Does Career and Technical Education Affect College Enrollment?

CTE
CAREER & TECHNICAL EDUCATION
NATIONAL RESEARCH CENTER
NATIONAL DISSEMINATION CENTER

This report is based on research conducted by the
National Research Center for Career and Technical Education
University of Minnesota

Distribution of this report is by the
National Dissemination Center for Career and Technical Education
The Ohio State University

This report and related information are available at www.nccte.com.
Additional printed, bound copies of the report are available from:

National Dissemination Center for Career and Technical Education
Product Sales Office
The Ohio State University
1900 Kenny Road
Columbus, Ohio 43210-1090
800-678-6011 ext. 24277
Fax: 614-688-3258

DOES CAREER AND TECHNICAL EDUCATION AFFECT COLLEGE ENROLLMENT?

Stefanie DeLuca
Stephen Plank
Angela Estacion

Johns Hopkins University

National Research Center for
Career and Technical Education
University of Minnesota

February 2006

FUNDING INFORMATION

Project Title:	National Dissemination Center for Career and Technical Education	National Research Center for Career and Technical Education
Grant Number:	V051A990004	VO51A990006
Grantees:	The Ohio State University National Dissemination Center for Career and Technical Education 1900 Kenny Road Columbus, OH 43210	University of Minnesota National Research Center for Career and Technical Education 1954 Buford Avenue St. Paul, MN 55108
Directors:	Floyd L. McKinney	James R. Stone, III
Percentage of Total Grant Financed by Federal Money:	100%	100%
Dollar Amount of Federal Funds for Grant:	$1,100,000	$2,237,615

Act Under Which Funds Administered: Carl D. Perkins Vocational and Applied Technology Education Amendments of 1998 Pub. L. No. 105-332

Source of Grant: Office of Vocational and Adult Education
U. S. Department of Education
Washington, DC 20202

Disclaimer: The work reported herein was supported under the National Dissemination Center for Career and Technical Education, PR/Award (No. VO51A990004) and/or under the National Research Center for Career and Technical Education, PR/Award (No. VO51A990006), as administered by the Office of Vocational and Adult Education, U.S. Department of Education.

However, the contents do not necessarily represent the positions or policies of the Office of Vocational and Adult Education or the U.S. Department of Education, and you should not assume endorsement by the federal government.

Discrimination: Title VI of the Civil Rights Act of 1964 states: “No person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance.” Title IX of the Education Amendment of 1972 states: “No person in the United States shall, on the basis of sex, be excluded from participation in, be denied the *benefits* of, or be subjected to discrimination under any education program or activity receiving Federal financial assistance.” Therefore, this National Dissemination Center for Career and Technical Education and the National Research Center for Career and Technical Education project, like every program or activity receiving financial assistance from the U.S. Department of Education, must be operated in compliance with these laws

ABSTRACT

Using the National Longitudinal Survey of Youth 1997 (NLSY97) and its transcript component, we examine vocational education (now known as career and technical education, or CTE) for a recent cohort of youths. We describe and distinguish between CTE coursetaking and participation in particular career-related programs of courses and activities (career majors, tech-prep, and work-based learning programs such as job shadowing and cooperative education). We find that the majority of American high school students participate in CTE courses and work-related activities, and this holds across demographic subgroups. Black students participate in career-related programs at higher rates than any other group, while males and females participate at similar rates. Students in the lowest income quartile are the *least* likely to report participation in career-related programs and activities, but the *most* likely to take proportionately more career and technical education courses than academic ones. Students who scored in the bottom half of the ASVAB Arithmetic Reasoning test distribution are also more likely to take high ratios of CTE-to-academic courses. We find that while participation in career-related programs does not generally *impede* college attendance, higher ratios of CTE-to-academic *courses* are associated with reductions in the chances of college attendance, even after adjusting for selection characteristics often associated with course trajectories.

TABLE OF CONTENTS

List of Tables

DOES CAREER AND TECHNICAL EDUCATION AFFECT COLLEGE ENROLLMENT?

Currently, there are visible efforts in American public education to increase academic standards and college attendance. This is evident in the recent federal No Child Left Behind Act of 2001, as well as efforts of individual states to increase graduation requirements, improve student academic test score performance, and raise high school graduation rates. Recently, there has also been much debate about efforts to improve the academic preparation and outcomes for students who do not traditionally participate in college preparation programs (Ravitch, 2005; "High School Reform," 2005; Hoachlander, 2005). Between 1990 and 1998, several pieces of legislation were passed that intended to directly affect the high school experience of students who participated in what has been known as vocational programs and curricula. The Perkins Amendments (of 1990, also known as Perkins II; and of 1998, also known as Perkins III) and the School-to -Work Opportunities Act (School-to-Work Opportunities Act [STWOA], 1994) supported career preparation through an integration of academic and vocational training, the targeting of special populations (such as disabled students and minorities), and an emphasis on nontraditional gender pathways to work.[1]

The rhetoric behind these efforts has been to "provide students with broader preparation so they have a greater choice of careers and postsecondary educational pathways" (National Center for Education Statistics [NCES], 2000). In our study, we examine what coursetaking patterns look like in an era of "de-tracking" and the integration of academic and vocational courses. We also explore whether career and technical education is associated with postsecondary enrollment, in light of recent efforts to revitalize vocational education. We employ the most recent panel data available, the National Longitudinal Study of Youth 1997 (NLSY97) to examine these outcomes. We describe how our current work adds to the existing research base, present basic descriptive statistics, and assess whether career and technical education (CTE[2]) experiences affect college attendance, net of background characteristics. The study has implications for what we know about the ways in which social structure and school organization affect educational attainment. We explore the following questions:

1) What does CTE look like for a recent cohort of students?

2) Which students participate in career-related programs of study and work-based activities?

3) Which students take a higher ratio of CTE-to-academic courses?

4) Which students are more likely to be academic, vocational, or dual concentrators?

---

[1]Specifically, we are referring to the following pieces of legislation: the Carl D. Perkins Vocational and Applied Technology Education Amendments of 1990 (Publ. L. No. 101-392; also known as Perkins II); the School-to-Work Opportunities Act of 1994 (Publ. L. No. 103-239); and the Carl D. Perkins Vocational and Applied Technology Education Amendments of 1998 (Publ. L. No. 105-332; also known as Perkins III).

[2]Throughout the text, we will be referring to what has been known as school-to-work or vocational education as *career and technical education*, or *CTE*. This is the result of changes in the way the federal government and vocational associations have conceptualized such high school experiences in light of recent legislation (Lynch, 2000).

5) Do students participating in career-related programs and CTE courses go on to attend college?

6) Are specific career-related programs and CTE courses associated with college enrollment?

7) Are career-related programs and CTE courses associated with enrollment in 2-year or 4-year colleges?

Theoretical Framework

To date, researchers have paid a great deal of attention to curricular differentiation in high school. Known as “tracking” research, the empirical examination of students’ curricular programs has told us much about the links between family background and schooling, and the links between a program of study in secondary schooling and later life outcomes.[3] Classic work in the field has demonstrated that minority students and students from less advantaged backgrounds tend to participate in vocational education at higher rates than other students, that vocational students are often exposed to less academically rigorous courses, and that such within-school stratification of learning opportunities can lead to diminished prospects for college (Oakes, 1985; Vanfossen, Jones, & Spade, 1987; Gamoran & Mare, 1989; Alexander, Cook, & McDill, 1978). These studies suggest that vocational students are less likely to transition to college because they are less likely to take advanced courses in math and science, and because most vocational programs do not teach material necessary for college entrance (Gamoran, 1987; Arum & Shavit, 1995).[4] The fact that vocational students take fewer advanced courses is a critical component in determining postsecondary outcomes, as recent research has shown strong links between advanced math and science course sequences and college enrollment (Schneider, Swanson, & Riegle-Crumb, 1998).

Historically, however, it was assumed that vocational education students would simply transition to work, not college (Oakes, 1985; Ravitch, 2001; Bills, 2004). Therefore, it might seem strange to focus on the role that CTE plays in influencing college enrollment, rather than strictly analyzing its relationship to postsecondary employment opportunities. For example, research examining the effect of vocational coursetaking on noncollege outcomes has shown some positive links between vocational education on employment outcomes (Arum & Shavit, 1995; Boesel & McFarland, 1994; Bishop, 1989; Mane, 1999). However, the recent “college for all” philosophy has been emphasized and adopted by the majority of American high school students (Schneider & Stevenson, 1999; Rosenbaum, 2001). Most high school students,

[3] Tracking can mean curriculum organization by ability level (e.g., honors or remedial) or by program of study (e.g., vocational or college preparatory). While both types of tracking are important for understanding the transition to college, we focused on the latter to examine the relationship between curricular focus and college enrollment. The research based on tracking has also tended to conflate “low ability” tracks with vocational tracks—a confusion we avoid in this study.

[4] However, the recent National Assessment of Vocational Education (NAVE) report shows that this trend appears to be changing, as more vocational students are taking academic and college preparatory courses (U.S. Department of Education, Office of the Under Secretary, Policy and Program Studies Service, 2004).

including many vocational students, express a desire to attend college at some point after high school graduation (Rosenbaum; MacAllum, Yoder, Kim, & Bozick, 2002; U.S. Department of Education, 2004).

Beyond the strong cultural rhetoric, it makes sense that such college plans materialize for some CTE students. Federal policy, parents, and guidance counselors emphasize the importance of a college degree for lifelong competitiveness in the labor market and as the primary avenue for achieving middle-class success (Rosenbaum, 2001). Even if youths plan to use their CTE training to transition to work directly after high school, recent research suggests that they may continue to alternate between work and postsecondary schooling for years (Deil-Amen, Rosenbaum, & Person, 2005; Bills, 2004).

How CTE Might Affect Postsecondary Outcomes

Given the discussion above, we need to know whether recent attempts to integrate academic and vocational preparation have been effective and whether CTE programs affect educational outcomes.[5] The corresponding policy rhetoric emphasizes giving students multiple choices and options—a notion that resonates well in the United States. However, we know that the American school-to-work transition has been poorly articulated in the past, given the lack of formal structures (e.g., institutional linkages) to facilitate such a transition (Rosenbaum, 2001; Mortimer & Kruger, 2000). Therefore, it is possible that broad preparation still leads to greater uncertainty during this transition, rather than providing a greater number of viable choices. Even if students take advanced math courses along with a particular sequence of occupational courses, they may fail to find a link between their high school preparation and the postsecondary world that awaits them.

However, it is also possible that curriculum integration in combination with the more formal structures of career preparation programs has positive results. Students who participate in academic *and* vocational courses may stay in school, rather than drop out (Plank, 2001; Plank, DeLuca, & Estacion, 2005). These students may experience high school more fully, engage academically, and feel less stigmatized than those in vocational classes alone, since they will have many different teachers and interact with multiple peer groups (see Oakes, 1985; Benson, 1997). Simultaneously, they may realize (at least short-run) college and labor market payoffs to their occupational training and work-based high school experience. Either through anticipated future payoffs or psychological engagement, certain balanced combinations of academic and vocational curricula may have a positive effect on school outcomes. The recent NAVE (U.S. Department of Education, 2004) report suggests:

[5]It is important to note that our study is not an evaluation of any of the Perkins legislation. It is difficult to know exactly when a particular wave of legislation was implemented in a state or a school district. However, the timing of the Perkins II and III, as well as the STWOA, does coincide with the time during which the cohorts in the NLSY97 were in high school, thus making it highly likely that CTE programs in high schools were influenced by the Perkins reforms during this period. Both Perkins II and III emphasized the integration of academic and vocational courses, as well as better articulations between secondary and postsecondary education (Castellano, Stringfield, & Stone, 2003). However, it is more likely that the students in our NLSY97 sample were affected by Perkins II, versus Perkins III.

> Students in vocational courses suggest a variety of other reasons for their participation: to gain career exposure, to help them select or prepare for a college major, to use as a fallback if college or other career plans fail to materialize, to pursue a leisure interest, or to take courses that present less of an intellectual challenge than do other courses. (p. 28)

It is important to know how CTE affects college enrollment. On the one hand, there are instrumental ways in which CTE might help students focus their high school efforts and enroll in college. Career exploration programs help students learn what certain desired careers require, in terms of postsecondary training at the sub-baccalaureate and 4-year levels (Hughes, Bailey, & Mechur, 2001). Some work-based programs might also link students with employers who could help pay for college later on. In terms of engagement, students might report having positive experiences in occupational courses, which include more-interesting applied work. As a recent report suggests, "Being able to see how learning is related to the world of work makes CTE classes more interesting and motivating, and more educationally powerful than standard academic classes" (Advisory Committee for the National Assessment of Vocational Education, 2003). This emphasis on "learning by doing" can help keep students engaged in school, which might help prevent dropout and encourage students to pursue more education after they graduate high school.

