Noncognitive Factors as Predictors of College Outcomes: A Review of the Literature and an Analysis of HSLS:09 Data to Inform the NAEP Preparedness Initiatives

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Executive Summary

Preparing students for postsecondary education has traditionally focused on providing them with a strong foundation in the core academic subjects: mathematics, science, and English/language arts. In recent years, however, there has been a growing realization that preparing students for college is dependent on a combination of both academic and noncognitive factors (e.g., Farrington et al., 2012; National Research Council, 2012).

The National Assessment of Educational Progress (NAEP) is tasked to monitor educational progress, especially that linked to student achievement, across the country. While NAEP is well known as a measure of student achievement, due to the cross-sectional design of the assessment, it has been difficult to establish to what extent its achievement and survey measures are related to postsecondary outcomes and what score levels are indicative of college preparedness. A study commissioned by the National Assessment Governing Board (NAGB) developed a NAEP preparedness indicator for mathematics using longitudinal data, but it only used data from the state of Florida (Fields, 2014). As preparing students for college is a key goal of many districts and states, additional evidence from NAEP on college preparedness could be used to examine to what extent different groups of students are on track to enrolling and succeeding in college. Ogut et al. (2021), in a study commissioned by the National Center for Education Statistics (NCES), analyzed a nationally representative sample of 12th-graders participating in the High School Longitudinal Study of 2009 (HSLS:09) and found that NAEP mathematics performance accounted for 28 percent of the variance in college enrollment and 34 percent of the variance in the selectivity of the colleges in which students enrolled.

In contrast to Ogut et al. (2021), the current study, also commissioned by NCES, focuses on the noncognitive factors associated with college preparedness. Using an in-depth literature review and exploratory analysis, this study examines the predictive validity evidence of noncognitive factors that NAEP could include in future versions of its student surveys. Although it is generally acknowledged that college preparedness necessitates noncognitive skills as well as academic preparation in the core subject areas, there is no consensus on which noncognitive factors measured in high school are considered to be most predictive of later college success (Farrington et al., 2012; National Research Council, 2012).

Specifically, it is unclear to what extent noncognitive factors would predict college success over and above NAEP scores. Decisions about what noncognitive constructs to measure within NAEP surveys are generally based on the survey constructs' relationship with NAEP achievement (NAGB, 2013). Predictive validity evidence showing the relationship between noncognitive factors and college success could provide another criterion to consider when deciding what to include in NAEP student surveys.

Our exploratory analysis focuses on motivational constructs, attitudes toward school and school participation, and life skills and engagement in society, analyzing nationally representative data from HSLS:09 to explore the relationship between high school noncognitive survey measures and enrollment in 4-year colleges 3 years after graduation.

In our analysis of the motivational constructs, academic interest (chapter 3), academic identity (chapter 5), academic self-efficacy (chapter 6), and perseverance (chapter 9) were all shown to have a positive relationship with college enrollment 3 years after a student's high school graduation, before controlling for mathematics achievement. However, these relationships virtually disappeared after controlling for algebra achievement scores. Only utility value (chapter 7) and growth mindset (chapter 8) had no relationship with college enrollment. Our research on enjoyment of complex problems (chapter 4) consisted only of a review of the literature, as this construct was not measured in HSLS:09. See Figure ES-1 below for a summary of the relationships between these motivational constructs and 4-year college enrollment.

Figure ES-1. Overall results for motivational constructs

Factor	Relationship with 4-year college enrollment	
	Not controlling for algebra achievement	Controlling for algebra achievement
Academic interest (Chapter 3)		
Mathematics interest	▲	○
Science interest	▲	○
Enjoyment of complex problems (Chapter 4)	—	—
Academic identity (Chapter 5)		
Mathematics identity	▲	○
Science identity	▲	▲
Academic self-efficacy (Chapter 6)		
Mathematics self-efficacy	▲	○
Science self-efficacy	▲	○
Utility value (Chapter 7)		
Mathematics utility value	○	†
Science utility value	○	†
Growth mindset (Chapter 8)	○	†
Perseverance (Chapter 9)	▲	○

▲ Positively practically significant. Standardized regression coefficient $\geq$ .1.
○ Not practically significant. Standardized regression coefficient > -.1 and < .1.
— Data not available.
† Not applicable (additional analysis was not conducted).

