Hard Work and Soft Skills

THE ATTITUDES, ABILITIES, AND CHARACTER OF STUDENTS IN CAREER AND TECHNICAL EDUCATION

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APRIL 2018

AMERICAN ENTERPRISE INSTITUTE

Executive Summary

Career and technical education (CTE) programs are diverse. But, historically, they have all carried a common stigma: They are *not* academic.

CTE has traditionally been seen as an alternative to academic programs. This *nonacademic* stigma brings on a stereotype, especially for high schoolers: Students in CTE programs are unmotivated, uninterested in learning, and unfocused. What truth is there in this stereotype? Are students who lack the noncognitive skills generally associated with academic success (e.g., motivation, persistence, self-control, and conscientiousness) more likely to take CTE courses?

We draw on data from the Educational Longitudinal Study of 2002, a US Department of Education survey that followed more than 15,000 American 10th graders for a decade, from 2002 through 2012. The data contain measures of noncognitive skills, such as student self-reports of self-efficacy in academics, teacher reports of student behavior, and observed levels of student conscientiousness and self-control (as measured by survey effort).

We examine two groups of CTE students: students in traditional comprehensive high schools who take CTE courses and students who enroll in stand-alone vocational-technical schools. Our analysis compares these groups of students to students who took few to no CTE courses in high school.

In traditional comprehensive high schools, students with lower test scores in math and reading are more likely to take large numbers of CTE courses. Yet once we control for test scores, CTE course takers are less likely to drop out of high school and on average have higher annual earnings by their mid-20s than students who take few or no CTE courses.

Students who attend vocational-technical schools also have test scores lower than the traditional high school student who takes few to zero CTE courses. Yet compared to these traditional high school students, students at vocational-technical schools are more likely to be employed full time by young adulthood and, hence, appear to have higher annual earnings. What can explain this difference in long-term outcomes?

We find that CTE course takers have other noncognitive skills that are higher than otherwise-similar students. Based on behavioral measures of noncognitive skills, we observe that CTE students exhibit more effort on routine tasks. According to teacher reports of student behavior, CTE students are just as attentive as their peers, just as likely to complete their homework, and much less likely to be absent from class.

In sum, CTE course takers have on average higher noncognitive skills, compared to otherwise-similar students. This conclusion belies the image of these students as unmotivated and unfocused, and it belies the stereotype that CTE programs recruit substandard students. To assess the true value of CTE programs, one should look beyond their participants' test scores.

Hard Work and Soft Skills

THE ATTITUDES, ABILITIES, AND CHARACTER OF STUDENTS IN CAREER AND TECHNICAL EDUCATION

Albert Cheng and Collin Hitt

Career and technical education (CTE) programs differ in substance and structure, but they have customarily carried a common stigma: They are *not* academic.

In the United States, CTE is a loose set of programs and policies. All aim to provide students with skills needed for a particular career. CTE can refer to specific programs such as vocational schools or career academies or more vague offerings such as technical education classes or shop class.

CTE programs have historically served as educational alternatives to more conventional high school programs that focus on academics. This *nonacademic* conception brings an old, durable stereotype: Students in CTE programs are unmotivated, uninterested in academics, and unfocused. What truth is there in this stereotype? We seek to explore this question regarding high school students.

Questions of motivation and focus get to a person's very character. So we ask: Do noncognitive skills predict whether students will pursue CTE offerings? That is, are students who lack the noncognitive skills generally associated with academic success (e.g., motivation, self-efficacy, conscientiousness, and grit) more likely to take CTE courses?

We use a national, longitudinal data set that allows us to look at students in two CTE settings:

- Students attending traditional, comprehensive high schools who take CTE courses; and
- Students attending full-time vocational-technical (voc-tech) high schools.

Do students who select these CTE tracks differ from their peers, in terms of academic achievement, attitudes, classroom behaviors, and other noncognitive skills? Do students in different CTE programs differ from each other?

In common conversation, students who attend vocational-technical schools and students in traditional public schools who predominantly take CTE courses may be thought of in the same way and be similarly stereotyped. However, our analysis shows these two CTE programs are quite different from each other and from their non-CTE peers, in both 10th-grade skills and later life outcomes.

In comprehensive high schools, students with lower test scores in math and reading are more likely to take large numbers of CTE courses. Yet once we control for test scores, CTE course takers are less likely to drop out of high school and on average have higher annual earnings by their mid-20s, as compared to students who take few or zero CTE courses.

Students who attend vocational-technical schools also have lower test scores than the traditional high school student who takes few to no CTE courses. Yet compared to these traditional high school students, students at vocational-technical schools are more likely to be employed full time by young adulthood and appear to have higher annual earnings.

These patterns are consistent with the recent findings of economists Daniel Kreisman and Kevin Stange.[1] Students with lower test scores take more CTE courses, yet taking more CTE courses is associated with higher earnings. Assuming that academic achievement is a key driver of long-run life success, this pattern of lower test scores appears inconsistent with the higher earnings experienced by CTE students.

Kreisman and Stange thus hypothesize that students who voluntarily enroll in CTE courses have *higher* unmeasured skills—presumably noncognitive skills—that lead to later life success. Our analysis will speak to this proposition. In other words, our paper examines a question that previous studies of CTE have almost entirely left out. Test scores aside, do the students who eventually pursue CTE offerings differ from their peers on measures of noncognitive skills?

Exactly what are noncognitive skills? Generally speaking, noncognitive skills are the skills that most standardized tests fail to measure. Such tests capture cognitive skills, by design. More specifically, noncognitive skills consist of character skills, emotional dispositions, and personality traits. Extensive research, including our own previous work, has demonstrated that high school students' noncognitive skills are important predictors of later life success.[2]

Noncognitive skills are difficult to measure, especially in schoolchildren; doing so requires a mix of self-reported surveys, third-party reports, and behavioral (or task-based) measures. That is one reason that policy research, including CTE research, relies heavily on tests that assess easier-to-measure skills such as literacy and numeracy.

Self-reports consist of students considering a series of statements such as "I take a positive attitude toward myself" and choosing an item from a scale indicating their degree of agreement. Third-party reports are when others, such as teachers or parents, fill out questionnaires about their students. Such data sources are well-known and frequently used. Behavioral measures based on observing a student completing a task are rarer.

In our previous work, we developed new behavioral measures of noncognitive skills. For instance, we look at the amount of effort that students show when taking surveys.[3] These effort-based measures, combined with those available in the Educational Longitudinal Study of 2002 (ELS:02) data set, allow us to conduct a novel study of CTE students.

We explore whether those who sort into CTE courses and vocational-technical schools are measurably different from their peers on several noncognitive skills, including self-efficacy, motivation, and attentiveness. Like practically all the literature on CTE course taking, our findings are descriptive. We examine differences between CTE students and their peers in 10th grade by asking: Do noncognitive skills predict enrollment in CTE courses or vocational-technical school?

As mentioned, student test scores are predictive of CTE course taking. In traditional high schools, the relationship is negative. Students with lower 10th-grade test scores in math and English are more likely to enroll in a higher number of CTE courses by the end of 12th grade.

Regarding noncognitive skills, CTE course takers have poorer attitudes about their math and English language arts (ELA) abilities. True perhaps to stereotype, 10th-grade students who express low opinions of their own self-efficacy, intrinsic motivation, study effort, or extrinsic motivation in these core academic subjects are more likely to eventually take large numbers of CTE courses.

However, on behavioral measures, CTE course takers score better than their peers even after accounting for demographic characteristics and test scores in math and reading. When it comes to teacher reports of student behavior and students' own behavioral measures of effort, students with higher levels of desirable noncognitive skills are more likely to enroll in CTE courses. In particular, students who according to their 10th-grade teachers were less likely to be "frequently absent" were more likely to take high numbers of CTE courses. Likewise, students who performed better in terms of effort on the survey—that is, they were less likely to skip questions or "just fill in the bubbles"—were more likely to enroll later in CTE courses. In short, students who select into CTE courses act more conscientiously than their peers, even if they express lower self-efficacy and motivation in ELA and math.