However, it is also possible that CTE programs and courses exclude students from the academically rich experiences necessary for college, as previous research indicates (Arum & Shavit, 1995). Students in vocational courses have traditionally enjoyed fewer educational resources than students in other courses. Often, occupational concentrators don't interact with college-bound peers or take courses with teachers who have connections or specialized knowledge about college options. Classic research in the field has also suggested that vocational students are socially stigmatized, and might not view themselves as "college material" (Oakes, 1985).

There are also more rational reasons why students who take many CTE courses might not enroll in college. It is likely that some students choose to take CTE courses precisely because they do not intend to pursue postsecondary education. Perhaps they also develop links more directly with labor market opportunities after high school (Bragg, 2001) and anticipate quicker financial payoffs to working once they graduate, rather than attending school—a hunch that is probably right in the short run (Bishop & Mane, 2004). However, in our NLSY97 sample, 75% of students taking CTE-to-academic course ratios between 0.2 and 0.5 expect to complete a 4-year college degree by age 30. Sixty percent of those students who take the highest ratios of CTE-to-academic courses (0.5–2.0) report the same expectations. This indicates that even if these students don't expect to enroll in college immediately, they might seek to enroll at some point in the future. Therefore, we want to know whether their chances of enrolling in college might be affected by their coursetaking in high school.

Despite these hypotheses, the research on the relationship between vocational education and college attendance has been outdated and the findings have been mixed. Some local-level demonstration programs (with comparison groups and matched controls) suggest that CTE can increase college enrollment for students who might not have gone in the absence of these programs (Griffith & Wade, 2001; MacAllum, et al., 2002). Other work using nationally representative data suggests that vocational education reduces the likelihood of college attendance relative to students concentrating in academic courses, or even career academy students[6] (Hotchkiss & Dorsten, 1987; Altonji, 1995; Maxwell & Rubin, 2002). The most recent reports on this topic conclude that although the students participating in CTE are more likely to attend college than they have been in the past, there is little evidence that CTE is actually responsible for this increase (U.S. Department of Education, 2004). Unfortunately, the data informing this federal report comes from the older NELS:88 study, which followed the high school class of 1992. Those data are too old to assess the effect of later CTE efforts, such as those encouraged in the Perkins II and III legislation.

What Does the Present Study Contribute?

The present study contributes to the current knowledge base about links between high school curriculum, career preparation, and college enrollment. *First, we use the most recent panel data available to examine CTE coursework in the years following targeted federal funding.* Previous analyses of NELS:88 data generally discuss students whose high school experiences came between 1989 and 1992 (e.g., NCES, 2000; Plank, 2001; Rasinski & Pedlow, 1998). We use the NLSY97 to examine outcomes for students who have been affected by the legislation efforts of the mid-to-late 1990s.

Second, we expand the notion of vocational education to include career-related programs of study, work-based learning programs, and CTE coursetaking. By including analyses of career preparation activities, programs that link school with work, and CTE coursetaking, we hope to capture the expanded idea of CTE summarized in Stone (2000) and Castellano, Stringfield, & Stone (2003) as “education through work, education about work, and education for work.” School reform efforts enabled by the Perkins II and III legislation focused on the integration of academic and vocational curricula as well as work-based learning and tech-prep linkages between high schools and community colleges (NCES, 2000). Programs supported by the STWOA usually involved activities that connected employers to schools, such as career exploration and internships (NCES, 2000). Students most likely participate in many combinations of experiences within and outside of the classroom. Therefore, we consider both credits earned in CTE as well as involvement in formalized programs connecting youths to career-related courses and work-related activities. These career-related programs include *career*

[6]In this study, we do not explicitly examine outcomes for students who attended career academies. Our focus is on programs of CTE study and coursetaking in comprehensive public or private high schools. However, there has been an extensive body of research comparing outcomes for students attending career academies versus control groups of similar students. These studies suggest some positive effects of career academy attendance on college outcomes (Maxwell, 2001; Orr, Hughes, & Karp, 2002; Stern, Raby, & Dayton, 1992; Stern, Stone, Hopkins, McMillion, & Crain, 1994). However, small sample sizes and nonrepresentative data sources make it hard to reach causal interpretations (see Castellano, Stringfield, & Stone [2003] for a review of such studies). The most rigorous example is the MDRC (Manpower Demonstration Research Corporation) evaluation of students randomly assigned to career academies (Kemple, 2001). However, this research found no significant improvement in college enrollment relative to the control group.

majors (which combine academic and vocational coursework organized around an occupational field); *tech-prep programs* (which link vocational coursework in high school with the first 2 years of postsecondary vocational training); *cooperative education* (which combines academic and vocational studies with a job in a related field); and *work-based learning* (i.e., internship/apprenticeship, mentoring, job shadowing, school sponsored enterprise).

Third, we look at the ratio of CTE-to-academic courses taken in high school. This is an especially important improvement over previous research, which has either used categorical distinctions (e.g., college prep and non-college prep), or simply tallied the total number of courses a student took in a particular curriculum area.[7] First, there is likely to be a positive relationship between the number of courses one takes and the number of CTE or academic courses one takes, and higher-performing students tend to take more courses overall (NCES, 1995). Therefore, using a ratio measure allows us to assess the relative proportion of a student's high school experience spent in CTE classes.

Additionally, since most students take the majority of CTE coursework in their junior or senior year, analyses of CTE credits alone would produce a spurious relationship between such coursework and outcomes of interest due to dropouts, who would have fewer CTE credits on average (noted also in Bishop and Mane, 2004). The ratio measure allows us to analyze the experience of students regardless of how many of their high school semesters we have observed. Lastly, the ratio measure is critical for utilizing transcript data across different high school credit systems. Although the High School and Beyond and NELS:88 data sets included transcript data standardized for use in Carnegie units, the NLSY97 transcripts are not as amenable to systematization.[8]

Data and Methods

NLSY97 Description

The NLSY97 tracks a nationally representative sample of U.S. youths who were 12 to 16 years old as of December 31, 1996. The survey collects detailed information about this sample of 8,984 youths on their labor market and educational experiences. There are several reasons to consider these data unique and appropriate for our research questions. First, these data describe the high school experiences of a nationally representative sample of youths who have been in school quite recently. Second, these data provide information on specific CTE programs, as well

[7]Early research in the sociology of education measured high school track with a three-category self-reported measure given by students (i.e., academic or college preparatory track, general track, vocational track). As work in this field developed, scholars began to recognize that such a measure was unreliable, since teachers, administrators, and students often disagreed about whether tracking existed in their schools and which tracks students were in (Rosenbaum, 1976, 1980). Given these discoveries, many researchers began to instead use transcript data with course level indicators to capture which courses students actually took, instead of using monolithic categories such as academic or vocational (e.g., Stevenson, Schiller, & Schneider, 1994; Lee & Burkham, 2003; Lucas, 1999, 2001).

[8]We have spent a great deal of time standardizing the way different high schools allot credits for courses in this dataset. The distribution of the total number of credits students earned seems to have several "modes," indicating multiple systems of course counting. Appendix 1 contains details about our coding procedures.

as CTE courses. Finally, NLSY97 provides contextual information through baseline parent interviews, two rounds of school surveys, and transcript data gathered as the youths leave high school.

In our analyses, we focus on an older subsample of NLSY97 youths born in 1980 (N = 1,691), as well as a subgroup of students born in 1980 for which we have transcript data (n = 873). The Round 1 interview included the longest period of data collection, including youths who were 15 to 18 years old during the first interview.[9] For the present analyses, we are interested in these older cohorts primarily because these respondents are furthest along in their school trajectories, and the transcript data we have is more representative of this cohort than for the others. These are students who graduated from high school roughly between 1997 and 1998, and who were between the ages of 20 and 23 at the time of the Round 5 survey.

While the majority of our control variables come from information provided during the 1st-round interview, we do use as many as 5 rounds of available data, when necessary. The longitudinal nature of these data and the detailed school roster data were essential to carefully track the schooling pathways for our sample and ultimately create our postsecondary education outcome variables. The second way in which we make use of 5 rounds of data is to replace earlier missing data (such as information on household income) that is gathered and updated in future rounds.

Measurement

In this study, we are interested in CTE during high school participation and its relationship to *postsecondary enrollment*. In these analyses, we first consider a dichotomous outcome variable indicating whether a respondent has ever attended college. Next, we looked at whether *first* college attendance was at a 2-year or a 4-year institution. By utilizing school roster data, we were able to create an event history of the nature of the schooling experience. For example, we considered start and stop dates of every school attended, type of school in question, and high school completion date. By utilizing all rounds of data, we were able to determine the first type of college enrollment, even when there was overlapping attendance in multiple institutions.

CTE—Career-Related Programs/Activities

In this study, we make a distinction between 1) *student reports* of participation in CTE programs of study that are organized around career-related goals, including work-based activities and, possibly, coursetaking (career majors, tech-prep, work-based learning, and cooperative education) and 2) *transcript data* on the proportion of CTE courses taken relative to academic courses. The distinction is important because we want to capture the effects of student participation in coherent programs of occupational study, work-related activities, *and* actual credits earned in CTE courses. This distinction does not indicate that students who participate in

[9]Round 1 was the longest period of data collection (February through October 1997, and March through May 1998); therefore, for the majority, Round 1 covered the 1996–1997 academic year, while for others, this covered the 1997–1998 academic year.

any CTE programs on the NLSY97 survey are not also taking CTE courses, and vice versa. These approaches simply allow us to look at the effects of different aspects of CTE.

The NLSY97 is unique in that it surveys youths on participation in *specific types* of CTE programs. The seven programs of interest are the following: 1) career major—a sequence of courses based on an occupational goal; 2) job shadowing—time spent following workers at a work site; 3) mentoring—a student matched with an individual in an occupation; 4) cooperative education—academic and vocational studies combined with a job in a related field; 5) school-sponsored enterprise—production of goods or services by students for sale or use by others; 6) tech-prep[10]—a planned program of study with a defined career focus that links secondary and postsecondary education; and 7) internship or apprenticeship—students actually employed in order to learn about a particular occupation or industry.[11]

For the sake of theoretical considerations and clarity, we will group these seven career-related programs and activities into four categories. These include *career major, tech-prep, cooperative education,* and *work-based learning activities* (internship/apprenticeship, mentoring, job shadowing, school-sponsored enterprise).[12] These four types of programs may affect student outcomes and postsecondary participation rates for very different reasons. Some of these programs might provide students with a clear sense of progress and purpose, since they include course sequences and higher-level coursework, practical relevance, and work-like responsibility. For example, career majors may affect college enrollment because students who might have traditionally taken mostly CTE courses (a concentration often stigmatized) will be participating in academic classes as well, and therefore experience teachers and peer groups who are more college-oriented. Tech-prep programs may be important for predicting the outcomes of students who transition directly to postsecondary education, since tech-prep programs engage students in community college courses while they are in high school. We suspect that the effects of work-based learning may vary, depending on whether they are combined with coursework or certain levels of employment intensity, but experiences in the workplace or with mentors might be particularly engaging and helpful for students determining how college fits into their career plans for a particular occupation.

[10]Tech-prep involves sequenced programs of study that combine at least 2 years of secondary and 2 years of postsecondary education (commonly referred to as *2+2* programs). These programs aim to increase postsecondary enrollment by allowing students to earn college credit for their secondary coursework. Programs are intended to lead to an associate degree or a certificate in a specific career field and, ultimately, to high-wage, high-skill employment or advanced postsecondary training. According to the U.S. Department of Education, Office of Adult and Vocational Education, “roughly 47% of the nation's high schools (or 7,400 high schools) offer one or more Tech Prep programs. Nearly every community and technical college in the nation participates in a Tech Prep consortium, as do many four-year colleges and universities, private businesses, and employer and union organizations” (http://www.ed.gov/about/offices/list/ovae/pi/cte/tpreptopic2.html, retrieved July 18, 2005).

[11]Program descriptions are the exact wording found in the NLSY97 Youth Questionnaire.

[12]We also group these work based learning categories together, since many students will experience more than one of these programs with varying levels of intensity. Some programs are one-time field experiences, while others last for a year or more.