Our analysis on attitudes toward school and school participation focuses on educational expectations (chapter 10), a sense of school belonging (chapter 11), academic behavior (chapter 12), and extracurricular participation (chapter 13). Educational expectations, a sense of school belonging, and academic behavior all showed a positive relationship with enrollment both before and after controlling for algebra achievement. Most of the extracurricular activities were also predictive of eventual enrollment in 4-year colleges, including participation at the 9th grade in mathematics and science activities and at the 11th grade in scouting or another group or club activity, drama/theater, and organized sports. Only participation in art and music/dance extracurriculars at the 11th grade did not predict eventual 4-year college enrollment. See Figure ES-2 below for a summary of the relationships between attitudes toward school and school participation and 4-year college enrollment.

Figure ES-2. Overall results for attitudes toward school and school participation factors

Factor	Relationship with 4-year college enrollment	
	Not controlling for algebra achievement	Controlling for algebra achievement
Educational expectations (Chapter 10)		
Expect associate's degree	○	○
Expect bachelor's degree	▲	▲
Expect graduate degree	▲	▲
Sense of school belonging (Chapter 11)	▲	▲
Academic behavior (Chapter 12)	▲	▲
Extracurricular participation (Chapter 13)		
9th-grader... Time spent on extracurriculars (continuous)	▲	▲
9th-grader participated in... Any math extracurricular since fall 2008	▲	▲
9th-grader participated in... Any science extracurricular since fall 2008	▲	▲
11th-grader participated in... Scouting or another group/club activity since fall 2009	▲	▲
11th-grader participated in... Organized sports since fall 2009	▲	▲
11th-grader participated in... Music or dance since fall 2009	▲	○
11th-grader participated in... Drama since fall 2009	▲	▲
11th-grader participated in... Art since fall 2009	▼	†

▲ Positively practically significant. Standardized regression coefficient ≥ .1.
▼ Negatively practically significant. Standardized regression coefficient ≤ -.1.
○ Not practically significant. Standardized regression coefficient > -.1 and < .1.
† Not applicable (additional analysis was not conducted).

Chapters 14-16 look at life skills and engagement in society, including collaborative skills (chapter 14), civic engagement (chapter 15), and work experiences in high school (chapter 16). None of the work experience variables showed positive relationships with 4-year college enrollment. Our research on collaborative skills and civic engagement only included a review of the literature as they were not measured in HSLS:09. See Figure ES-3 below for a summary of the relationships between these factors and 4-year college enrollment.

Figure ES-3. Overall results from life skills and engagement in society factors

Factor	Relationship with 4-year college enrollment	
	Not controlling for algebra achievement	Controlling for algebra achievement
Collaborative skills (Chapter 14)	—	—
Civic engagement (Chapter 15)	—	—
Work experience (Chapter 16)		
Teenager worked spring 2012	○	†
Teenager ever worked during school year	○	†
Time teenager spent working (continuous)	▼	†
Teenager worked in job related to career goals	○	†
Teenager participated in an internship	▼	†

▲ Positively practically significant. Standardized regression coefficient ≥ .1.
▼ Negatively practically significant. Standardized regression coefficient ≤ -.1.
○ Not practically significant. Standardized regression coefficient > -.1 and < .1.
— Data not available.
† Not applicable (additional analysis was not conducted).

This research provides key evidence that attitudes toward school and school participation are not only related to concurrent academic performance measures but also to later college enrollment, even after controlling for prior academic achievement. Students' academic motivation is also important, but much of the relationship between motivation and enrollment is captured by measures of students' prior academic achievement.

Based on this HSLS:09 analysis, it would be important for NAEP survey developers to consider collecting data on student-reported school factors such as educational expectations, a sense of school belonging, academic behavior, and extracurricular participation, as these variables tend not to be extensively measured in NAEP and have strong relationships with college enrollment.

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Chapter 1: Introduction

There is growing acknowledgment that college and workforce preparedness necessitates "noncognitive" traits, including intrapersonal skills, such as perseverance and self-efficacy, and interpersonal skills, such as collaborative skills (Farrington et al., 2012; Farrugia et al., 2018; Kyllonen, 2012; Prince et al., 2017; National Research Council, 2012).

While a number of research studies have examined the evidence supporting National Assessment of Educational Progress (NAEP) achievement results predicting college and workforce readiness (Fields, 2014; Moran et al., 2012; Ogut et al., 2011; Ogut et al., 2021; Schneider et al., 2015), little is known about the relationship of the noncognitive information collected through NAEP survey data and college and workforce outcomes.