We also examine students who attend full-time voc-tech schools. On average, these students do not differ from students who attend traditional high schools in terms of their cognitive and noncognitive characteristics.

Our analysis adds to an extensive descriptive literature on CTE course takers in traditional public schools. Previous and contemporary research shows consistently that students with lower test scores are more likely to sort into CTE classes. Yet, controlling for test scores, CTE course takers fare better at least upon entry into young adulthood. They are more likely to complete high school, and, though they may not necessarily be more likely to complete four-year degrees, they are more likely to be employed full time and have higher employment earnings.[4] We observe these same patterns in our analysis.

Literature Review

Our study ties together two strands of research. The first is a growing literature on students who pursue CTE. The second is the newly popular field of noncognitive skills.

In the context of CTE research, we examine two groups of students: students in traditional comprehensive high schools who take CTE courses and students who enroll in stand-alone vocational-technical schools. These are separate groups of students, defined as follows:

- *CTE course takers*, as we shall call them, are students in traditional public schools who take a higher-than-average number of CTE-labeled courses. Our analysis and much of the previous literature we cite contrast these students with otherwise-similar (often same-school) peers who take few or no CTE courses.

- *Vocational-technical school students,* or voc-tech students, are students who attend stand-alone, full-time vocational-technical high schools. Such schools are schools of choice—some admit students by lottery, others based on test scores—which allows researchers to conduct rigorous program evaluations. The literature on vocational-technical schools makes stronger claims about cause and effect, so that any observed differences in outcomes for students who attend vocational-technical schools relative to students who do not can confidently be attributed to attending a vocational-technical school.

CTE Course Takers in Traditional High Schools. The previous literature on CTE course takers is largely descriptive. It explores questions about the academic credentials and later life outcomes of students who take large numbers of CTE courses. But there is little in the CTE literature that untangles cause and effect.

For example, previous studies, as well as our findings below, show that students who take relatively large CTE course loads have higher incomes later in life, controlling for test scores and educational attainment. In a recent paper that also employs ELS:02, Michael Gottfried and Jay Plasman from the University of California, Santa Barbara, find that high school students who took more CTE courses, especially toward the end of their secondary education, were more likely to graduate from high school on time, even after controlling for test scores.[5] Is this because CTE courses on balance help students or because students who opt into CTE courses have talents that would have led to later life success even if CTE courses had not been available? We do not yet know.

As mentioned earlier, the most recent study on this topic is a National Bureau of Economic Research working paper by economists Kreisman and Stange.[6] The authors use the National Longitudinal Survey of Youth of 1997 (NLSY:97), which followed a cohort of high-school-age students into adulthood. Participants in the NLSY:97 were born about four to eight years earlier than the cohort we examine in ELS:02. The authors find that students with lower test scores are significantly more likely to enroll in CTE courses in high school.

Once controlling for test scores, however, Kreisman and Stange show that CTE course taking predicts

higher earned income a decade after high school. Our findings, described below, are practically identical. Kreisman and Stange speculate that students who take a CTE course of study have *higher* unobserved skills that lead to success in adulthood—a proposition that we test.

However, in a novel approach, the authors then examine the effects of *involuntary* CTE coursework. Some states have created mandatory CTE course loads, thus increasing the CTE courses taken by students who otherwise preferred to take other courses. The authors find that these mandates increase CTE course taking, but they find no positive effect due to those increases. Forcing students into CTE does not appear to improve later outcomes. This raises questions about universal CTE mandates while also pointing to the important role that *choice* plays in CTE.

Kreisman and Stange do not examine the effect of voluntary course taking in the context of a traditional high school. We know of no convincing research that does so.

There is, however, a persuasive body of literature on career academies, which are a hybrid between a stand-alone vocational-technical school and a traditional high school that offers CTE courses. Career academies are often described as "schools within schools"—insular programs in traditional public schools. They have existed in many traditional public schools for decades. Career academies provide CTE concentrations in combination with career-focused student supports and immersive out-of-school apprenticeship and internship programs.

Career academies exist in thousands of traditional high schools. In our data set, many students who take heavy CTE course loads were likely enrolled in career academies, but we do not know for sure. There is no indicator in ELS:02 for career academy enrollment.

The leading research on career academies comes from MDRC, whose hallmark evaluation of career academies stretches back to the 1990s.[7] MDRC identified "high-fidelity" career academies that admitted students by lottery. Students who won the lottery were compared to students who lost, allowing researchers to use the gold-standard experimental research design. The groups were identical in terms of baseline characteristics, thanks to the random lottery. By the end of high school, career academy students had practically identical test scores and high school graduation rates. They attended college at the same rate of their peers. So, despite the supposed de-emphasis of academic content in career academies, career academy students fared no worse academically. Yet, by their mid-20s, career academy students had significantly higher earnings.

Later, in discussing our results on CTE course takers in traditional public schools, we will return to the literature on career academies. However, it is important to repeat that we do not know which high schools in our data housed career academies. This means we do not know which students in our sample enrolled in career academies and which students simply took heavy CTE course loads.

Our data set does, however, identify students who attended stand-alone vocational-technical schools. Whereas the literature on CTE course taking is largely descriptive, the research designs used to evaluate vocational schools allow much stronger causal claims about the impacts these educational programs have on student outcomes.

Vocational-Technical Schools. Many large urban districts have large stand-alone schools of choice that focus on vocational and technical training. States such as Massachusetts have full-time regional vocational schools. In these locales, voc-tech schools represent perhaps the largest and oldest experiment in public school choice. Chicago, for example, has had large, voc-tech high schools for generations. So has Philadelphia. A growing number of well-designed studies show that voc-tech schools improve educational attainment and labor-market outcomes, even while having essentially no impact on test scores.

Economist Julie Cullen and her colleagues examined the effect of attending vocational high schools in Chicago, using an instrumental variables research design.[8] They estimated that vocational-technical schools increased graduation rates by 15 percentage points or more. In Philadelphia, Ruth Curran Neild and colleagues conducted a gold-standard evaluation of the city's CTE-focused high schools.[9] The voc-tech

schools admitted students by lottery, and comparing lottery winners and losers allowed the authors to make strong claims about cause and effect, since at the time of admission the two groups were separated only by random chance. The impacts on high school graduation rates were large, significant, and consistent across cohorts.

Massachusetts has a large statewide sector of regional vocational and technical schools. Shaun Dougherty has done the strongest work investigating the impact of those schools on student outcomes.[10] Regional vocational schools in Massachusetts are selective: Applicants must score above a certain level on standardized tests. Dougherty uses a regression-discontinuity approach to compare students just above and below the test-score cutoff. These two groups of students, other than being separated by an arbitrary score level, are practically identical. Attending a regional vocational school in Massachusetts increases the likelihood of high school graduation by about 7 percentage points.[11]

There is scant evidence from these studies that vocational and technical schools either increased or decreased test scores. A consistent criticism for vocational-technical education is that it is nonacademic. That is, voc-tech schools de-emphasize traditional academic content. If this is true in practice, the lack of a voc-tech impact on test scores raises questions about the actual academic focus of traditional high schools.

The clear implication of these findings is that voc-tech schools affected noncognitive skills because test scores do not match later life impacts. The exact noncognitive skills that were affected, however, are unknown. In the literature on noncognitive skills, this is a common pattern. We know that voc-tech schools influenced *something* beyond test scores in these students, but we do not know what exactly.

Voc-Tech Schools, CTE Course Takers, and Noncognitive Skills. Here the literature on voc-tech schools and CTE course takers coincides. We time and again see long-term benefits produced by vocational-technical schools. We see a wage premium associated with enrollment in CTE courses and higher rates of high school completion. Yet these long-term benefits are not explained by growth in test scores.

CTE course takers and voc-tech students must differ from their peers in ways that test scores do not capture. Despite what is now an overwhelmingly common finding in the CTE literature, little of the research on CTE programs examines CTE students' noncognitive skills. This is a natural direction for the field to head in.