This group of questions allowed youths to report participation in multiple career-related programs; therefore, the categories are not mutually exclusive.[13] We are able to determine, at the Round 1 interview, if the youths have ever participated in these CTE programs.[14] In additional rounds, youths were asked specifically about participation since the initial interview. As our cohort aged, we took precautions to link the reports of program participation with high school attendance. In this way, we took into consideration the possibility that youths could be participating in postsecondary vocational training.

Career and Technical Education—Coursetaking

In addition to analyzing student-reported participation in career-related *program*s, we examined the effects of credits earned in CTE *courses*. To do this, we examined high school transcript data. Transcript data is a valuable way to capture the kinds of exposure and experiences students have while in high school. It has the advantage of being administrative data, correcting for some of the validity problems of previous research, which was based on self-reported tracks (see Rosenbaum, 1976, for a discussion). For our sample of youths born in 1980, we have transcript data for about 873[15] (see Appendix 1 for more details). Though not nationally representative, the transcript subsample resembles the larger 1980 cohort used for the multivariate CTE program analyses (see Appendix 2 for exceptions and a comparison of the two samples by all variables used in the analyses).[16] For example, the transcript subsample differs from the larger 1980 cohort in that it has more White students, higher family incomes, more parental education, and more intact families, and the students themselves report fewer problem behaviors and score higher on the ASVAB test.

We used transcript data to create several measures. First, we created a CTE-to-academic coursetaking ratio. This ratio is the number of CTE credits earned during high school divided by the number of academic credits earned. We defined academic credits as the core courses in English, math, science, and social science. CTE courses include all CTE courses taken, whether in general or specific labor market preparation areas.[17] Previous research (Plank, 2001) suggests

---

[13]To capture the effects of participation in multiple programs, we include interaction terms for all combinations of career related programs in our regression analyses.

[14]At Round 1, only a handful of cases have any college experience therefore we include all reports of participation as high school CTE participation for this round.

[15]The U.S. Bureau of Labor Statistics, the agency that sponsored the NLSY, had a difficult time collecting the transcripts from respondents' high schools, and has just completed some additional transcript collection, which we hope to capitalize on to assess a larger portion of the total NLSY sample.

[16]It is clear that there are some differences between the 1980 cohort sample and the transcript subsample, as demonstrated in Appendix 2. As presented in this report, we view the unweighted transcript sample as a diverse group comprising individuals from across the United States, but not as a sample that directly represents the demographic or social composition of U.S. youths born in 1980.

[17]It is possible that CTE courses are recorded on transcripts with a different metric than academic courses. This might reflect the use of double periods for CTE courses with machine and technology labs, or the enrollment of CTE

that such ratios can be predictors of high school persistence. Although this ratio is a continuum, we break it into three categories to test for nonlinear effects. Low CTE-to-academic course ratios are those falling between 0 and 0.2 (0 representing no CTE courses, and 0.2 meaning one CTE course for every five academic courses); moderate CTE-to-academic ratios fall above 0.2 and below 0.5 (0.5 being one CTE course to every two academic courses); high CTE-to-academic ratios fall above 0.5 through 2.0 (these students have taken more than one CTE course for every two academic courses).[18]

Control Variables

Demographics

In the models, we controlled for many of the usual individual and family characteristics. We included gender (dummy variable for female), race/ethnicity (a series of dummy variables including Black and Hispanic, with non-Black/non-Hispanic as the reference category). We controlled for family SES (socio-economic status) by including the log of gross household income at Round 1. The second SES variable is parental education, which describes the highest grade completed by the parent.[19] Household income (derived from parent reports) and parental education are both continuous variables in our models. We included a variable indicating residence in an urban or rural setting as of the survey date (with urban as the reference category).[20]

NLSY97 provided detailed information on family structure for our cohort. We incorporated the following dummy variables in our models: 1) living with two biological parents; 2) living with a biological mother only; 3) living with a biological father only; 4) living with one biological parent and one stepparent; and 5) living in any other arrangement. The first of the four is our reference category. Finally, we controlled for the age of our respondents at the time of the Round 1 interview, using months of age (e.g., 17 years and 0 months is entered as 204 months).

---

students in both a local high school and a county or district-wide CTE center. In our coding of the transcript data, we noticed that a CTE course often would be given double the number of credits that an academic course would yield. We looked at observations for students in the same school, and noted patterns of credits across different types of courses. We then divided the credits the same way as academic credits, so that a student who earned 3.0 credits for a single CTE course would still have 3.0 credits count toward the total CTE credit count.

[18]While the ratio measure is an improvement over other methods, it does not take into consideration the possible rigor or level of the CTE courses being taken. Some of the courses in SLMPs (specific labor market preparation areas) are more advanced than others, and some courses are taken in an occupational sequence. Unfortunately, we do not have the course catalogues for the NLSY97 schools, so we can't know for sure how advanced or challenging any CTE course might have been in a given school without making problematic assumptions about the data.

[19]Most of these data are based on the residential mother's or father's highest education level (whether or not she/he was a biological parent).

[20]"Suburban" residence is not given as an option for this variable.

Schooling Experience

We included school type as another control variable. This variable indicates the type of school at Round 1. We included dummy variables for private and Catholic, with public school as the reference group. In order to determine a baseline for academic achievement, we controlled for self-report of grades in high school by including the following dummy variables: 1) mostly Ds or below Ds; 2) half Cs and Ds, or mostly Cs; 3) half Bs and Cs; 4) mostly Bs, or half Bs and As; 5) mostly As; and 6) other (mixed, ungraded, skipped eighth grade, or other). The third group is our reference comparison. In addition to including this particular measure of academic success, we included aptitude scores from one subsection of the computer-adaptive form of the CAT-ASVAB. Although the entire sample was eligible, approximately 80% of the NLSY97 sample participated in the CAT-ASVAB administration during the Round 1 interview. For these particular analyses, we included the final ability estimate of the Arithmetic Reasoning subset. This estimate is based on the scale of the original calibration sample, which was set to a mean of 0 and a standard deviation of 1 in that population of respondents.[21]

In addition to using measures of achievement and attainment, we include proxies for disengagement.[22] We included information asked at Round 1 about how many days youths were absent from school the previous fall using four cut-off points: no days, 1–5 days, 6–13 days, and 2 weeks or more. A more extreme proxy for engagement is suspension. We include this dichotomous variable in our model, as well.

Missing Data

Missing data were treated via multiple imputation, using SAS procedures MI and MIANALYZE (programming procedures needed to carry out missing data analysis using multiple imputation; Little & Rubin, 1987; Allison, 1995; Schafer, 1997). The Markov Chain Monte Carlo (MCMC) method was used, and 20 imputations were generated. Inspection of diagnostic statistics suggested that the relative efficiency of estimates was markedly better with 20 imputations, rather than 5 or 10, but that any additional improvements were minimal if more than 20 imputations were used.[23]

[21]NLSY97 User's Guide, Appendix 10.

[22]There are many ways one can measure student engagement in school. As Finn (1989) notes, there are behavioral and affective components of student engagement. Some of these behavioral components can include effort in school, cutting classes, getting into trouble, and absences. Given the available measures in the NLSY97, we chose to use days absent from school and suspension as two proxies. Questions involving time spent on homework were not asked of all youths, so we could not use that additional measure.

[23]Additional missing-data approaches were used before deciding on MI procedures. In previous analyses, we used mean imputation with a dummy indicator for missing, as well as listwise deletion. Neither the mean imputation nor the listwise deletion produced results that differed substantively from the MI estimates. However, the standard errors reported here for the MI estimates are slightly larger. To create our missing data imputation, we used a large number of covariates that we believe to be related to "missingness" in the data. These include all of the covariates in our models, as well as additional variables describing educational expectations and family structure.

Analytic Plan[24]

First, we present descriptive statistics on national and sample CTE participation rates, and compare participation across socioeconomic groups of interest. Second, we present descriptive analyses from the transcript data, showing the kinds of students participating in varying ratio levels of CTE-to-academic courses. Third, we show the college attendance rates of students participating in career-related activities and programs by sociodemographic characteristics, to get a sense of what the trends look like before we move to multivariate analyses. Fourth, we show results from detailed descriptive analyses for the transcript sample. Fifth, we present logistic regression analyses predicting the effect of career-related activities and programs and CTE coursework on any college enrollment after high school. Lastly, we present multinomial logistic regression analyses to contrast the effects of CTE participation on type of postsecondary institution first attended.

Results

What Were the Participation Rates for High School Vocational Education (CTE)?[25,26]

CTE is organized into three main areas, although the content and extent of student participation varies across individuals and schools. The three areas are: general labor market preparation (GLMP), which provides students with basic and general introductory skills required for many jobs (e.g., typing); specific labor market preparation (SLMP, or occupational education), which involves specific and advanced training for a variety of careers in 10 broad areas (agriculture, business, marketing, trade/industry, technology, health care, protective services, child care, food service, and other personal services); and family and consumer sciences education (FCSE), which prepares students for work outside of the formal labor market (e.g., home economics).[27]

---

[24]All analyses using the student self-report of career-related program participation have been weighted with panel weights created by the U.S. Bureau of Labor Statistics. These weights apply to youths who were in the sample from Round 1 through Round 5. However, there were no weights created for the transcript subsample at the time of our study.

[25]We wanted to compare our findings from this most recent data set with other estimates from the 1980s and 1990s, from all of the NCES reports used in Table 1. Since these reports rely primarily on data gleaned from transcripts, rather than student self-report of specific career-related program/activity participation, we show comparisons here only for courses taken, rather than career-related program groupings (i.e., career major, tech prep).

[26]We also used the NCES statistics on coursetaking because the transcript data we have for the NLSY97 is somewhat limited in scope at present, as noted. Therefore, we wanted to use the NCES calculations to present more nationally representative numbers and as a comparison for the NLSY97 transcript sample estimates.

[27]For more details on the taxonomy for CTE, see the NAVE report (U.S. Department of Education, 2004). For additional data on participation in specific SLMPs, see the NCES, *Trends in High School Vocational/Technical Coursetaking, 1992–1998* (NCES, 2003).

As shown in Table 1, between 1982 and 2000, the vast majority of students took at least one vocational course in high school (98.2% and 96.6%, for respective years). However, while the average total number of credits earned in high school increased from 21.6 to 26.0 between 1982 and 2000, the average number of vocational credits decreased slightly from 4.7 to 4.2. These estimates included computer-related courses, which increased slightly from 1990 through 2000 (NCES, 2004). If you count the change *without* computer courses, the average number of Carnegie units in vocational courses fell from about 3.5 to 3.1 from 1990 through 2000 (NCES, 2004.). This can be compared to about 15 credits students took in core academic courses (i.e., math, English, social studies, and science) (NCES, 2004). One interesting change is the increase in vocational credits earned between 1998 and 2000 (4.0 to 4.2). The final column in Table 1 shows how the NLSY97 data compares to the NCES estimates.

Table 1.
Trends in Vocational Coursetaking (Selected Years, 1982–2000)

	1982	1990	1992	1994	1998	2000	NLSY97
Percentage of students taking at least one vocational credit	98.2[a]	98.0[a]	97.7[a]	97.2[a]	96.5[a]	96.6[c]	93.8[b]
Total credits	21.6[a]	23.5[a]	23.9[a]	24.2[a]	25.1[a]	25.9[c]	24.7[b]
Total vocational credits	4.7[a]	4.2[a]	4.0[a]	4.0[a]	4.0[a]	4.2[c]	3.9[b]
Total credits in GLMP	0.95[a]	0.7[a]	0.6[a]	0.6[a]	0.6[a]	0.7[d]	0.8[b]
Total credits in SLMP	3.0[a]	2.9[a]	2.8[a]	2.8[a]	2.9[a]	3.0[d]	2.5[b]
Total credits in FCSE	0.7[a]	0.6[a]	0.5[a]	0.5[a]	0.5[a]	0.5[d]	0.4[b]
Total percentage of vocational concentrators	33.7[a]	27.8[a]	24.9[a]	25.4[a]	25.0[a]	26.0[c]	22.4[b]

Note: Some of the estimates for vocational credits differ across various NCES reports.

Sources: a) Trends in Vocational Coursetaking, NCES Report 2003-025; b) National Longitudinal Study of Youth 1997, Transcript Component for the 1980 cohort; c) National Assessment of Vocational Education, Final Report to Congress; d) NCES Digest of Education Statistics, 2002, Table 154.