With an eye toward providing predictive validity evidence to guide future NAEP and other large-scale assessment questionnaire development, this report examines 14 noncognitive constructs through a two-part research effort:

- An extensive literature review on the predictive validity of noncognitive constructs, with a special focus on reviewing findings from analyses of large-scale datasets; and
- An analysis of the High School Longitudinal Study of 2009 (HSLS:09) data to explore the relationship between various noncognitive factors available in the HSLS:09 database and college outcomes before and after controlling for performance on an HSLS:09 algebra assessment, which is strongly correlated with NAEP grade 12 mathematics scores.

NAEP preparedness research

Beginning in 2002, the National Assessment Governing Board (the Governing Board, or NAGB) began examining how information gathered from 12th-graders participating in NAEP could be enhanced. In 2003, it charged the National Commission on NAEP 12th-Grade Assessment and Reporting with evaluating the 12th-grade NAEP assessment. The commission developed several recommendations, including that NAEP should highlight students' preparedness for college coursework as well as entry into employment or the military (National Commission on NAEP 12th-Grade Assessment and Reporting, 2004, p. 6).

In 2009, the Governing Board established a working definition for college preparedness: "the reading and mathematics knowledge and skills to qualify for entry into a credit-bearing course en route to a 4-year undergraduate degree" as well as a separate definition for workplace training preparedness (NAGB, 2009, p. 3).

Based on the recommendations of an expert panel, a program of preparedness research was established in 2010. Research studies examining preparedness covered five categories, including statistical relationships, standard setting, benchmarking, content alignment, and a higher education survey (NAGB, 2016a). In 2013, the decision was made to establish scale score cut points for both the 12th-grade reading and mathematics assessments that would indicate college preparedness for 12th-grade students (NAGB, 2013, p. 53).

In 2016, the Governing Board developed its Strategic Vision through the year 2020, which included the initiative to "develop new approaches to measure the complex skills required for transition to postsecondary education and career" (NAGB, 2016b, p. 2).

Work surrounding preparedness continues, including a Preparedness & Preparedness Overview Focus on NAEP. Therefore, it is important that factors leading to students' postsecondary success continue to be explored.

NAEP academic performance predicting preparedness

Multiple studies have looked at NAEP achievement and postsecondary education outcomes. Using longitudinal data from the state of Florida, the Governing Board conducted linking studies to establish and confirm the validity of NAEP preparedness benchmark scores (Fields, 2014). For example, analyzing a sample of students from Florida who participated in the 2009 NAEP mathematics (n=3,200) or reading (n=3,400) assessments, Moran et al. (2012) found results that supported relationships between 12th-grade NAEP performance and preparedness indicators, including SAT performance, ACT performance, ACCUPLACER performance, 4-year state university enrollment, first-year college remedial courses, and first-year college achievement (i.e., grade point average of at least a B-).

Extending this research, Ogut et al. (2021), in a study commissioned by NCES under the ESSIN Task 14 contract, analyzed a nationally representative sample of 12th-graders participating in HSLS:09, imputing NAEP scores for the sample based on the 3,470 12th-graders who participated in both HSLS:09 and the 2013 NAEP. Ogut et al. (2021) found that NAEP mathematics performance accounted for 28 percent of the variance in college enrollment and 34 percent of the variance in the selectivity of the college enrolled in. In addition, performing at NAEP achievement levels with higher cut scores was associated with increased probabilities of overall entry into a 4-year college, entry into a selective 4-year college, entry into college without remedial courses, majoring in a STEM subject, and staying in college through students' expected junior year.

NAEP noncognitive survey data and preparedness research

Given this context, the goal of this study is to explore the predictive validity of noncognitive constructs that could be collected through the NAEP student surveys.

This research builds on that of Zhang et al. (2021), who, in another study commissioned by NCES under the ESSIN Task 14 contract, examined the relationship between motivation, STEM coursetaking in high school, and majoring in a STEM-related field in college. Zhang et al. (2021) analyzed an imputed HSLS:09 dataset containing 6,820 4-year college attendees derived from the NAEP 2013 and HSLS:09 overlap sample. They found a relationship between holding a mathematics or science identity and pursuing a STEM major in college as well as having higher educational expectations and pursuing a STEM major. Additionally, students who took an AP science course, a physics course, an engineering course, or an overall STEM-related course were more likely to pursue a STEM-related major.

In contrast with Zhang et al.'s approach, which focused on majoring in STEM fields in college, our research focuses on how noncognitive constructs predict eventual enrollment in 4-year colleges. Additional outcomes can be investigated in future research efforts.

Report structure

We begin this 16-chapter report by outlining our analysis methodology in chapter 2.