The purpose of CTE is to provide students with skills that employers value. So we draw on the work of personality psychologists, who for decades have been studying the role of personality in the workplace. The influence of personality psychology in education policy has grown substantially in recent years. Early childhood advocates in particular are focused on noncognitive skills or social-emotional learning.

Researchers are now focusing on noncognitive skills for a simple reason: Measures of personality and attitudes—such as grit and self-efficacy—predict later educational outcomes. But there is a more nuanced reason as well. Some programs are producing strong test-score gains but no long-term benefits; others are producing long-term benefits while having little impact on test scores.[12] As discussed earlier, we see this paradox in the CTE literature. We see it in other areas of education policy as well. This is why early childhood education advocates are focusing strongly on noncognitive skills.

The early childhood literature looks much the same as that for vocational-technical high schools: Many programs are producing long-term impacts while having no measurable effect on test scores.[13] Different hypotheses have emerged as to what skills were affected by influential preschool programs. But one fact is certain: Noncognitive skills that were affected went unmeasured in past evaluations. Nobel Laureate economist James Heckman likens noncognitive skills to dark matter: They are both unobserved but could explain observed phenomena. Changes to noncognitive skills resulting from these programs in particular would explain why these programs altered life outcomes without affecting test scores.[14]

The "dark matter" findings on vocational-technical school and CTE are intriguing: *What did these programs*

do? That alone could compel curious researchers to explore student metrics other than test scores. But there is another more obvious reason to examine the noncognitive skills of CTE students, even if it were not for the dark matter phenomenon.

Employers value noncognitive skills highly. This is obvious to anyone who has worked in private industry. It is also one of the most well-established findings in personality psychology. Apart from research on schoolchildren, a long literature from psychology, economics, and human resource management demonstrates that skills such as self-regulatory skills and social skills are consistent predictors of on-the-job success[15] and desired by employers.[16] It is natural for CTE research to focus on these skills. For the remainder of this paper, that is what we do.

We cannot ascertain with our data whether CTE courses or full-time voc-tech schools causally affect students' noncognitive skills. Rather, we take an initial step into understanding the intersection of noncognitive skills and CTE by describing the noncognitive skills of students who elect to take a higher volume of CTE courses in traditional high schools or enroll in full-time voc-tech schools.

Methodology

The data set we use is ELS:02, which followed more than 15,000 American 10th graders for 10 years, from 2002 through 2012. Among those students, 780 were enrolled in full-time vocational-technical high schools. Of students enrolled in traditional high schools, more than 2,300 took five or more CTE courses.

ELS:02 was administered by the US Department of the Education. The sample of students was selected first by randomly sampling public and private schools in the US. (We focus on public schools only.) Within each selected school, a random sample of 10th graders was selected to participate in the study. All our analyses employ weights to account for this sampling design so that our results can be viewed as nationally representative.

Students were surveyed in four waves beginning in the spring of 2002, then as 12th graders in the spring of 2004, two years later in 2006, and in 2012 when they were about 25 years old. During the first two waves of data collection, students took standardized tests in math and English and completed questionnaires in which they responded to items related to their school experiences, educational aspirations, and families. The later waves queried students about their transition into early adulthood, asking questions about their college and work experiences or family life.

Attrition rates are modest across all waves of ELS:02. Nearly 80 percent of students in the first wave of the survey are also present in the second wave, and two-thirds of the original sample is also present in the final follow-up. Importantly, the number of high school dropouts is small among the first two waves of ELS:02, which occurred at the end of 10th grade. Students who remained in high school by the end of 10th grade typically go on to graduate. Only 4 percent of students in the base year of the sample dropped out by 12th grade, and sampling weights partially account for any potential attrition bias.

During the baseline year of data collection in 2002, the students' parents, math teacher, English teacher, and school principal were also surveyed. Parents, for instance, were asked about their student's family background, school, and school life, while school principals and teachers responded to questions about school climate, governance, and organization. Teachers were additionally asked about their own background and classroom practices and about the 10th-grade student, such as his or her behavior in class and academic progress. Our analysis is based on information from all these questionnaires, student transcripts, and multiple waves of the student questionnaire in ELS:02. We discuss each of our key measures in turn.

CTE Coursework and Vocational-Technical School Enrollment. The US Department of Education obtained high school transcripts for students in the ELS:02 sample. Using these transcripts and a standardized taxonomy of high school courses called the Classification of Secondary School Courses system, we quantify the amount of CTE coursework that each student took in high school.

We count the amount of CTE coursework that a student took in each year of high school, regardless of whether they passed the course and earned credit. We also express this measure in years of coursework, taking into account courses that did not last a full year, given the different durations of academic terms and course offerings across high schools. That is, CTE courses listed as lasting one quarter, trimester, or semester of an academic year count as 0.25, 0.33, and 0.50 years of CTE coursework, respectively. On average, students take 22.5 credits of coursework in high school, of which 2.8 consist of CTE courses.

We divide our sample into five categories to identify the amount of CTE coursework that each student took. For students in traditional public high schools, we categorize students as taking 0–2 CTE credits, 3–4 CTE credits, 5–7 CTE credits, and at least eight CTE credits by 12th grade. These four categories are mutually exclusive. The last three categories make up what we call CTE course takers. The fifth category of students we examine are those attending full-time vocational and technical schools (hereafter, voc-tech students). A school's designation as a vocational-technical school was drawn from the ELS:02 principal survey.

Summary statistics for our full sample, for students who attend vocational-technical schools, and by the amount of CTE coursework taken by 12th grade are listed in Table 1. We also indicate the number of students in each of the categories. Observed patterns are akin to those of Kreisman and Stange, who examine CTE course taking using NLSY:97.[17] Male students and students who have lower levels of academic achievement, whose mothers have lower educational attainment, who are from rural regions, or who are from the South tend to take more CTE courses.

Self-Reported Noncognitive Skills. In the ELS:02 base-year student survey, students completed a variety of multiple-question scales designed to measure noncognitive skills. We focus on six self-reported skills: self-efficacy in math class, self-efficacy in English class, general academic effort, intrinsic motivation in math, intrinsic motivation in English, and extrinsic motivation. These scales were selected by the US Department of Education and have been validated and used in other important data sets such as the Programme for International Student Assessment.[18] Appendix A contains the wording of these items on the student questionnaire.

Summary statistics for these self-reports of noncognitive skills are listed in Table 2 for the full sample of students and by the amount of CTE coursework that students took. Based on these raw means, it appears that students who take more CTE courses self-report lower levels of these noncognitive skills at baseline. Later we assess whether these differences are attributable to other observable student characteristics.

Teacher-Reported Noncognitive Skills. As part of ELS:02, the US Department of Education surveyed the 10th-grade math and English teachers of students in the sample. Teachers responded to five five-point Likert items asking how often the student disrupted class, was attentive, was tardy, was absent, and completed his or her homework. We regard disruptiveness and attentiveness as subjective measures perceived by the teachers. Tardiness, absenteeism, and homework completion are much more concrete and objective. Teachers presumably keep official records of these objective measures.