For students participating in at least one vocational course, 90.8% completed courses in an SLMP area, 61.1% in a GLMP area, and 45.1% in a FCSE area (NCES, 2000). Most vocational education courses are taken in an SLMP area (an average of 3 credits in 2000), relative to GLMP courses (0.7 credits in 2000) or FCSE courses (0.5 credits in 2000; Table 1). The total number of vocational concentrators (students taking three or more courses in an SLMP) fell from 33.7% in 1982 to 26.0% in 2000 (Table 1).

Which Students Participated in Career-Related Activities and Programs?

In addition to specific courses, students may participate in groupings of courses and other CTE-related activities.[28] These include career majors, work-based learning activities, cooperative education, and tech-prep programs. Table 2 presents data from the NLSY97 student reports of participation in career-related programs of study. We see that a majority of students in our sample (58.1%) have participated in at least one career-related or CTE program (which might or might not entail formal coursetaking credit). Almost 30% of the students reported participating in CTE programs during more than 1 year of high school (in analyses not shown).

Table 2.
Demographic Characteristic & Participation in Career-Related Activities and Programs (1980 Cohort, Weighted; N = *1,691)*

	% ever participating in CTE programs[c]
Total	58.1
Race/Ethnicity	
Hispanic[a,b]	50.8
White, not Hispanic	59.1
Black, not Hispanic	61.6
Gender	
Male	57.2
Female	59.0
Family income	
Quartile 1 (Q1; lowest)[c,d,e]	52.3
Quartile 2	61.6
Quartile 3	59.3
Quartile 4 (A4; highest	57.6
ASVAB Arithmetic Test	
Quartile 1 (lowest	58.9
Quartile 2	59.1
Quartile 3	62.8
Quartile 4 (highest)	56.3

Note: These estimates are derived from student self-reports of participation in career-related programs and activities, including career major, work-based learning activities, cooperative education, and tech-prep programs.

Bonferroni Corrections: [a]Sig. Hispanic–White diff [b]Sig. Hispanic–Black diff
[c]Sig. Q1–Q4 income diff [d]Sig. Q1–Q3 income diff [e]Sig. Q1–Q2 income diff

[28]The opportunity for students to participate in CTE courses and work-related activities depends on the extent to which their high schools offer such experiences and curriculum. Therefore, the participation rates that we show here reflect not only student choice, but also the offerings provided by their schools. In future analyses, we plan to incorporate restricted school-level data into the analyses to account for the differential participation in CTE across schools with varying levels of offerings. This is an important consideration for understanding which students participate in which kinds of schools, and how school-level characteristics affect the relationship between CTE and other educational outcomes.

An interesting result, shown in Table 2, is the relative lack of variation in at least some program participation across socioeconomic background and academic correlates. Across ethnicities, we see that Blacks have the highest program participation rate (61.6%), followed by Whites (59.1%), and then Hispanics, who have the lowest participation rates (50.8%).[29] The difference between Black and Hispanic participation rates and White and Hispanic participation rates are statistically significant. Males and females participate at similar rates (57.2% and 59.0%, respectively). We also see similar rates across most family income groupings, though the lowest-income students participate at the lowest rate (52.3%), while the second-lowest quartile students participate at the highest rate (61.6%). The participation rate of the lowest-income students is significantly different from all other income quartiles. This finding is especially interesting, since it suggests that the lowest-income students are the least likely to be served by career-related programs and activities, while their slightly more advantaged counterparts enjoy higher rates. There are no statistically significant relationships between ASVAB Arithmetic Reasoning test scores and career-related program participation.

Table 3.
Participation Rates for Specific CTE Programs (1980 Cohort, Weighted)

	% of Sample					
		Race/Ethnicity			Gender	
	Total	White	Black	Hispanic	Male	Female
Curriculum integration						
Career major[a,c]	31.4	31.5	36.5	26.5	30.5	32.4
Linkages						
Tech-prep[c]	11.9	10.8	16.1	12.7	12.6	11.1
Work-based learning						
Any work-based learning[a,b,d]	36.7	37.8	39.2	28.2	32.9	40.8
Job shadowing[a,b,d]	21.5	22.5	21.4	15.9	19.7	23.4
Mentoring[a,c,d]	8.8	8.3	10.8	6.9	7.5	10.2
Cooperative education[a,c]	14.9	14.0	21.2	13.2	15.5	14.3
School-sponsored enterprise[a,c,d]	12.5	12.2	16.4	9.0	11.1	14.0
Internship/Apprenticeship	10.8	10.4	13.1	10.7	10.8	11.6

Note: These estimates are derived from student self-reports of participation in career-related programs and activities, including career major, work-based learning activities, cooperative education, and tech-prep programs.

[a]Sig B–H diff, $p < 0.05$ [b]SigW–H diff, $p < 0.05$ [c]Sig W–B, $p < 0.05$ [d]Sig M–F diff, $p < 0.05$

Table 3 shows the participation rates for students by particular career-related activities and course programs. The most popular individual programs are career majors (31.4%) and job shadowing (21.5%), while many students participate in some kind of work-based learning experience (36.7%). Hispanic students are significantly less likely to be involved in career

[29]We had previously included results for Asian students as well, but the sample sizes became too small for reliable estimates in some of the later cross-tabulations, so, for now, we have omitted them.

majors, relative to Black students, while Black students participate in career majors at higher rates than White students. Black students are more likely than Whites to be in tech-prep, but there is no significant difference between Black and Hispanic tech-prep rates. Both Black and White students are more likely to be involved in some kind of work-based learning than Hispanic students, and Black students are significantly more likely to participate in mentoring, cooperative education, and school-sponsored enterprises than White and Hispanic students. Female students report significantly higher levels of most work-based learning experiences than their male counterparts, though only job shadowing, mentoring, and school-sponsored enterprise participation rates are significantly different.

Which Students Took a Higher Ratio of CTE-to-Academic Courses?

Turning to Table 4 (which includes only 1980-cohort students with transcript data), we confirmed NCES numbers for the high proportion of students participating in at least one CTE course (above 90% for most groups in our smaller transcript sample).[30] White and Hispanic students are significantly more likely to have lower CTE-to-academic ratios (less than 0.2) than Black students. Black youths are more likely to have moderate ratios of CTE-to-academic courses than White youths (0.2 to 0.5, or one CTE course for every two to five academic courses). However, White students are significantly more likely than Hispanic students to be in the highest ratio grouping of CTE-to-academic courses (or more than one CTE course for every two academic courses). Male students are more likely than females to have CTE-to-academic ratios above 0.5.

As for family income, we find a stark pattern for coursetaking ratios. The results for career-related program participation (in Table 2) include the finding that those from the lowest quartile (Q1) were least-likely to have participated in such activities and programs. In terms of income, we find the *opposite* trend when we look at transcript-based coursetaking. The lowest-income students were more likely to fall into moderate and high CTE-to-academic coursetaking ratios, relative to more advantaged students. The highest-income quartile of students was significantly more likely to have the lowest CTE-to-academic course ratios than any of the other income quartiles.

We are also interested in the relationship between academic achievement (as measured by the ASVAB Arithmetic Reasoning test) and coursetaking, since the students who take CTE courses are not randomly selected into them. Students with the highest test scores are more likely to take low CTE-to-academic course ratios, and the least likely to have the highest CTE-to-academic coursetaking ratios.[31] These results are similar to trends noted in traditional tracking research, which suggest that socioeconomically advantaged, high-performing students are more likely to take academic courses than their less-advantaged counterparts (Oakes, 1985; Lucas, 1999).

Overall, students with better test scores and those coming from more advantaged families tended to participate in career-related activities at higher rates than their less-well-off

[30]See Table 1 for NCES estimates from 1982–2000.

[31]We found similar results when looking across high school grade distributions.

counterparts, but the *opposite* is true for CTE coursetaking as measured on transcripts, where we see lower-income and low-performing students have taken more CTE credits relative to academic credits. The results from Tables 2–4 tell us an interesting story about proportions of CTE courses and career-related programs of study. Namely, the two phenomena may be related and overlap, but they are not always the same thing. Students may take CTE courses, but may not participate in formalized programs of CTE study (e.g., career majors), and vice versa.

Table 4.
Demographic Characteristics by Coursetaking Ratios (1980 Cohort, Transcript Data; n *= 873)*

	% ever taking any CTE courses	% CTE-to-academic ratio < 0.2	% CTE-to-academic ratio 0.2–0.5	% CTE-to-academic ratio 0.5–2.0
Total	93.80	36.61	39.77	17.43
Race/Ethnicity				
Hispanic	91.14	37.34[b]	41.77	12.03[d]
White, not Hispanic	95.11	41.06[c]	34.68[c]	19.36
Black, not Hispanic	93.37	24.49	49.49	19.39
Gender				
Male	93.35	33.49	39.19	20.67[a]
Female	94.24	39.63	40.32	14.29
Family income				
Quartile 1 (lowest)	91.72	22.76[e,f,g]	47.59[e]	21.38[e]
Quartile 2	92.38	28.57[f,i]	44.29	19.52
Quartile 3	94.14	40.17[g,j]	37.24	16.74
Quartile 4 (highest)	95.49	47.95[e,i,j]	34.02	13.52
ASVAB Arithmetic Reasoning test				
Quartile 1 (lowest)	86.89[e,f,g]	15.57[e,f,g]	45.9[e]	25.41[e,g]
Quartile 2	97.68[f]	31.4[h,i]	41.28	25.00[h,i]
Quartile 3	95.12	37.07	42.93	15.12
Quartile (highest)	93.64[e]	54.09[e,i,j]	31.82[e,j]	7.73[e,i,j]

[a]Sig M–F diff, $p < 0.05$ [b]Sig B–H diff, $p < 0.05$ [c]Sig W–B, $p < 0.05$ [d]SigW–H diff, $p < 0.05$ [e]Sig Q1–Q4 diff, $p < 0 .05$
[f]Sig Q1–Q2 diff, $p < 0.05$ [g]Sig Q1–Q3 diff, $p < 0.05$ [h]Sig Q2–Q3 diff, $p < 0.05$ [i]SigQ2–Q4 diff, $p < 0.05$ [j]Sig Q3–Q4 diff, $p < 0.05$

Which Students Were More Likely to be Academic, CTE, or Dual Concentrators?

Table 5 shows more detail for the transcript sample, including the total number of credits, concentration rates, and numbers of credits taken in particular subject areas across several socioeconomic subgroups. The analyses here are shown for all students in the transcript subsample, and some are also shown for only those with complete transcripts. It is clear that students whose schools responded with complete transcripts earned more credits overall, and were more likely to be academic or New Basics concentrators.[32]

Table 5.
Descriptives for Transcript Analyses (1980 Birth Cohort; N = *1,691)*

			Race/Ethnicity			Gender					
Average number of credits earned	Total *n = 873*	Complete transcripts* *n* = 706	White	Black	Hispanic	Female	Male	HISES	SES3	SES2	LoSES
Total credits	22.6	24.67	23.19[cd]	21.13[c]	22.23[c]	23.00[a]	22.1	24.17[e,i]	23.37[g,h,i]	21.36[g,h,I]	20.25[e,f,g]
Total academic credits	12.93	14.19	13.31[c]	12.04[c]	12.8	13.19	12.67	14.11[e,i]	13.44[g,h]	12.07[f,h,i]	11.37[e,f,g]
Total math credits	3.02	3.31	3.07[c]	2.88[c]	3.00	3.07	2.97	3.29[e,i]	3.13[g,h]	2.85[f,h,i]	2.63[e,f,g]
Total English credits	3.87	4.23	3.86	3.67[b]	4.14[b]	3.98[a]	3.76	4.12[e,i]	3.91[g]	3.68[i]	3.66[e,g]
Total CTE credits	3.53	3.86	3.60[d]	3.80[b]	3.07[b,d]	3.47	3.59	3.29[e]	3.46	3.71	3.75[e]
Total SLMP credits	2.31	2.55	2.37	2.40	2.07	2.11[a]	2.51	2.20	2.33	2.44	2.21
Average CTE-to Academic coursework ratio	0.303	0.292	0.295[c]	0.369[b]	0.259	0.293	0.312	0.257[c]	0.278[g]	0.355	0.342[e,g]
Curricular focus	*n* = 873	*n* = 706									
New Basics**	36.9	43.6	41.95[c,d]	27.45[c]	31.88[d]	36.00	37.85	46.94[e,i]	43.93[g]	27.1[f,I]	23.68[e,f,g]
CTE concentrator***	11.4	12.5	12.92	11.27	7.50	9.33	13.55	11.02	10.88	11.68	12.50
Dual concentrator	8.3	9.9	8.05	12.25[b]	3.75[b]	9.57	7.00	5.31[j]	10.46[j]	9.81	5.92
Neither	43.4	34.0	37.08[c,d]	49.02[c]	56.88	45.10	41.59	36.73[e,i]	34.73[g,h]	51.4[h,i]	57.89[e,g]

[a]Sig M–F diff, $p < 0.05$
[b]Sig B–H diff, $p < 0.05$
[c]Sig W–B, $p < 0.05$
[d]Sig W–H diff, $p < 0.05$
[e]Sig Q1–Q4 diff, $p < 0.05$
[f]Sig Q1–Q2 diff, $p < 0.05$
[g]Sig Q1–Q3 diff, $p < 0.05$
[h]Sig Q2–Q4 diff, $p < 0.05$
[j]Sig Q2–Q4 diff, $p < 0.05$
[j]Sig Q3–Q4 diff, $p < 0.05$

Note These estimates are derived from the transcript component of the NLSY97.
*Complete transcripts refer to students with 4 complete years of transcript data; however, all demographic analyses used total transcripts.
**These categories are mutually exclusive.
***To calculate the total number of students completing a vocational or New Basics concentration, add the vocational concentrator or the New Basics concentrator cell with the dual concentrator cell.

