9
<0.05	4	22	1	28	5	26
Standard bias of propensity score	1.002	0.001	0.709	0.000	0.836	0.000

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