Teachers also answered "yes" or "no" to an item asking if the student generally works hard to achieve good grades—another subjective measure. Appendix B shows the exact wording of these items on the questionnaire. We average the responses of the math and English teachers for each of these six items. Following the approach of several studies, we use these teacher reports as additional measures of student noncognitive skills.[19] Measures of classroom behavior capture student noncognitive skills that are important for academic and later life success.[20]

Summary statistics for teacher-reported measures are shown in the bottom panel of Table 2. Higher numbers indicate that teachers report a higher frequency of observing a particular behavior. These means suggest that CTE course takers score worse on ratings of subjective behaviors that are less conducive to academic success. But when it comes to

Table 1. Means of Demographic Variables

	All Students (N = 10,050)	Voc-Tech Schools (N = 780)	CTE Course Load by 12th Grade			
			0–2 (N = 4,780)	3–4 (N = 3,290)	5–7 (N = 1,930)	8 or More (N = 440)
Male	0.50	0.50	0.45	0.50	0.59	0.69
Baseline Math Test Scores	0.00	–0.01	0.14	–0.05	–0.20	–0.28
Baseline Reading Test Scores	0.00	–0.03	0.16	–0.06	–0.23	–0.37
Student Race						
Asian	0.04	0.02	0.05	0.04	0.02	0.02
Black	0.14	0.15	0.14	0.16	0.13	0.12
Hispanic	0.17	0.13	0.18	0.17	0.15	0.10
Other Race	0.05	0.05	0.05	0.05	0.06	0.05
White	0.60	0.66	0.58	0.58	0.64	0.71
Mother's Educational Background						
Less Than High School	0.14	0.17	0.13	0.15	0.15	0.12
High School	0.29	0.30	0.25	0.29	0.35	0.42
Some College	0.35	0.35	0.34	0.36	0.33	0.35
Four-Year Degree	0.16	0.14	0.19	0.14	0.12	0.08
Postbaccalaureate Degree	0.07	0.04	0.09	0.07	0.04	0.03
Annual Household Income						
Less Than $20,000	0.16	0.14	0.14	0.17	0.18	0.16
$20,000–34,999	0.20	0.21	0.18	0.21	0.23	0.24
$35,000–49,999	0.20	0.20	0.19	0.19	0.21	0.26
$50,000–74,999	0.21	0.24	0.21	0.20	0.21	0.21
$75,000–99,000	0.12	0.10	0.14	0.12	0.11	0.07
More Than $100,000	0.11	0.10	0.14	0.11	0.06	0.05
School Locale						
Urban	0.27	0.16	0.31	0.29	0.23	0.10
Suburban	0.50	0.68	0.50	0.48	0.47	0.45
Rural	0.22	0.16	0.19	0.22	0.31	0.45
US Region						
Northeast	0.13	0.14	0.18	0.09	0.08	0.10
Midwest	0.26	0.29	0.20	0.28	0.33	0.36
South	0.35	0.41	0.31	0.38	0.37	0.40
West	0.26	0.16	0.30	0.25	0.21	0.14

Note: Sampling weights included. All variables are dichotomous except for baseline math and reading test scores, which are continuous measures expressed in standard deviations. Sample sizes rounded to the tens place per data-use agreement.
Source: Authors' calculations using Educational Longitudinal Study of 2002, US Department of Education.

Table 2. Means of Student Noncognitive Skills

	All Students (N = 10,050)	Voc-Tech Schools (N = 780)	CTE Course Load by 12th Grade 0–2 (N = 4,780)	3–4 (N = 3,290)	5–7 (N = 1,930)	8 or More (N = 440)
Self-Reported Noncognitive Skills						
Self-Efficacy in Math (1–4)	2.50	2.46	2.57	2.47	2.41	2.32
Self-Efficacy in ELA (1–4)	2.70	2.64	2.83	2.64	2.52	2.44
Study Effort (1–4)	2.73	2.71	2.81	2.72	2.60	2.50
Extrinsic Motivation (1–4)	2.64	2.65	2.71	2.62	2.54	2.48
Intrinsic Motivation in Math (1–4)	2.39	2.37	2.41	2.37	2.38	2.28
Intrinsic Motivation in ELA (1–4)	2.57	2.54	2.70	2.51	2.38	2.43
Survey-Effort Measures						
Item Nonresponse Rate (0–100)	0.09	0.08	0.08	0.09	0.10	0.10
Careless Answering (–2.6–8.5)	0.00	0.00	0.02	0.01	–0.04	–0.03
Teacher Evaluations of Behavior						
Student Is Disruptive (1–5)	1.61	1.65	1.58	1.61	1.69	1.70
Student Is Attentive (1–5)	3.89	3.86	3.95	3.89	3.81	3.77
Student Completes Homework (1–5)	3.90	3.88	3.94	3.90	3.83	3.71
Student Works Hard to Get Good Grades (0–1)	0.66	0.67	0.68	0.66	0.62	0.57
Student Is Often Tardy (1–5)	1.66	1.67	1.65	1.68	1.65	1.62
Student Is Often Absent (1–5)	2.20	2.22	2.20	2.22	2.16	2.18

Note: Sampling weights included. Numbers in parentheses indicate range of measure. Sample sizes rounded to the tens place per data-use agreement.
Source: Authors' calculations using Educational Longitudinal Study of 2002, US Department of Education.

more objectively understood student behaviors, CTE course takers score better than their peers. They are less often tardy to and absent from class. Again, we will assess whether these results persist after controlling for other background characteristics.

Survey-Effort Measures of Noncognitive Skills. We also use new measures of student noncognitive skills, drawn from the work of Charassein: The Character Assessment Initiative at the University of Arkansas.[21] We use two behavioral measures of noncognitive skills based on efforts that students exhibited while completing questionnaires for ELS:02.

The intuition behind these measures is simple. Surveys—like the one given in ELS:02—are long, tedious, and low stakes. Basically, they are a rigmarole. As researchers, we do not get to observe the effort that students put into the small tasks that make up much of school or work, but we can observe the effort they put into surveys. And since surveys like ELS:02 are given *in school*, during school hours, we posit that effort on the ELS:02 survey can proxy for

the effort that students put forward at other times on other routine tasks.

Our first measure of student effort on a survey is the number of questions that each student skips. We compute item nonresponse rates as the percentage of items on the questionnaires that students skipped but should have answered. Our previous work has shown that this measure captures important new information. In several longitudinal data sets including ELS:02, we demonstrate that item nonresponse rates on the base-year survey predict future educational attainment and labor-market outcomes, independent of cognitive ability and demographic background variables.[22]

Our second measure of student effort on a survey is the extent to which they appear to just be filling in the bubbles. We call this "careless answering." That is, survey respondents may exhibit low effort on surveys by providing thoughtless and inconsistent answers. Along with item nonresponse rates, we use a measure of careless answering as a second behavioral measure of noncognitive skills.

"Careless answering" indexes are a measure of such behavior. Technical details for detecting this behavior and constructing careless answering can be found in our own prior work.[23] Intuitively, we measure the extent to which a student provides unexpected responses on a given item based on his and his peers' answers to other items. For instance, students who express high confidence that they can do an excellent job on math tests should also generally express high confidence in understanding difficult material presented in math class. Students who exhibit low effort and ultimately submit inconsistent responses are deemed more careless.

In earlier research, we show that, like item nonresponse rates, careless answering is predictive of educational attainment in ELS:02.[24] We also provide additional validation of careless answering in a nationally representative sample of US adults, demonstrating that the careless answering measure is correlated with self-reported neuroticism, conscientiousness, educational attainment, and labor-market outcomes, net of cognitive ability and demographic background variables.[25]

Summary statistics for item nonresponse and careless answering are shown in the middle of Table 2. Students in the ELS:02 sample skip about 9 percent of items. This raw-average rate does not seem to differ among students who earn a different number of CTE course credits. The careless-answering measure is standardized to have a mean equal to 0 and standard deviation equal to 1 by construction, with a higher number indicating a greater prevalence of careless answering. Based on these raw means, it appears that students who take heavier concentrations of CTE courses are less careless on surveys.

In Table 3, we report the pairwise correlations across all measures of student noncognitive skills. We make four observations at this point. First, self-reported noncognitive skills are most strongly correlated with each other. Aside from the correlations between self-efficacy and intrinsic motivation across different subject areas, correlations range from about 0.20 to 0.70.

Second, survey-effort measures exhibit modest correlations with all other measures of noncognitive skill. These correlations range in magnitude from 0 to 0.14 and are consistent with those found in prior research on survey-effort measures. In fact, survey-effort measures are more strongly correlated with teacher reports of noncognitive skills rather than with the students' self-reports.

Third, we note that the magnitude of the correlations between teacher-reported measures and student self-reports span from 0.04 to nearly 0.30. Yet correlations among teacher-reported measures are stronger with magnitudes from 0.40 to over 0.70.