Many of the trends in Table 5 are similar to those found in Table 4, though here the particular credits are broken down by category. One notable difference is the classification of students into academic, or New Basics concentrators (those earning the New Basics requirements of 4 years of English, 3 years of mathematics, 2 years of science, and 2 years of social studies); CTE concentrators (students taking three or more courses in a SLMP area); dual concentrators

[32] To account for this selection, we included a dummy variable in the regression analyses that indicates if a student's transcript was incomplete.

(students fulfilling both academic and CTE requirements); and neither (students who took a combination of courses that did not add up to a concentration in academic or CTE studies).

Female students completed more credits than males, particularly in English, but took fewer SLMP courses. White students completed more total credits than Black or Hispanic youths, took more credits in academic subjects relative to Black students, and completed more CTE courses than Hispanic students. However, Whites also were more likely to be New Basics concentrators than either Blacks or Hispanics, and less likely to leave high school with no curricular concentration. Relative to Hispanic students, Black students took more CTE courses, had a higher average CTE-to-academic course ratio, and were more likely to have completed a dual concentration.

Students in the upper-half of the income distribution earned more total credits, academic credits, and math credits than those students in the bottom half. These more advantaged students were more likely to complete a concentration in New Basics, and less likely to leave high school without having completed a curricular concentration. Students in the lowest-income quartile took more CTE courses than those in the highest income quartile.

Did Students Participating in Career-Related Activities Go on to Attend College?

Table 6 presents the percentages of students going on to postsecondary education by institution type, sociodemographic characteristics, and self-reported participation in any career-related activities and CTE programs. By 2001, almost 55% of those sample members born in 1980 had enrolled in some kind of college—that number being almost equally split between 2- and 4-year institutions. CTE participants were significantly more likely to attend a 2-year college than nonparticipants. Overall, the rest of the findings reflect differing patterns for 2-year and 4-year college enrollment. For most student groups, there is a positive relationship between CTE participation and enrolling in 2-year institutions, but a negative relationship between CTE participation and enrolling in 4-year institutions. It appears that CTE participation was significantly related to any college enrollment for Hispanic participants (versus nonparticipants). The same is true for students in the second income quartile, who were significantly more likely to attend college—especially a 2-year college—if they were involved in some career-related or CTE programs in high school. However, these associations are not adjusted for background characteristics and other selection factors. To account for these differences, we turn to the regression models.

Table 6.
Means for Participation in Career-Related Activities/Programs, Demographic Characteristics, and College Enrollment (by 2001, Student-Reported; N *= 1,691)*

	Any college	2-year college	4-year college		Any college	2-year college	4-year college
Total sample	54.8	27.8	27.00				
Non-CTE participants Total	59.33	25.86	33.51	CTE participants	62.21	31.36*	30.85
Race/Ethnicity				Race/Ethnicity			
White	64.9	25.5	39.4	White	64.4	29.9	34.5
Black	42.7	24.8	17.9	Black	52.0	30.1	21.8
Hispanic	48.8	30.8	18.1	Hispanic	56.5*	38.4	18.1
Gender				Gender			
Female	64.0	25.2	38.8	Female	69.5	34.8	34.8
Male	55.2	26.5	28.7	Male	55.1	28.0	27.0
HiSES	82.0	25.1	56.9	HiSES	83.3	33.8	49.5
3SES	65.1	27.4	37.7	3SES	63.8	31.7	32.1
2SES	43.3	27	16.3	2SES	54.6*	35.1*	19.5
LoSES	36.2	24.5	11.7	LoSES	31.8	20.7	11.1
HiTest	85.7	24.5	61.2	HiTest	84.5	26.2	58.3
3 Test	70.5	28.8	41.7	3 Test	72.6	33.5	39.1
2 Test	45.5	25.5	20.0	2 Test	49.9	31.8	18.1
LoTest	27.4	26.1	1.3	LoTest	31.5	26.4	5.2

* p <. 05, if the difference between participating in CTE and not participating in CTE is significant for the group.
Note: These estimates are derived from student self-reports of participation in career-related programs and activities, including career major, work-based learning activities, cooperative education, and tech-prep programs.

After Controlling for Differences in Students' Backgrounds, What was the Relationship Between Participation in Career-Related Programs and College Enrollment?

Table 7 shows logistic regression analyses predicting college enrollment with self-reported participation in some career-related programs (career major, tech-prep, work-based learning, or cooperative education). To account for simultaneous participation in multiple programs, we include interaction terms for all program combinations. Model 1 shows coefficients for the relationship between CTE participation and college attendance, holding constant race, gender, family income, parental education, and school type.[33] Model 2 adds high school grades and

[33]All of these models have been run with SAS MIANALYZE to account for missing data. Because MI procedures can only run when there is missing data, our most basic analyses include family background variables.

engagement behaviors, and Model 3 adds ASVAB Arithmetic Reasoning test scores.[34] This allows us to see whether there is some selection into CTE that mediates its relationship to college attendance.[35]

Across Models 1–3, it appears that work-based learning and cooperative education programs are not significantly related to the odds of college attendance. In Model 1, career majors are positively related to college enrollment, but this effect becomes nonsignificant after controls for grades and school behaviors. However, tech-prep programs are associated with a reduction in students' chances of enrolling in college once background and school characteristics are accounted for. Students who reported participating in tech-prep had less than half the odds of enrolling in college, relative to students who were not involved in tech-prep.

Overall, this suggests to us that although CTE participation is not an exclusive function of social class background (an observation made from Tables 2–4) it is unlikely to influence college enrollment net of students' individual characteristics and demonstrated academic performance.[36] With the exception of tech-prep, these results are in line with the NAVE (U.S. Department of Education, 2004), which found that although higher proportions of the students participating in CTE might be attending college, it was not clear that CTE was driving those results.

[34]We also ran models using career-related programs to predict college enrollment without controls. The results are similar, in that most of the programs are not significantly related to college enrollment. However, before we add controls, any work-based learning is positively related to any college enrollment, and tech-prep programs are negatively related to any college enrollment. In the multinomial model before controls, career majors are positively related to 2-year enrollment versus none, and work-based learning is positively related to 4-year enrollment versus none. The models using transcript data on coursetaking ratios show results that are substantively the same.

[35]The choice to enroll in CTE is not random (and perhaps not always a choice). It is very likely that the student characteristics or circumstances of students that lead them to enroll in CTE courses also influence their likelihood of college enrollment. To adjust for such possible selection effects, we control for a number of *proxy* variables, or factors that affect both coursetaking and college enrollment. However, there may still be unobservable characteristics that underlie selection into CTE courses and are correlated with college enrollment. To account for this possibility, we ran Durbin–Wu–Hausman tests for endogeneity. In this procedure, we first estimated several ordinary least squares regression models where the dependent variable is either the number of CTE credits (continuous), the ratio of the number of CTE-to-Academic courses, or the number of CTE programs a student has participated in. The dependent variables are all covariates used in our models predicting enrollment. We then used the residuals from each the previous equations, and added them in separate models to our full model predicting college enrollment. The parameter estimate for the residuals was not significant, and the relationship between CTE programs or courses and college enrollment was unaltered. \We take this as evidence that unobserved heterogeneity is not a severe threat to our findings.

[36]It is likely that teachers in academic programs differ with respect to their performance criteria and grading procedures from vocational teachers. Therefore, grades might reflect those program differences and be endogenous to the CTE program variables. However, we also estimated models using self-reported eighth grade grades instead of high school grades, and found the results to be almost identical to the high school grades.

Table 7.
Logistic Regression Models Predicting First Postsecondary College Enrollment With Participation in Career-Related Activities and Programs (Odds Ratios; Student-Reported; N = *1,691)*

Predictors	Any college^ Model 1 Gender, race, family background	Model 2 Plus grades & school behavior	Model 3 Plus test scores
CTE programs			
Work-based learning	1.301	1.165	1.209
Career major	1.559*	1.326	1.265
Cooperative education	1.084	1.200	1.303
Tech-prep	0.546	0.477*	0.474*
Career major/Tech-prep	0.889	1.198	1.230
Career major/Cooperative education	1.057	0.966	0.963
Career major/Work-based learning	0.663	0.729	0.771
Tech-prep/Cooperative education	1.685	2.054	1.943
Cooperative education/Work-based learning	0.768	0.723	0.643
Tech-prep/Work-based learning	2.004	1.885	1.906
Demographics			
Black	0.915	1.247	1.883**
Hispanic	1.095	1.302	1.458
Asian	2.096	2.522*	2.079
Female	2.010**	1.351*	1.584***
Household income (log)	1.153***	1.155***	1.124**
Parental education	1.267***	1.259***	1.213***
Age at Round 1	0.974*	0.983	0.982
Lives w/biological mother only	0.432***	0.538***	0.551***
Lives w/biological father only	0.356***	0.371**	0.341**
Lives w/one biological parent & one stepparent	0.509***	0.557**	0.556**
Lives in other arrangement	0.371***	0.482**	0.534**
Urban	1.106	1.290	1.261
General schooling experiences			
Catholic school	1.537	1.480	1.623
Private school	3.165**	2.396	2.550
HS grades: mostly below Ds or Ds		1.023	1.175
HS grades: half Bs/Cs		1.707**	1.667**
HS grades: mostly Bs, or half Bs/As		3.347***	2.625***
HS grades: mostly As		6.666***	3.885***
HS grades: other		1.149	1.013
Absent 0 days		1.125	1.134
Absent 6 to 13 days		0.824	0.820

Absent 2 weeks	0.552**	0.571*
Ever suspended	0.357***	0.386***
ASVAB Arithmetic Reasoning (/100)		1.075***

*$p < .05$, **$p < .01$, ***$p < .001$; ^ Reference group is No College.
Note: Missing data has been accounted for with multiple imputation; therefore, only estimates are shown for models with enough variation between imputations to recover estimates.
Note: These estimates are derived from student self-reports of participation in career-related programs and activities, including career major, work-based learning activities, cooperative education, and tech-prep programs.

Additional results in Table 7 replicate previous research in the sociology of education. For example, females are more likely to attend college than males, and Black students appear more likely to attend college once test scores are accounted for. Family structure, parental income, and education level strongly affect college attendance, as do grades and school engagement behaviors such as absences and those that lead to suspension (Hearn, 1984). Test scores are also a significant predictor of whether a student will ever attend college.

Were Students in Career-Related Programs More Likely to Attend 2-Year Versus 4-Year Colleges?

We expected that the effects of career-related programs of study might differ when examining attendance at 2- versus 4-year schools. Many CTE participants may find that their high school career preparation puts them in a good position to obtain a postsecondary vocational certificate at a 2-year institution—for example, through a tech-prep partnership with a local community college. Therefore, we expected to find that some CTE participation increases the odds of attendance at 2-year schools, while other activities might increase enrollment at traditional 4-year schools. Table 8 shows multinomial logistic regression results comparing the effects of self-reported career-related activities and programs on 2-year and 4-year college attendance versus no college attendance.

In Model 1, which adjusts for family and sociodemographic characteristics, it appears that career majors are associated with increased odds of attending a 2-year college versus no college. However, once we adjust for high school grades, school behaviors, and test scores (Models 2 and 3), we essentially see the same results for the logistic regression, which show that CTE programs have no significant effect on college enrollment of any kind. The negative effect of tech-prep on any college enrollment does not appear to differ by type of postsecondary institution.

The results for socioeconomic characteristics are largely the same in Table 8 as Table 7, with a few exceptions. The negative effects of family arrangements other than two-parent households are replicated here, but these effects are larger for decreasing the odds of 4-year college attendance versus none, relative to 2-year college attendance versus none. Grades, absences, suspensions, and test scores appear to matter slightly more for determining 4-year college attendance than 2-year college attendance.

Table 8.
Multinomial Logistic Regression Models Predicting First Postsecondary College Enrollment With Participation in Career-Related Activities and Programs (Odds Ratios; Student-Reported; N = *1,691)*

	Model 1 Gender, race, family background		Model 2 Plus grades & school behavior		Model 3 Plus test scores	
Predictors	2- year college	4- year college	2-year college	4-year college	2- year college	4- year college
CTE programs						
Work-based learning	1.226	1.369	1.181	1.097	1.206	1.182
Career major	1.689*	1.443	1.514	1.077	1.438	0.989
Cooperative education	1.275	0.840	1.313	1.028	1.363	1.230
Tech-prep	0.563	0.562	0.498	0.495	0.487	0.529
Career major/Tech-prep	1.011	0.712	1.239	1.019	1.266	1.012
Career major/ Cooperative education	1.014	1.027	0.931	0.989	0.955	0.977
Career major/Work-based learning	0.753	0.579	0.760	0.703	0.793	0.777
Tech-prep/Cooperative education	1.530	1.964	1.898	2.268	1.808	2.030
Cooperative education/ Work-based learning	0.733	0.894	0.722	0.746	0.656	0.640
Tech-prep/Work-based learning	1.970	1.874	1.852	1.917	1.889	1.881
Demographics						
Black	0.904	0.953	0.438	1.791*	1.499	3.297***
Hispanic	1.296	0.761	1.402	1.045	1.519	1.224
Asian	1.694	2.529*	2.201	3.206*	1.898	2.489
Female	1.797***	2.293***	1.425*	1.224	1.579**	1.614**
Household income (log)	1.133**	1.183***	1.138**	1.192**	1.120**	1.140*
Parental education	1.161***	1.420***	1.182***	1.418***	1.151**	1.354
Age at Round 1	0.976	0.974	0.981	0.988	0.981	0.986
Lives w/biological mother only	0.658**	0.240***	0.693*	0.326***	0.695*	0.323***
Lives w/biological father only	0.364**	0.343**	0.385*	0.392*	0.358*	0.340*
Lives w/one biological parent & one stepparent	0.644*	0.403***	0.636*	0.450**	0.625*	0.452**
Lives in other arrangement	0.488***	0.265***	0.549**	0.374***	0.586*	0.426**
Urban	0.876	1.034	1.322	1.171	1.289	1.151
General schooling experiences						
Catholic school	0.274	2.620*	0.302	3.662*	0.319	4.586*
Private school	2.085	4.518	1.881	3.190*	2.014	3.476*
HS grades: mostly below Ds or Ds			1.069	0.000	1.177	0.000

HS grades: half B/Cs	1.351	4.208***	1.337	4.246***
HS grades: mostly Bs, or half Bs/As	1.852*	14.154***	1.605*	10.155***
HS grades: mostly As	1.839	40.977***	1.326	18.746***
HS grades: other	0.750	4.297**	0.696	3.781*
Absent 0 days	0.995	1.358	0.997	1.401
Absent 6 to 13 days	0.884	0.736	0.877	0.729
Absent 2 weeks	0.598*	0.441*	0.618*	0.416*
Ever Suspended	0.413***	0.271***	0.433**	0.312***
ASVAB Arithmetic Reasoning(/100)			1.054**	1.122***

* $p < .05$, ** $p < .01$, *** $p < .001$; ^ Reference group is No College.

Note: Missing data has been accounted for with multiple imputation; therefore, only estimates are shown for models with enough variation between imputations to recover estimates.

Note: These estimates are derived from student self-reports of participation in career-related programs and activities, including career major, work-based learning activities, cooperative education, and tech-prep programs.

Given our previous descriptive results in Tables 3–4, it seemed as if the student participation in career-related programs of study and work activities was a somewhat different phenomenon from credits earned in CTE coursework alone. Although students from all backgrounds seemed to report that they participated in career-related programs, we noted that less-advantaged students were more likely to take higher proportions of CTE courses than academic courses. To compare the effects of self-reported CTE program participation with transcript reports of CTE courses, we ran the same logistic and multinomial logistic regression models as Tables 7 and 8, but used the transcript data sample to capture the effect of credits earned in CTE on type of college attended.[37]

[37] In separate analyses, we also ran these models comparing the effects of being a CTE or dual concentrator on college enrollment, relative to an academic concentrator. Both dual concentrators and CTE concentrators are significantly less likely to attend college, relative to students who completed an academic curriculum. When comparing dual, CTE, and academic concentrators to students who had neither an academic nor CTE concentration, only the academic concentrators are significantly more likely to attend college.

Table 9.
Logistic Regression Models Predicting First Postsecondary College Enrollment With CTE Coursetaking (Odds Ratios; n *= 873)^*

Predictors	Any college		
	Model 1 Gender, race, family background	Model 2 Plus grades & school behavior	Model 3 Plus test scores
CTE-to-Academic course ratios			
> 0, < 0.2 CTE credits[a]	0.416*	0.409*	0.427*
0.2–0.5 CTE-to-academic ratio	0.620*	0.713	0.783
0.6–3.0 CTE-to-academic ratio	0.159***	0.201***	0.246***
Incomplete transcript	0.187***	0.256***	0.291***
Demographics			
Black	1.117	1.266	1.742*
Hispanic	0.951	1.093	1.126
Female	1.770***	1.435	1.749**
Household income (log)	1.220***	1.240***	1.229***
Parental education	1.148***	1.271***	1.112**
Age at Round 1	0.972	0.979	0.975
Lives w/biological mother only	0.569*	0.636*	0.621
Lives w/biological father only	0.435	0.449	0.498
Lives w/one biol. parent & one stepparent	0.565*	0.612	0.557*
Lives in other arrangement	0.585	0.626	0.656
Urban	0.878	0.993	1.043
General schooling experiences			
Catholic school	0.593	0.483	0.572
Private school	5.114*	3.781	3.353
HS grades: mostly below Ds, or Ds		0.494	0.467
HS grades: half Bs/Cs		1.592	1.640
HS grades: mostly Bs, or half Bs/As		1.972**	1.616
HS grades: mostly As		4.071***	2.678*
HS grades: other		1.711	1.499
Absent 0 days		0.992	0.966
Absent 6 to 13 days		0.654	0.620*
Absent 2 weeks		0.594	0.559
Ever suspended		0.492***	0.515**
ASVAB Arithmetic Reasoning(/100)			1.072***

*$p < .05$, **$p < .01$, ***$p < .001$; ^ Reference group is No College.

Note: Missing data has been accounted for with multiple imputation; therefore, only estimates are shown for models with enough variation between imputations to recover estimates.

Note: These estimates are derived from the transcript component of the NLSY97.

To assess the effects of coursetaking, we break the CTE-to-academic ratio into dummy variables, to test for nonlinear effects, with the most common category (a ratio of 0.2 , or one-to-five, CTE-to-academic courses, or less) as the reference group.[38] The results differ from the previous two tables. Table 9 shows that, overall, high ratios of CTE-to-academic courses are related to reduced chances for attending college (Models 1–3). For those students who took more than half of their courses in CTE, the odds of college attendance are almost 80% lower than the odds of college attendance for students taking smaller proportions of CTE courses. These effects hold even after adjusting for individual, family, and school background variables, including test scores (Model 3).

Taking no credits of CTE (relative to a ratio of 0.1–0.2, the reference group) is also negatively associated with college attendance, though not after controls for school performance. These results suggest a nonlinear effect, whereby *some* mix of CTE and academic coursetaking is less detrimental to college enrollment than taking *no* CTE courses or *mostly* CTE courses. This is largely because those students who take no CTE credits are likely to take very few credits in general. The effects of family characteristics and school performance on the college enrollment of this transcript sample look similar to those for the fuller 1980 sample. However, the family structure variables and high school grades are less-often significant predictors of college enrollment for the transcript sample. These estimates reflect the differences between the full 1980-cohort sample and the transcript sample (Appendix 2).

Table 10 shows results for models using CTE-to-academic course ratios to predict the type of first postsecondary institution. The results are consistent with those presented in Table 9—the higher the CTE-to-academic course load students took, the less likely they were to enroll in college. However, this is much more pronounced for enrollment in a 4-year school versus no college, as compared to enrollment in a 2-year college versus none. For students taking 0.2–0.5 CTE courses per academic course, there are no significant effects on enrollment in 2-year schools once we control for test scores; but the odds of enrolling in 4-year schools are about half those of students taking a few CTE courses (the reference group is a CTE-to-academic ratio of 0.1–0.2). These effects remain largely the same when we add controls for family background and indicators of academic performance or test scores.

[38]In other analyses, we used several different specifications to capture the effect of CTE coursetaking on college enrollment: one model included a continuous measure of CTE-to-academic courses (and a control for the squared term); another used a continuous measure of CTE courses, adjusting for academic credits, to assess the effect of CTE courses beyond academic requirements; a third model used a continuous measure of coursework in SLMP areas (e.g., business and marketing, technology), adjusted for academic credits. Since we know that many students dabble across multiple career and technical areas, we ran these analyses as a way to capture more serious investment in vocational training. Additionally, many students take computer courses under the umbrella of CTE, and we wanted to adjust our estimates for those kinds of courses. All of these models produced results that are consistent with the ones we present here—primarily that there is a negative relationship between high levels of CTE coursetaking and college enrollment.

Table 10.
Logistic Regression Models Predicting First Postsecondary College Enrollment With CTE Coursetaking (Odds Ratios; N = *1,691)*^

	Model 1 Gender, race, family background		Model 2 Plus grades & school behavior		Model 3 Plus test scores	
Predictors	2-year college	4-year college	2-year college	4-year college	2-year college	4-year college
CTE programs						
> 0, < 0.2 CTE credits[a]	0.313*	0.582	0.320*	0.523*ns*	0.312*	0.481
0.2–0.5 CTE-to-academic ratio	0.900	0.398**	0.927	0.481**	1.022	0.550*
0.6–3.0 CTE-to- academic ratio	0.434**	0.084***	0.273***	0.121***	0.329***	0.162***
Incomplete transcript	0.259***	0.102***	0.320***	0.149***	0.340***	0.172***
Demographics						
Black	1.061	1.281	1.044	1.980*	1.328	3.152***
Hispanic	1.088	0.705	1.145	0.879	1.181	0.948
Female	1.728**	1.829**	1.665*	1.107	1.935**	1.491
Household income (log)	1.267***	1.164*	1.274***	1.188*	1.276***	1.182*
Parental education	1.051	1.317***	1.070	1.323***	1.045	1.269***
Age at Round 1	0.979	1.041	0.984	0.970	0.978	0.964
Lives w/biological mother only	0.795	0.358***	0.778	0.436**	0.763	0.418**
Lives w/biological father only	0.382	0.489	0.450	0.414	0.494	0.459
Lives w/one biological parent & one stepparent	0.702	0.432*	0.708	0.502	0.651	0.436*
Lives in other arrangement	0.735	0.433*	0.728	0.460	0.764	0.483
Urban	0.944	0.792	1.039	0.884	1.106	0.928
General schooling experiences						
Catholic school	0.000	0.822	0.000	0.804	0.000	1.093
Private school	3.165	7.561*	2.333	5.172	2.257	4.899
HS grades: mostly below Ds, or Ds			0.520***	0.000	0.493	0.000
HS grades: half Bs/Cs			1.323	3.168**	1.385	3.680**
HS grades: mostly Bs, or half Bs/As			1.059	7.846***	0.934	6.495***
HS grades: mostly As			1.028	1.156***	0.823	13.971***
HS grades: other			1.203	5.680	1.019	5.033
Absent 0 days			0.871	1.198	0.833	1.150
Absent 6 to 13 days			0.637	0.712	0.609*	0.656
Absent 2 weeks			0.588	0.652	0.586	0.543
Ever suspended			0.525**	0.409**	0.548**	0.453**
ASVAB Arithmetic Reasoning (/100)					1.059***	1.113***

**p* < .05, ***p* < .01, ****p* < .0001; ^Reference group is No College.
Note: Missing data has been accounted for with multiple imputation; therefore, only estimates are shown for models with enough variation between imputations to recover estimates.