Fourth, measures of noncognitive skills generally exhibit correlations with student test scores in the range of 0.10 to 0.35, suggesting that test scores do not fully capture noncognitive skills.

Outcome Measures. We conduct a secondary analysis to assess the longer-run outcomes of students who enroll in vocational-technical school or take large volumes of CTE courses. We focus on three outcomes: educational attainment, employment, and income. Educational attainment is defined as the highest level of education attained, along four categories:

Table 3. Correlation Matrix of Noncogntive and Cognitive Measures

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Self-Reports of Noncognitive Skills	(1) Math Self-Esteem															
	(2) ELA Self-Esteem	0.40														
	(3) Study Effort	0.54	0.61													
	(4) Extrinisic Motivation	0.42	0.50	0.73												
	(5) Math Intrinsic Motivation	0.49	0.04	0.28	0.23											
	(6) ELA Intrinsic Motivation	0.07	0.34	0.23	0.17	0.21										
Survey-Effort Measures	(7) Item Nonresponse	–0.08	–0.14	–0.14	–0.12	0.05	–0.01									
	(8) Careless Response	–0.05	0.00	0.01	–0.03	–0.08	–0.04	0.08								
Teacher Reports of Noncognitive Skills	(9)Disruptive	–0.09	–0.10	–0.14	–0.12	–0.06	–0.14	0.08	0.10							
	(10) Attentive	0.22	0.19	0.26	0.22	0.13	0.14	–0.11	–0.11	–0.52						
	(11) Does Homework	0.22	0.18	0.27	0.24	0.12	0.11	–0.15	–0.13	–0.44	0.73					
	(12) Works Hard	0.19	0.17	0.24	0.21	0.13	0.11	–0.10	–0.10	–0.42	0.66	0.72				
	(13) Tardy	–0.15	–0.10	–0.16	–0.13	–0.08	–0.08	0.08	0.09	0.47	–0.49	–0.47	–0.40			
	(14) Absent	–0.14	–0.10	–0.14	–0.12	–0.08	–0.04	0.07	0.09	0.25	–0.44	–0.50	–0.41	0.47		
Cognitive Skills	(15) Math Test Scores	0.35	0.23	0.18	0.14	0.10	0.13	–0.26	–0.19	–0.23	0.32	0.35	0.27	–0.25	–0.23	
	(16) Reading Test Scores	0.20	0.31	0.19	0.14	–0.05	0.26	–0.29	–0.16	–0.25	0.32	0.34	0.26	–0.22	–0.18	0.76

Note: Sampling weights included.
Source: Authors' calculations using Educational Longitudinal Study of 2002, US Department of Education.

Table 4. Summary Statistics for Long-Run Outcomes

	All Students (N = 10,050)	Voc-Tech Schools (N = 780)	CTE Course Load by 12th Grade			
			0–2 (N = 4,780)	3–4 (N = 3,290)	5–7 (N = 1,930)	8 or More (N = 440)
Completed High School	0.97	0.97	0.96	0.97	0.98	0.98
Earned Two-Year Degree	0.50	0.47	0.56	0.50	0.42	0.39
Earned Four-Year Degree	0.31	0.31	0.39	0.28	0.21	0.13
Any Employment	0.88	0.88	0.87	0.88	0.87	0.88
Full-Time Employment	0.72	0.74	0.70	0.72	0.75	0.78
Annual Employment Income ($)	28,062	27,799	28,100	27,235	29,024	30,754

Note: Sample weights included. Sample sizes rounded to the tens place per data-use agreement.
Source: Authors' calculations using Educational Longitudinal Study of 2002, US Department of Education.

high school dropout, high school graduate, two-year college graduate, and four-year college graduate. With employment, we consider whether the student is employed part or full time. Employment income is simply a continuous measure of self-reported income. While years of education and employment status are measured in 2012 during the final wave of ELS:02, annual income is based on 2011 figures.

Summary statistics for these outcome variables are shown in Table 4. Educational attainment appears slightly lower for students who take greater amounts of CTE coursework. Although employment rates are similar regardless of CTE course taking when we combine full- and part-time workers, students who take more CTE courses in high school are on average more likely to be employed full time. These students also seem to have higher annual incomes at the time of the final ELS:02 follow-up. Our subsequent analysis will examine whether these differences hold after controlling for other background factors.

Empirical Strategy. To provide a noncognitive-skills profile of students who pursue a CTE course of study in high school, we estimate two sets of linear regression models that use measures of noncognitive skills to predict selection into a full-time vocational school and the number of credits of CTE courses that students who do not attend full-time vocational schools have taken, while controlling for student achievement and other demographic background characteristics. These models are near replications of those found in economists Daniel Kreisman and Kevin Stange's analysis,[26] except that we explicitly model students' noncognitive skills. Specifically, we use ordinary least squares regression to estimate:

$$CTE_i = \alpha_0 + \alpha_1 NC_i + \alpha_2 X_i + \theta_i + \varepsilon_i \quad (1)$$

and

$$Voc_i = \beta_0 + \beta_1 NC_i + \beta_2 X_i + \nu_i \quad (2).$$

In equation 1, CTE_i indicates the number of credits of CTE courses in which student i has enrolled during high school.[27] Note that this measure does not capture the number of CTE credits that a student has *earned* because we are interested in course taking. In other words, instances in which a student enrolls in a CTE course but fails and earns no credits count toward the total of the dependent variable, CTE_i. Moreover, the analytic sample in equation 1 excludes students enrolled in full-time vocational schools, as our goal is to describe students in conventional high schools who pursue a CTE course of study.

NC_i is one of our measures of noncognitive skills for student i. X_i is a vector of student baseline test scores in math and English along with the demographic background variables listed in Table 1, and ε_i

is the usual error term. Finally, θ_i is a vector of school fixed effects to capture unobserved characteristics in schools that might influence CTE course taking, such as local labor markets and the availability of CTE courses.

The independent variables in equation 2 are the same as those in equation 1. However, the dependent variable, Voc_i, is a binary variable equal to 1 if student i is enrolled in a full-time vocational-technical school, while v_i is the error term. Although the dependent variable is binary, we present results based on this linear probability model given that the results do not differ from more conventional logistic regression models and are easier to interpret.

Our coefficients of interest are captured by α_1 and β_1. These coefficients will convey whether students with higher or lower levels of particular noncognitive skills are more likely to pursue a greater or lesser load of CTE coursework or enroll in vocational-technical school.

To address our second research aim, we estimate models that predict six longer-run outcomes: high school graduation, completion of a two-year degree, completion of a four-year degree, any employment, full-time employment, and employment income. We run versions of the model specified as follows:

$$Y_i = \gamma_0 + \gamma_1 Voc_i + \gamma_2 CTE_i + \gamma_3 X_i + \theta_i + \mu_i \qquad (3).$$

In equation 3, Y_i is one of the long-run outcomes for student i. We note that the educational attainment outcomes (i.e., high school graduation, completion of a two-year degree, and completion of a four-year degree) and the two employment outcomes (i.e., any employment and full-time employment) are binary dependent variables. As in equation 2, we report results based on linear probability models given that they do not differ from logistic regression models. The remaining variables are equivalent to those in equation 1, except that CTE_i is now a vector of three dummy variables indicating whether student i took 3–4, 5–7, or more than eight credit years of CTE courses in a conventional high school.

We model our CTE credits variable in a nonlinear fashion for two reasons. First, we wish to underscore patterns for students who concentrate in CTE courses to varying extents relative to students who take few CTE credits (i.e., 0–2 units). These patterns would otherwise be masked in a model that specified CTE course taking as a continuous variable. Second, our specification makes it easier to interpret the coefficient on Voc_i, which now captures the difference in long-run outcomes between students who enroll in a full-time vocational school and students who take 0–2 units in conventional high schools. Lastly, we note that μ_i is the random error term in equation 3.