Note: These estimates are derived from the transcript component of the NLSY97.

Across Models 1–3, there is some evidence that academic performance and test scores mediate some of the negative effects of high CTE-to-academic ratios on 4-year-college enrollment—revealing the tendency of lower-performing students to be in CTE courses.

Students with the highest CTE-to-academic ratios (more than one CTE course per academic class), have the lowest odds for any kind of college enrollment. All things being equal, students taking more than half of their courses in CTE have 67% lower odds of attending 2-year schools and 83% lower odds of attending 4-year colleges than peers who had taken more academic courses (Table 10, Model 3).

Discussion

Despite ample research on tracking and more limited work on vocational education, few studies have explicitly examined payoffs for students who pursue *both* academic and CTE coursework. Further, we know less about CTE education since the wave of reforms carried out in the 1990s. The current paper examines the ways in which vocational education has been treated in past research, recent developments in CTE programs and courses, and corresponding participation rates across socioeconomic groups. We also test associations between CTE participation and first college attendance.

First, we see that the majority of American high school students participated in some CTE programs and work-related activities, and even more took at least one CTE education course. This finding holds true across all racial and ethnic groups, as well as socioeconomic backgrounds and levels of academic performance. This underscores the importance of examining the effects of CTE on education and work outcomes, since the programs serve most students. Second, we see that there are some differences in participation rates for self-reported career-related activities and work-based programs. Black students participated at higher rates than any other group, while males and females participated at similar rates. Students in the top three income quartiles participated at higher levels than the lowest quartile.

A third result is that when students participated in CTE programs, they were most likely to participate in some kind of work-based learning experience, relative to career majors or tech-prep programs. We also see demographic differences across these kinds of programs. This indicates that many high school students may have had exposure to some career-awareness-enhancing experience in high school, even if they were not participating in advanced CTE courses.

Our fourth finding is that, despite high levels of participation in career-related programs of study across sociodemographic groupings, including high-income and academically strong students, the opposite trend held true when we examine transcript-based coursetaking patterns. We see that economically disadvantaged and low-performing students took proportionately more CTE courses than academic ones, relative to their more-advantaged counterparts. This finding is interesting, since it tells us that career preparation activities and actual CTE courses do not necessarily serve the same groups of students, and may have very different effects on their academic outcomes. This also indicates that one of the more general effects of the Perkins and STWOA policies has been to increase career program awareness and exposure, while not necessarily changing the curricular trajectories students take (Hughes, Bailey, & Mechur, 2001; U.S. Department of Education, 2004). Surprisingly, however, we find that White students are more likely to take the highest ratios of CTE-to-academic courses, when compared to Black and Hispanic youths.

In terms of the transition to college, we find mixed results. On the one hand, while there was no significant effect of career majors, cooperative education, or work-based learning program participation on first college enrollment, tech-prep programs seem to be associated with lower chances of college enrollment. It appears that career-related activities and some CTE program participation do not *impede* college attendance—a finding that differs from expectations derived from classic research in educational stratification. This is in line with some more recent research (U.S. Department of Education, 2004), but still seems counterintuitive for tech-prep programs, which are supposed to link students to 2-year schools and ease the transition to postsecondary CTE training (see Bragg et al., 1997, for a more detailed discussion of tech-prep programs).

On the other hand, we find that higher proportions of CTE *courses* relative to academic courses yield *negative* effects on college attendance, even after adjusting for many of the selection characteristics often associated with course trajectories. In particular, once students take more than half their courses in CTE, their odds of college enrollment are significantly reduced. It appears that there still exists some kind of curriculum tracking effect for students taking high levels of CTE education courses, in terms of postsecondary enrollment. However, when we look at the self-reported rates of participation in most career preparation and work-based learning programs, we do not see the same evidence of lower levels of college attendance.

Conclusion

Despite the recent reauthorization of the Perkins legislation, the mass appeal and political salience of CTE have been waning—replaced by the "college for all" philosophy (Rosenbaum, 2001; Boesel, 2001; Lerman, 2002). Therefore, our finding that high levels of CTE-to-academic course ratios are associated with a reduction in students' chances of college enrollment leads us to consider whether CTE students have the opportunity to attend college immediately after high school, despite the intention of recent legislation to promote the college enrollment of CTE students. While students are neither helped nor harmed by some career-related programs, such as work-based learning, there does appear to be a stratification effect on the postsecondary transitions of those students taking the most CTE courses. Whether this is a process of excluding low-performing students from rigorous courses, or a function of students' preferences for college attendance, we cannot say with the present data. For example, it is possible that some of the students who participated most intensely in CTE courses did not intend to go to college, and therefore we should not expect to find such effects on college enrollment. It is also possible that many of the students who participated in CTE eventually enrolled in college, and we cannot see such transitions less than 5 years after high school completion (this notion is supported by the high levels of expected college completion reported by the sample youths).

However, because these outcomes are not long-term enough, we caution against concluding that it is a good or a bad thing for students to take many CTE courses, or for CTE students to go directly to college. Unfortunately, we can only examine the first part of the process with our current data (college enrollment), since our cohorts of high school students range in age from 18 to 23 at the last available data point. As the NLSY97 data collection continues, we will be able to assess the effect of CTE on college completion rates and labor market experiences. It is important to keep in mind that, although we found largely negative effects of CTE courses on college attendance, many students who receive vocational training go directly into the labor market after high school to begin a career. There is evidence that the wages of students with vocational training are higher when they go directly into the labor market after high school compared to no vocational training (Stern, Finkelstein, Urquiola, & Cagampang, 1997; Bishop & Mane, 1999, 2004; Light, 2002). In addition, it is important to remember that many students do not finish college even if they enroll, and perhaps the costs of some college programs outweigh their benefits, relative to vocational training (Kerckhoff & Bell, 1998; Rosenbaum, 2001; Bishop & Mane, 2004).

To more specifically address whether CTE affects college enrollment, future research should consider the effects of CTE programs and courses on longer-term educational and economic outcomes—particularly for those students who may not transition to quality employment after high school. Research should also examine the ways in which specific school characteristics, such as the level of administrative involvement in career preparation and the percentage of college-bound students in the school, interact to make CTE more or less beneficial to the students participating in such programs. It is possible that the effects of CTE courses differ depending on the context in which students take these courses.

REFERENCES

Advisory Committee for the National Assessment of Vocational Education. (2003). *Report of the Advisory Committee for the National Assessment of Vocational Education*. Washington, DC: U.S. Department of Education Office of the Under Secretary.

Alexander, K. L., Cook, M., & McDill, E. L.(1978). Curriculum tracking and educational stratification: Some further evidence. *American Sociological Review, 43,* 47–66.

Allison, P. D. (1995). *Survival analysis using the SAS system: A practical guide.* Cary, NC: SAS Institute.

Altonji, J. (1995). The effects of high school curriculum on education and labor market outcomes. *Journal of Human Resources, 30,* 40–438.

Arum, R., & Shavit, Y. (1995). Secondary vocational education and the transition from school to work. *Sociology of Education, 86* (July), 187–204.

Benson, C. S. (1997). The new vocationalism in the United States: Potential problems and outlook. *Economics of Education Review, 16,* 202–212.

Bills, D. (2004). *The sociology of education and work*. Oxford, England: Blackwell.

Bishop, J. (1989). Occupational training in high school: When does it pay off? *Economics of Education Review, 8,* 1–15.

Bishop, J., & Mane, F. (1999). Impacts of minimum competency exam graduation requirements on learning, high school graduation, college attendance and early labor market success. *Labor Economics, 8,* 203–222.

Bishop, J., & Mane, F. (2004). The impacts of career-technical education on high school labor market success. *Economics of Education Review, 23,* 381–402.

Boesel, D. (2001, April). *Student attitudes toward high school and educational expectations.* Paper prepared for the annual meeting of the American Educational Research Association, Seattle, WA.

Boesel, D., & McFarland, L. (1994). *National assessment of vocational education final report to Congress: Vol. 1: Summary and recommendations*. Washington, DC, U.S. Department of Education.

Bragg, D. (2001). *Promising outcomes for tech prep participants in eight local consortia: A summary of initial results*. St. Paul: National Research Center for Career and Technical Education, University of Minnesota.

Bragg, D., Puckett, P. A., Reger, W., IV, Thomas, H. S., Ortman, J., & Dornsife, C. J. (1997). *Tech prep/school-to-work partnerships: More trends and challenges*. (MDS-1078). National Center for Research in Vocational Education, University of California at Berkeley.

The Carl D. Perkins Vocational and Applied Technology Education Amendments of 1990.

The Carl D. Perkins Vocational and Applied Technology Education Amendments of 1998.

Castellano, M., Stringfield, S., & Stone, J. R., III. (2003). Secondary career and technical education and comprehensive school reform: Implications for research and practice. *Review of Educational Research, 73*, 231–272.

Deil-Amen, R., Rosenbaum, J. E., & Person, A. E. (2005). *Universal higher education and social capital: Student difficulties and institutional procedures*. New York: Sage.

Finn, J. D. (1989). Withdrawing from school. *Review of Educational Research, 59*, 117–142.

Gamoran, A. (1987). The stratification of high school learning opportunities. *Sociology of Education*, *60*, 135–155.

Gamoran, A., & Mare, R. D. (1989). Secondary school tracking and education inequality: Compensation, reinforcement, or neutrality? *American Journal of Sociology, 94*(5), 1146–1183.

High school reform, Round 1 (2005, February 23). *The New York Times.* Op-Ed, p. A18.

Hoachlander, G. (2005). Does vocational education have a role to play in high school reform? *Education Week*, *24*(33), 38, 48.

Hotchkiss, L., & Dorsten, L. E. (1987). Curriculum effects on early post-high school outcomes. In R. Corwin (Ed.), *Research in the sociology of education and socialization* (vol. 7, pp. 191–219). Greenwich, CT: JAI Press.

Hughes, K. L., Bailey, T. R., & Mechur, M. J. (2001). *School-to-work: Making a difference in education: A research report to America.* New York: Columbia University Teachers College, Institute on Education and the Economy.

Kemple, J. J. (2001). *Career academies: Impacts on students' initial transitions to postsecondary education and employment.* New York: MDRC (Manpower Demonstration Research Corporation).

Kerckhoff, A., & Bell, L. (1998). Hidden capital: Vocational credentials and attainment in the United States. *Sociology of Education, 71*(April), 152–174.

Lee, V., & Burkham, D.(2003). Dropping out of high school: The role of school organization and structure. *American Educational Research Journal, 40*, 353–393.

Lerman, R. L. (2002, November). Promoting quality careers with intensive school-to-work activities. Paper prepared for the annual meeting of the Association for Public Policy and Management. Dallas, TX.

Light, A. (2002). High school employment, high school curriculum, and post-school wages. *Economics of Education Review, 18*, 291–309.

Little, R. J. A., & Rubin, D. B. (1987). *Statistical analysis with missing data*. New York: Wiley.

Lucas, S. (1999). *Tracking inequality*. New York: Teachers College Press.

Lucas, S. (2001). Race, class, and tournament track mobility. *Sociology of Education, 74*, 139–156.

Lynch, R. L. (2000). High school career and technical education for the first decade of the 21st century. *Journal of Vocational Education Research, 26*, 412–446.

MacAllum, K., Yoder, K., Kim, S., & Bozick, R. (2002). *Moving forward: College and career transitions of LAMP graduates*. Washington, DC: National Institute for Work and Learning, Academy for Educational Development.

Mane, F. (1999). Trends in the payoff to academic and occupation-specific skills: The short and medium run returns to academic and vocational high school courses for non-college-bound students. *Economics of Education Review, 18*, 417–437.

Maxwell, N. (2001). Step to college: Moving from the high school career academy through the four-year university. *Evaluation Review, 25*, 619–654.

Maxwell, N., & Rubin, V. (2002). High school career academies and postsecondary outcomes. *Economics of Education Review, 21*, 137–152.

Mortimer, J. T., and Kruger, H. (2000). Pathways from school to work in Germany and the United States. In M. Hallinan (Ed.), *Handbook of the Sociology of Education* (pp. 475–497). New York: Kluwer Academic/Plenum.

National Center for Education Statistics (1995). *Vocational education in the United States: The early 1990s*. (NCES 95-024). Washington, DC: U.S. Department of Education, Office of Educational Research and Improvement.

National Center for Education Statistics (2000). *Vocational education in the United States: Toward the year 2000*. (NCES 2000-029). Washington, DC: U.S. Department of Education, Institute of Education Sciences.