Results for the Noncognitive-Skills Profile of CTE Students

We begin by describing the noncognitive skill set of students who do not attend full-time vocational schools but select into taking CTE classes throughout high school. For each dependent variable, we estimate two models—one without school fixed effects and one with school fixed effects—so we can account for unobserved school characteristics that might independently affect student outcomes. Results are based on estimations of equation 1, and we present results separately for each of our three types of noncognitive-skill measures—self-reports, survey effort, and teacher reports. We only show coefficient estimates for the measures of noncognitive skills. The full set of results are available upon request and are consistent with prior analyses.[28]

Self-Reported Measures. Beginning in Table 5, we examine the relationship between self-reported measures of noncognitive skills and CTE course taking. In Panel A of Table 5, we report results pertaining to self-reports of noncognitive skills related to academic tenacity—namely, self-efficacy in math and English and general study effort. Students who take more CTE credits are more likely to self-report lower levels of self-efficacy and study effort. All else equal, a student whose self-reported measure of self-efficacy in math is one standard deviation higher takes 0.10 fewer credits of CTE coursework. These results

Table 5. CTE Courses Taken by 12th Grade Among Conventional High School Students and Self-Reported Noncognitive Skills

	(1)		(2)		(3)	
Panel A: Academic Tenacity						
Math Self-Efficacy	–0.099**	–0.096**				
	(–0.028)	(–0.024)				
ELA Self-Efficacy			–0.197**	–0.170**		
			(–0.028)	(–0.024)		
Study Effort					–0.158**	–0.146**
					(–0.027)	(–0.024)
School Fixed Effects	No	Yes	No	Yes	No	Yes
Observations	7,000	7,000	6,880	6,880	6,830	6,830
R^2	0.120	0.479	0.127	0.487	0.125	0.485
Panel B: Motivation						
Math Intrinsic Motivation	–0.076*	–0.067+				
	(–0.038)	(–0.036)				
ELA Intrinsic Motivation			–0.230**	–0.240**		
			(–0.037)	(–0.029)		
Extrinsic Motivation					–0.092**	–0.100**
					(–0.025)	(–0.023)
School Fixed Effects	No	Yes	No	Yes	No	Yes
Observations	7,160	7,160	7,170	7,170	6,930	6,930
R^2	0.121	0.478	0.128	0.483	0.122	0.482

Note: Students enrolled in full-time vocational schools are excluded from this analysis. Models control for gender, race, household income, mother's educational attainment, US region, urbanicity, and baseline test scores in reading and math. Sample sizes rounded to the tens place per data-use agreement. + $p < 0.1$; * $p < 0.05$; ** $p < 0.01$.
Source: Authors' calculations using Educational Longitudinal Study of 2002, US Department of Education.

change little when we include school fixed effects in our models. We also observe the same patterns with English self-efficacy and general study effort, but the differences are slightly larger and range from 0.15 to 0.20 credits of CTE coursework.

In Panel B, we consider noncognitive skills related to motivation. We find that students who report lower levels of intrinsic motivation in math, intrinsic motivation in English, and general extrinsic motivation ultimately take more CTE coursework. All else equal, a standard deviation increase in self-reported intrinsic motivation to do math is associated with completing 0.08 fewer CTE credits, and students who self-report levels of intrinsic motivation in ELA and overall extrinsic motivation that are one standard deviation higher take about 0.25 and 0.10 fewer credits of CTE coursework, respectively.

Survey-Effort Measures. Table 6 displays results based on our behavioral, survey-effort measures of noncognitive skills. We observe that students with higher item nonresponse rates appear to take fewer CTE courses. Based on the model that includes school fixed effects, a standard deviation increase in item nonresponse rate is associated with taking up to 0.07 fewer CTE credits.

Table 6. CTE Courses Taken by 12th Grade Among Conventional High School Students and Survey-Effort Measures of Noncognitive Skills

	(1)		(2)	
Item Nonresponse Rate	–0.033	–0.067**		
	(–0.032)	(–0.026)		
Careless Answering			–0.079**	–0.054**
			(–0.027)	(–0.020)
School Fixed Effects	No	Yes	No	Yes
Observations	9,190	9,190	8,860	8,860
R^2	0.124	0.467	0.125	0.466

Note: Students enrolled in full-time vocational schools are excluded from this analysis. Models control for gender, race, household income, mother's educational attainment, US region, urbanicity, and baseline test scores in reading and math. Sample sizes rounded to the tens place per data-use agreement. +p < 0.1; * p < 0.05; ** p < 0.01.
Source: Authors' calculations using Educational Longitudinal Study of 2002, US Department of Education.

Table 7. CTE Courses Taken by 12th Grade Among Conventional High School Students and Teacher Reports of Noncognitive Skills

	(1)		(2)		(3)	
Panel A: Subjective Measures						
Disruptiveness	–0.026	–0.014				
	(–0.031)	(–0.024)				
Attentiveness			0.000	–0.021		
			(–0.031)	(–0.025)		
Works Hard					–0.007	–0.031
					(–0.029)	(–0.024)
School Fixed Effects	No	Yes	No	Yes	No	Yes
Observations	8,420	8,420	8,380	8,380	8,380	8,380
R^2	0.128	0.471	0.128	0.472	0.128	0.471
Panel B: Objective Measures						
Does Homework	0.030	0.001				
	(–0.033)	(–0.026)				
Tardiness			–0.065*	–0.011		
			(–0.032)	(–0.025)		
Absenteeism					–0.100**	–0.082**
					(–0.032)	(–0.025)
School Fixed Effects	No	Yes	No	Yes	No	Yes
Observations	8,370	8,370	8,400	8,400	8,410	8,410
R^2	0.127	0.471	0.128	0.471	0.13	0.472

Note: Students enrolled in full-time vocational schools are excluded from this analysis. Models control for gender, race, household income, mother's educational attainment, US region, urbanicity, and baseline test scores in reading and math. Sample sizes rounded to the tens place per data-use agreement. + p < 0.1; * p < 0.05; ** p < 0.01.
Source: Authors' calculations using Educational Longitudinal Study of 2002, US Department of Education.

Similarly, students who exhibit more careless answering on their surveys enroll in fewer CTE courses. A standard deviation increase in the prevalence of careless answering is associated with taking between 0.05 and 0.08 fewer CTE courses, depending on the inclusion of school fixed effects.

Teacher-Reported Measures. Our final approach to measuring student noncognitive skills is based on reports by the students' math and English teachers. Results using these measures of noncognitive skills are shown in Table 7. As shown in Panel A, subjective teacher reports of student noncognitive skills—such as how often the student is disruptive, is attentive, and works hard—are not predictive of subsequent CTE course taking. Nor do students who more often complete their homework necessarily go on to take more or fewer CTE credits, as displayed in the first column of Panel B, which displays objective teacher reports of noncognitive skills.

However, we observe that students who take more CTE courses are less often tardy and absent from class. A standard deviation increase in the measure of teacher-reported tardiness is associated with a 0.07 decrease in the amount of CTE credits a student takes. Notably, this finding is not robust to the inclusion of school fixed effects. Still, a standard deviation increase in teacher-reported absenteeism is associated with taking about 0.10 fewer CTE credits.

Noncognitive Skills of Conventional High School Students Who Take CTE Courses. We now turn to our estimates of equation 2, which describe the noncognitive skill set of students who select into full-time vocational schools. These results are shown in Tables 8–10 and are analogous to Tables 5–7 but predict enrollment into full-time vocational schools instead of the number of CTE credits that the student completed. As before, we show coefficient estimates for the measures of noncognitive skills for brevity.

As demonstrated by the substantively small and statistically insignificant coefficient across Tables 8–10, students who attend full-time vocational schools and students who attend conventional high schools self-report the same levels of noncognitive skills, whether these skills are captured by self-reports of academic tenacity and motivation, survey-effort measures, or teacher-reported measures.[29]

Discussion of Results for the Noncognitive Profile of CTE Students

Using our three approaches to measure student noncognitive skills, we have presented a nuanced picture of students who take a larger concentration of CTE courses. Popular stereotypes of CTE students portray them as less academically engaged, less motivated, and lower-achieving individuals. We find evidence consistent with this portrayal, but failure to view these students with a broader set of indicators would mischaracterize them.

Indeed, as shown in the summary statistics in Table 2, students who take more CTE courses tend to have lower levels of achievement, be male, have lower socioeconomic backgrounds, and come from rural areas and the South. In our analysis of these students' noncognitive skills, we find evidence that they possess lower levels of confidence and interest in math and English coursework. They also self-report lower levels of effort while studying.

However, when coupled with our survey-effort measures and teacher-reported measures of noncognitive skills, a more complex picture arises. In particular, students who take more CTE courses in high school exhibit greater levels of survey effort, and their teachers report that they are less often tardy and absent from class. Overall it appears there is at least a subgroup of CTE students who are not academically inclined but nevertheless well-behaved in school. Although they may look deficient on common academic indicators, they exhibit higher levels of behaviors and noncognitive skills that are conducive to long-run life success.

Whether CTE students actually fair better in the long run is an empirical question. We present our findings on this issue next.

Table 8. Enrollment in Full-Time Vocational Schools and Self-Reported Noncognitive Skills

	(1)	(2)	(3)
Panel A: Academic Tenacity			
Math Self-Efficacy	–0.003		
	(–0.004)		
ELA Self-Efficacy		–0.003	
		(–0.004)	
Study Effort			0.000
			(–0.003)
Observations	7,550	7,430	7,370
R^2	0.017	0.017	0.017
Panel B: Motivation			
Math Intrinsic Motivation	–0.001		
	(–0.006)		
ELA Intrinsic Motivation		0.001	
		(–0.004)	
Extrinsic Motivation			0.003
			(–0.003)
Observations	7,730	7,740	7,480
R^2	0.017	0.017	0.017

Note: Models control for gender, race, household income, mother's educational attainment, US region, urbanicity, and baseline test scores in reading and math. Sample sizes rounded to the tens place per data-use agreement. +p < 0.1; * p < 0.05; ** p < 0.01.
Source: Authors' calculations using Educational Longitudinal Study of 2002, US Department of Education.

Table 9. Enrollment in Full-Time Vocational Schools and Survey-Effort Measures of Noncognitive Skills

	(1)	(2)
Item Nonresponse Rate	–0.003	
	(–0.007)	
Careless Answering		0.001
		(–0.004)
Observations	9,930	9,580
R^2	0.020	0.018

Note: Students enrolled in full-time vocational schools are excluded from this analysis. Models control for gender, race, household income, mother's educational attainment, US region, urbanicity, and baseline test scores in reading and math. Sample sizes rounded to the tens place per data-use agreement. +p < 0.1; * p < 0.05; ** p < 0.01.
Source: Authors' calculations using Educational Longitudinal Study of 2002, US Department of Education.

Table 10. Enrollment in Full-Time Vocational Schools and Teacher Reports of Noncognitive Skills

	(1)	(2)	(3)
Panel A: Subjective Measures			
Disruptiveness	0.002		
	(–0.004)		
Attentiveness		–0.001	
		(–0.004)	
Works Hard			0.002
			(–0.004)
Observations	9,100	9,070	9,050
R^2	0.022	0.022	0.022
Panel B: Objective Measures			
Does Homework	0.005		
	(–0.004)		
Tardiness		0.000	
		(–0.005)	
Absenteeism			0.000
			(–0.004)
Observations	9,100	9,100	9,100
R^2	0.022	0.022	0.022

Note: Models control for gender, race, household income, mother's educational attainment, US region, urbanicity, and baseline test scores in reading and math. Sample sizes rounded to the tens place per data-use agreement. +p < 0.1; * p < 0.05; ** p < 0.01.
Source: Authors' calculations using Educational Longitudinal Study of 2002, US Department of Education.

Results for Long-Run Outcomes of CTE Students

We remind readers that we consider educational attainment and labor-market outcomes for students as they enter young adulthood. Specifically, these long-run outcomes are measured when students are about 25 years old. Results are based on equation 3 in the data and methodology section and displayed in Table 11.

The estimates in Panel A pertain to educational attainment outcomes. We find that students who are enrolled in conventional high schools but take more CTE courses are more likely to complete high school. For instance, relative to students who take 0–2 units of CTE credit, students who take 3–4 CTE credits are about 2 percentage points more likely to graduate from high school. These differences grow for students who take 5–7 or at least eight CTE credits to 4 and 5 percentage points, respectively. We estimate that the corresponding difference for students in full-time vocational schools is about 1 percentage point, but this difference is not statistically significant. In the second set of results under the first column, we show that these results are robust to the inclusion of school fixed effects.

In the remaining columns of Panel A, we observe that students who take more credits of CTE coursework are less likely to earn a two-year and four-year degree. In particular, students at conventional high schools who take 5–7 CTE credits are about 4 percentage points less likely to earn a two-year degree relative to their peers who take only 0–2 units. Relative to the same group of students, students who take more CTE credits are 5–10 percentage points less likely to earn a four-year degree, as shown in the third column. We observe a similar pattern for

Table 11. CTE Course Takers and Long-Run Outcomes

Panel A: Educational Attainment	(1) High School Graduate		(2) Two-Year College Degree		(3) Four-Year College Degree	
3–4 CTE Credits	0.020**	0.029**	–0.009	–0.005	–0.052**	–0.049**
	–0.006	–0.006	–0.014	–0.016	–0.013	–0.014
5–7 CTE Credits	0.037**	0.050**	–0.035+	–0.044*	–0.065**	–0.076**
	–0.006	–0.008	–0.018	–0.020	–0.014	–0.016
At Least 8 CTE Credits	0.047**	0.067**	–0.027	–0.032	–0.104**	–0.113**
	–0.010	–0.013	–0.035	–0.037	–0.021	–0.027
Vocational School	0.014		–0.030		–0.027	
	–0.011		–0.024		–0.027	
School FE	No	Yes	No	Yes	No	Yes
Observations	8,070	8,070	8,070	8,070	8,070	8,070
R^2	0.054	0.149	0.153	0.225	0.251	0.318

Panel B: Labor Market Outcomes	(1) Any Employment		(2) Full-Time Employment		(3) Employment Earnings	
3–4 CTE Credits	0.018+	0.019+	0.026+	0.034*	0.026	0.037
	–0.010	–0.011	–0.014	–0.015	–0.035	–0.038
5–7 CTE Credits	0.009	0.004	0.051**	0.058**	0.081+	0.110*
	–0.012	–0.014	–0.017	–0.019	–0.044	–0.048
At Least 8 CTE Credits	0.010	0.015	0.057+	0.078*	0.157*	0.251**
	–0.022	–0.026	–0.032	–0.033	–0.071	–0.090
Vocational School	0.005		0.043*		0.051	
	–0.014		–0.022		–0.048	
School FE	No	Yes	No	Yes	No	Yes
Observations	7,490	7,490	7,490	7,490	7,130	7,130
R^2	0.038	0.125	0.047	0.131	0.075	0.169

Note: Earnings model is conditional on having a nonzero income. Employment status refers to 2012 status while earnings data reflect 2011 annual earnings. Models control for gender, race, household income, mother's educational attainment, US region, urbanicity, and baseline test scores in reading and math. Sample sizes rounded to the tens place per data-use agreement. +p < 0.1; * p < 0.05; ** p < 0.01.
Source: Authors' calculations using Educational Longitudinal Study of 2002, US Department of Education.

students who attend full-time vocational schools. These students are about 3 percentage points less likely to earn either postsecondary degree than students in conventional high schools who take 0–2 CTE credits, though these estimates are not statistically significant due to a smaller sample size.

Turning to labor-market outcomes in Panel B of Table 11, we find that the amount of CTE coursework a student takes is not strongly associated with his or her likelihood of any employment—full time or part time. The only exception is that students from conventional high schools who take 3–4 CTE credits are

2 percentage points more likely to be employed than students who take 0–2 CTE credits.