National Center for Education Statistics (2003). *Trends in high school vocational/technical coursetaking: 1982–1998 Statistical Analysis Report.* (NCES 2003-025). Washington, DC: U.S. Department of Education, Institute of Education Sciences.

National Center for Education Statistics (2004). *The high school transcript study: A decade of change in curricula and achievement, 1990–2000* (NCES 2004-455). Washington, DC: U.S. Department of Education, Institute of Education Sciences.

National Longitudinal Study of Youth 1997.

No Child Left Behind Act of 2001.

Oakes, J. (1985). *Keeping track.* New Haven, CT: Yale University Press.

Orr, M. T., Hughes, K., & Karp, M. (2002, April). *A quality transition: Career academy seniors' improved preparedness and alumni's career and educational success.* Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.

Plank, S. B. (2001). A question of balance: CTE, academic courses, high school persistence, and student achievement, *Journal of Vocational Education Research, 26*(3), 279–327.

Plank, S. B., DeLuca, S., & Estacion, A. (2005). *Dropping out of high school and the place of career and technical education: A survival analysis of surviving high school.* Paper under review.

Rasinski, K. A., & Pedlow, S. (1998). The effect of high school vocational education on academic achievement gain and high school persistence: Evidence from NELS:88. In A. Gamoran (Ed.), *The quality of vocational education: Background papers for the 1994 National Assessment of Vocational Education (chap. 5).* Washington, DC: U.S. Department of Education, Office of Educational Research and Improvement.

Ravitch, D. (2001). *Left back: A century of battles over school reforms.* New York: Simon & Schuster.

Ravitch, D. (2005, March 15). Failing the wrong grades. *The New York Times*, p. A25.

Rosenbaum, J. E. (1976). *Making inequality: The hidden curriculum of high school tracking*. New York: Wiley.

Rosenbaum, J. E. (1980). The social implications of educational grouping. *Review of Research in Education, 8,* 361–401.

Rosenbaum, J. E. (2001). *Beyond college for all: Career paths for the forgotten half.* New York: Russell Sage Foundation.

Schafer, J. L. (1997). *Analysis of incomplete multivariate data.* London: Chapman and Hall.

Schneider, B., & Stevenson, D. (1999). *The ambitious generation.* New Haven, CT: Yale University Press.

Schneider, B., Swanson, C., & Riegle-Crumb, C. (1998). Opportunities for learning: Course sequences and positional advantages. *Social Psychology of Education, 2,* 25–53.

School-to-Work Opportunities Act (1994).

Stern, D., Finkelstein, N., Urquiola, M., & Cagampang, H. (1997). What difference does it make if school and work are connected? Evidence on cooperative education in the United States. *Economics of Education Review, 16,* 213–229.

Stern, D., Raby, M., & Dayton, C. (1992). *Career academies: Partnerships for reconstructing American high schools*. San Francisco: Jossey-Bass.

Stern, D., Stone, J. R., III, Hopkins, C., McMillion, M., & Crain, R. (1994). *School-based enterprise: Productive learning in American high schools*. San Francisco: Jossey-Bass.

Stevenson, D. L., Schiller, K. S., & Schneider, B. (1994). Sequences of opportunities for learning. *Sociology of Education, 67*, 184–198.

Stone, J. R., III, (2000). Editor's notes. *Journal of Vocational Education Research, 25,* 85–91.

U. S. Department of Education, Office of the Under Secretary, Policy and Program Studies Service (2004). *National assessment of vocational education: Final report to Congress.* Washington, DC: Author.

Vanfossen, B., Jones, J., & Spade, J. (1987). Curriculum tracking and status maintenance. *Sociology of Education*, *60*, 104–122.

APPENDIX 1.
USE AND PREPARATION OF NLSY97 HIGH SCHOOL TRANSCRIPT DATA

This appendix describes how we have treated the NLSY97 transcript data. We understand that these data have limitations; however, we have systematically cleaned, recoded, and compared these data with other national data (see Table 1). Ultimately, while we cannot conclude that the NLSY97 transcript sample is nationally representative, we believe that it is appropriate to use the NLSY97 transcript data in our analyses as a way to explore the association between CTE coursetaking and college enrollment.

Data and Coding

Based on communication with staff at the Center for Human Resources Research at The Ohio State University, NORC (National Opinion Research Center), and the U.S. Bureau of Labor Statistics, we understand that the transcript data are most representative of the 1980 cohort. Therefore, all of the data presented in our study refer to transcript data collected for the 1980 birth cohort of the NLSY97 sample. While the total sample number of youths born in 1980 is 1,691, transcript data are available for 873 individuals (or 52%).

Timing of Coursetaking

The transcript data provide information on every term for every school attended by a student. In addition to course titles and grades received for each course, we know the start and stop dates for each of these terms. The timing of these terms is important for some of our analyses. Therefore, it is important to describe our hand-coding procedures to deal with incomplete dates.

For some transcripts, the dates were incomplete; a *start* month or year, or *stop* month or year or some combination of months/years was incomplete. To complete the trajectory for a particular student with missing start and/or stop dates, we utilized available information for the academic schedule of that same school, information available about the type of term (i.e., fall, spring, summer), and information on a student's high school completion date. In some cases, we made general decision rules based on our knowledge of the start and stop months of a typical school system (e.g., the school year generally begins in September).

Credits

In addition to the timing and names of courses, we also know the credits earned for each course. We first standardized credits received for coursework across all transcripts. More specifically, we recoded each school's credit system to be comparable to a Carnegie unit system.[39]

[39]Generally, course credits are listed in multiples of .5, 1, or 5. The irregular credit systems appear to be concentrated in certain schools and in certain courses, such as special education and the arts, as well as cooperative education. Often, such courses brought more than one credit, or a single credit was split over several semesters.

In a handful of cases, we corrected obvious data entry errors (e.g., one course bringing 50 credits while every other course brought 0.5 or 1.0 credits indicates a missing decimal point). In other cases, we could tell that a course brought a passing grade with no credits. After careful hand-inspection, we identified these cases and assigned what we judged to be the appropriate number of credits (based on other information available on that same individual's transcript).

Data Generalizability

We examined whether the transcript subsample differed significantly from the larger 1980 sample (see Appendix 2). Overall, the transcript subsample resembles the whole 1980 cohort, with a few exceptions. The transcript sample appears to be slightly more advantaged socioeconomically and academically. For example, the transcript sample has fewer minority students, more educated parents, and a higher family income. These students are also more likely to be living with both parents.

In terms of academic achievement, the transcript sample is more likely have mostly As and less likely to have mostly Ds than the fuller 1980 sample.[40] They also score higher on the ASVAB Arithmetic Reasoning test, and are less likely to have been suspended. However, the two samples are very similar with respect to gender composition, age, household size, region of residence, and school type, as well as absences. They are also comparable in terms of career-related/CTE program participation, across all types of programs.

We also compared our results on some basic coursetaking patterns to those found in other nationally representative data sets, such as High School and Beyond, National Education Longitudinal Study, and the High School Transcript Study of 2000 (see Table 1). The NLSY97 1980 cohort represents students attending high school sometime between 1994 and 2000, depending on the year of graduation. Therefore, the data is mostly comparable to the later survey time-points shown for the High School Transcript Study. The NLSY97 sample seems to show a similar, but slightly lower, percentage of students ever taking a CTE course, while the numbers are very close for vocational credits, SLMP courses, GLMP courses, and FCSE courses. The NLSY97 1980 cohort sample shows about 22.4% vocational concentrators (students taking three or more courses in a single SLMP area), as compared to the NAVE survey, which shows 26% of American students as vocational concentrators.

We were also able to make a comparison of the CTE-to-academic coursetaking ratios from our NLSY97 transcript sample with those from the High School Transcript Study of 2000.[41]

[40]These comparisons were made based upon student self-reported grades, which are distinct from transcript-recorded grades.

[41]We thank an anonymous reviewer from the Office of Adult and Vocational Education for these additional calculations.

The HSTS:2000 numbers show:

CTE-to-academic ratio

< 0.2 = 42%

0.2–0.5 = 41%

> 0.5 = 16%

Average ratio = 0.30

Our numbers now show:

< 0.2 = 37%

0.2–0.5 = 40%

> 0.5 = 17%

Average ratio = 0.30

Data Limitations

Given the comparisons we have made with the full 1980 cohort and other national data sets, we feel confident that these data can begin to give us an understanding of the relationship between CTE and college enrollment. However, the data at present are somewhat limited, relative to the entire NLSY97 data set. First, we are missing transcripts for about half of the 1980 birth cohort, making a full-scale analysis of the experiences of that cohort problematic. Second, although we carefully inspected each student's transcript, which was supplemented by other available information about the student or school, it is possible that one could misinterpret a school's credit system or grading system. Third, although we have done comparisons between complete and incomplete transcripts, there are indeed some incomplete transcripts. While this is to be expected with student dropout rates and transfer, it still poses some problems for generalizability and a count of how many students were concentrating in CTE or New Basics.

APPENDIX 2.
UNWEIGHTED DESCRIPTIVE STATISTICS: NLSY97 YOUTHS BORN IN 1980 AND TRANSCRIPT SUBSAMPLE

Variable	1980 cohort (*N* = 1,691)	Transcript subsample (n = 873)[a]
Demographics		
Black	28.2%	23.7%
Hispanic	20.5%	18.6%
White	50.4%	56.8%
Asian	2.0%	2.0%
Other	1.2%	1.3%
Female	49.5%	50.4%
Household income	*M* = 50,105.18, *SD* = 54,703.94	*M* = 54,664, *SD* = 53269
Parental education	*M* = 12.46, *SD* = 2.81	*M* = 12.80, *SD* = 2.81
Household size	*M* = 4.48, *SD* = 1.57	*M* = 4.41, *SD* 1.45
Number of youths in household under age 18	*M* = 2.27, *SD* = 1.30	*M* = 2.2, *SD* = 1.07
Age at Round 1 (in continuous months)	*M* = 202.38, *SD* = 4.56	*M* = 202.37, *SD* = 4.23
Lives w/biological mother only	26.3%	22.0%
Lives w/biological father only	3.1%	2.9%
Lives w/one biological parent & one stepparent	10.1%	11.8%
Lives w/two biological parents	47.7%	52.8%
Lives in other arrangement	12.8%	10.5%
Urban	75.4%	72.3%
Rural	24.0%	27.5%
Other location	0.6%	0.2%
General schooling experiences		
Public school	89.2%	92.8%
Catholic school	2.4%	2.5%
Private school	2.4%	2.8%
Other type of school	0.6%	0.7%
High school grades		
Mostly below Ds or Ds	3.3%	2.3%
Half Cs/Ds, and mostly Cs	22.6%	18.7%
Half Bs/Cs	27.1%	27.1%
Mostly Bs, or half Bs and As	34.9%	37.8%
Mostly As	10.0%	12.3%
Other	2.1%	1.9%
Absent 0 days	16.5%	16.5%
Absent 1 to 5 days	53.7%	54.2%
Absent 6 to 13 days	19.6%	21.2%
Absent 2 weeks	10.20%	8.1%
Ever suspended	35.80%	30.6%
ASVAB Arithmetic Reasoning	*M* = -200.72, *SD* = 950.51	*M* = -23.9, *SD* = 907.8
CTE experiences (based on up to five rounds of available data)		
Ever participated in any of seven CTE programs	57.5%	58.2%
Ratio of years participating in CTE program to rounds of data available	*M* = 0.18, *SD* = .21	*M* = 0.18, *SD* = .18
Participation in career major	32.2%	30.5%

Participation in job shadowing	20.4%	22.1%
Participation in mentoring	9.0%	8.4%
Participation in cooperative education	15.6%	15.1%
Participation in school-sponsored enterprise	13.3%	13.6%
Participation in tech-prep	13.0%	12.4%
Participation in internship/apprenticeship	11.1%	10.2%
Curriculum concentration[b]		
Vocational concentrator	(see subsample in next column)	36.7%
Academic (New Basics) concentrator	(see subsample in next column)	11.3%
Dual concentrator	(see subsample in next column)	8.2%
Neither	(see subsample in next column)	43.8%
College outcomes		
Any college enrollment	54.80%	63.96%
2-year college enrollment	27.80%	30.48%
4-year college enrollment	27.00%	33.50%

[a]Note that this includes both complete and incomplete transcripts. See Table 6 for details.

[b]Note that these categories are mutually exclusive.

Gray shading indicates a significant difference ($p < .05$) between the full sample and the transcript sample.