However, when we run models predicting full-time employment, more noticeable differences emerge. Students who take 3–4 CTE credits in conventional high schools are 3 percentage points more likely to be employed full time. Differences for students who take 5–7 or at least eight CTE credits are larger and range from 5 to 8 percentage points. Similarly, students who attend full-time vocational education schools are 4 percentage points more likely to be employed full time than students in conventional high schools who take few CTE credits. With full-time employment rates at about 68 percent for students who take few to no CTE courses in high school, these differences of 3–8 percentage points are sizable and substantively meaningful.

It may, therefore, not be surprising that we find wage premiums for CTE students. Our estimates are based on the log of annual incomes measured in 2011 and conditional on having a nonzero income. The wage premium dramatically grows as students increasingly concentrate in CTE courses. Relative to students who take 0–2 CTE credits, students who take 3–4 CTE credits realize a substantively significant but statistically insignificant wage premium of only 3–4 percent. Students who enroll in 5–7 credits of CTE courses realize wage premiums of about 8–11 percent. Students who take at least eight credits of CTE courses realize even larger gains on the order of 16–25 percent. We also estimate students in full-time vocational schools appear to realize a wage premium of about 5 percent relative to students who did not attend those schools. Although this difference is not statistically significant, it is meaningfully large.

Conclusion

We began this paper by pointing out the common perceptions of CTE programs and the students who enroll in them. These programs are often portrayed in a negative light because of their nonacademic nature and are criticized all the more given that lower-achieving students typically enter them. Our findings validate some of these perceptions but undermine others.

As in prior research, we find that students who have lower standardized test scores in math and ELA are more likely to enroll in CTE programs. Unsurprisingly, we also find that these students have lower levels of self-efficacy and motivation when it comes to engagement with these core academic subjects. However, it is not clear from our results and those from prior work that the nonacademic orientation of CTE coursework is doing students a disservice.

In comprehensive high schools, students who take large numbers of CTE courses are less likely to drop out of high school, and eight years later, they are more likely to be employed full time and have higher annual earnings. These results hold even after accounting for their lower test scores in math and ELA. CTE course takers seem to leave high school with an edge in skills that test scores do not capture.

Students attending full-time vocational-technical schools complete high school at lower rates compared to students in traditional high schools who concentrate in a CTE course of study. However, their high school completion rates are similar to students who take few to no CTE courses. Students at full-time vocational-technical schools are also more likely to be employed full time in their mid-20s.

All these results are descriptive, but our findings are consistent with a long and persuasive body of causal research that shows that vocational-technical high schools have increased high school graduation rates. That same research finds little evidence that vocational-technical schools affect test scores. The implication is that vocational-technical schools improve noncognitive skills, establish employment networks, or confer credentials for their students that enable them to enter young adulthood on a good note, so to speak.

That said, additional research into these students' later life outcomes would be valuable. We do not know whether these labor-market benefits to students in CTE programs persist into later adulthood. These higher earnings and rates of employment could disappear as other students complete

their education and enter the workforce. Wage premiums experienced by CTE students coupled with more years in the labor market by age 25 compound to large gains in lifetime earnings. At some point over these students' lives, however, the cumulative and annual earnings of students who opted to pursue a baccalaureate or postbaccalaureate degree may surpass those of students who pursued a CTE course of study and entered the workforce earlier in their lives. But even then, a CTE course of study in high school may sufficiently allow students to attain some level of flourishing in the long run. Research that estimates the causal effects of CTE programs by following students into later stages of adulthood would speak to this issue.

Our findings also cause us to question another prevailing stereotype of CTE students. We find that students who take large numbers of CTE courses by the 12th grade had significantly lower 10th-grade test scores, compared to their peers who took little or no CTE coursework. They also have lower self-esteem and motivation in reading and math. These patterns align with conventional perceptions of CTE students—namely, that they are not as academically engaged and adept as their peers.

However, we find that CTE students have other desirable noncognitive skills that are no different and in some cases higher. According to teacher reports of student behavior, CTE students are just as attentive and likely to complete their homework, but they are also less likely to be absent from class. Moreover, based on our behavioral measure of noncognitive skills, we observe that CTE students exhibit more effort on the ELS:02 survey, which we have shown in prior work to forecast higher levels of educational attainment and labor-market outcomes.

In short, CTE students typically are not academically inclined but exhibit higher levels of other noncognitive skills such as conscientiousness that are important for later life success. And irrespective of whether CTE programs subsequently improve these noncognitive skills, students who select into CTE programs seem to fare well in young adulthood. Prior evaluations of CTE programs suggest that they may be a viable means to give students an alternative educational path to later life well-being. Our findings, in particular, suggest that these benefits accrue to a unique population of students who would otherwise not obtain them in a conventional secondary school course of study.

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Acknowledgments

The authors would like to thank Nat Malkus, Rooney Columbus, Andy Smarick, Nancy Hoffman, Gary Hoachlander, and RJ Martin for their comments on an earlier draft of this paper.

Appendix A: Items for Students' Self-Reported Measures of Noncognitive Skills

All data in the paper are from the Educational Longitudinal Study of 2002. Survey forms given to ELS:02 participants are available publicly online. The following is the text from questions used to measure student attitudes, motivation, and noncognitive skills.

Self-Esteem in Math

Answer options: Almost never, sometimes, often, almost always

1. I'm confident that I can do an excellent job on my math tests.
2. I'm certain I can understand the most difficult material presented in math texts.
3. I'm confident I can understand the most complex material presented by my math teacher.
4. I'm confident I can do an excellent job on my math assignments.
5. I'm certain I can master the skills being taught in my math class.

Self-Esteem in English

Answer options: Almost never, sometimes, often, almost always

1. I'm confident I can do an excellent job on my English tests.
2. I'm certain I can understand the most difficult material presented in English texts.
3. I'm confident I can understand the most complex material presented by my English teacher.
4. I'm confident I can do an excellent job on my English assignments.
5. I'm certain I can master the skills being taught in my English class.

General Effort

Answer options: Almost never, sometimes, often, almost always

1. When I study, I make sure that I remember the most important things.
2. When studying, I try to work as hard as possible.
3. When studying, I keep working even if the material is difficult.
4. When studying, I try to do my best to acquire the knowledge and skills taught.
5. When studying, I put forth my best effort.

Extrinsic Motivation

Answer options: Almost never, sometimes, often, almost always

1. I study to get a good job.
2. I study to ensure that my future will be financially secure.
3. I study to increase my job opportunities.

Intrinsic Motivation in Math

Answer options: Strongly agree, agree, disagree, strongly disagree

1. When I do mathematics, I sometimes get totally absorbed.
2. Because doing mathematics is fun, I wouldn't want to give it up.
3. Mathematics is important to me personally.

Intrinsic Motivation in English

Answer options: Strongly agree, agree, disagree, strongly disagree

1. Because reading is fun, I wouldn't want to give it up.
2. I read in my spare time.
3. When I read, I sometimes get totally absorbed.

Appendix B: Items for Teacher Reports of Students' Noncognitive Skills

All items presented teachers with five response options: never, rarely, some of the time, most of the time, or all of the time. The only exception is the last item asking whether the student usually works hard for good grades, for which teachers were presented two response options: yes or no.

1. How often does this student complete homework assignments for your class?
2. How often is this student absent from your class?
3. How often is this student tardy to your class?
4. How often is this student attentive in your class?
5. How often is this student disruptive in your class?
6. Does this student usually work hard for good grades in your class?

Notes

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number of CTE courses does not yield demonstrably different results. If anything, voc-tech students self-report lower self-efficacy and intrinsic motivation in ELA compared to traditional high school students who take few to no CTE courses. In contrast, voc-tech students self-report more study effort, extrinsic motivation, and self-efficacy in ELA compared to traditional high school students who enroll in heavy volumes of CTE courses. These differences net out to zero in the empirical models we present in which CTE course loads of traditional high school students are not disaggregated. All other differences are statistically indistinguishable.