The chapters covering each of the 14 noncognitive constructs follow in chapters 3-16. Each chapter focuses on a noncognitive factor, first reviewing the literature on the concurrent and predictive validity evidence associated with each factor and then reporting on our HSLS:09 analysis of the relationship between the factor and college enrollment. As HSLS:09 does not include high school measures of enjoyment of complex problems (chapter 4), collaborative skills (chapter 14), or civic engagement (chapter 15), those chapters do not include analysis sections.

Chapters 3-9 focus on noncognitive motivational constructs, including academic interest (chapter 3), enjoyment of complex problems (chapter 4), academic identity (chapter 5), academic self-efficacy (chapter 6), utility value (chapter 7), growth mindset (chapter 8), and perseverance (chapter 9).

Chapters 10-13 examine attitudes toward school and school participation, including educational expectations (chapter 10), a sense of school belonging (chapter 11), academic behavior (chapter 12), and extracurricular participation (chapter 13).

Chapters 14-16 look at life skills and engagement in society, including collaborative skills (chapter 14), civic engagement (chapter 15), and work experience (chapter 16).

This study was commissioned by NCES under the ESSIN Task 14 contract.

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Chapter 2: Methodology

Introduction

As outlined in Chapter 1, the purpose of this study is to examine which noncognitive constructs measured in high school predict eventual enrollment in a 4-year college. Identifying such constructs has the potential to provide a new criterion for deciding what constructs are important to include in NAEP and other large-scale assessment surveys—e.g., the Trends in International Mathematics and Science Study (TIMSS), Progress in International Reading Literacy Study (PIRLS), and Program for International Student Assessment (PISA)—going forward.

The scope for this research is wide, with 14 constructs being examined individually across the following 14 chapters. We examined the ability to predict college enrollment through a literature review and, when data were available, through a simple structural equation model using the longitudinal data available through the first two waves of the High School Longitudinal Study of 2009 (HSLS:09). The first wave of HSLS:09, conducted in 2009, collected data from a random sample of U.S. ninth-graders; the second wave (first follow-up) was conducted 2 years later, in 2012, when most of these students were in the 11th grade. The college outcome measures were taken from the fourth wave, which collected data from the same participants in 2016, when many following the standard progression would be juniors in college. These waves collected data on 11 of the 14 constructs examined in this publication.

Identifying and defining the constructs

To begin this research, we first identified constructs measured in recent NAEP student surveys and in surveys from TIMSS, PIRLS, and PISA. Then, we examined which of these constructs were measured in the first wave of HSLS:09, when students were in the ninth grade, and in the second wave (first follow-up), when most students were in the 11th grade. Constructs overlapping HSLS:09 and NAEP and other large-scale assessments were included in the study. We also included constructs measured in HSLS:09 that could be measured more regularly in large-scale assessments.

Three constructs not included in HSLS:09 were also included in this research: collaborative skills, enjoyment of complex tasks, and civic engagement. The collaborative skills construct was deemed to be relevant to measure because it is often considered an important 21st century skill and was recently assessed through PISA (OECD, 2017); enjoyment of complex tasks was included as it is a construct measured in NAEP in both 2017 and 2019; finally, civic engagement was included as it is an important construct measured in the 2018 NAEP civics assessment.

Each chapter begins with a definition of the construct being measured. We endeavored to clearly and concisely explain what the construct includes and also differentiate it from other similar constructs. For example, in Chapter 6: Academic Self-Efficacy, we define both what self-efficacy is ("the belief of individuals in their ability to complete an academic task or achieve an academic goal") and how it is different from similar constructs, like academic self-concept.

Throughout the writing process, we were challenged by the jingle-jangle fallacy, a term coined by Marsh (1994) to refer to the misalignment between construct names and construct definitions in the educational and psychological literature. The jingle fallacy occurs when two different constructs are referred to by the same name in the literature, and the jangle fallacy occurs when the same construct is called by different names. For example, we encountered the jangle fallacy during the writing of Chapter 11: Sense of School Belonging, with the "school belonging" construct being variously referred to in the literature as school bonding, school connectedness, and social bonds.

To overcome this challenge, we strove to clearly define the construct at the beginning of each chapter, so that our literature review could then clearly identify which papers examined our target constructs without getting sidetracked by differences in naming conventions in the literature.

Literature review

Our literature review is focused on synthesizing research across large-scale studies. For each chapter, one section examines concurrent validity evidence and the subsequent section examines predictive validity evidence.

Concurrent validity focuses on the relationships between the target construct and favorable outcomes that are measured around the same time point. Most large-scale assessment surveys are administered together with the cognitive assessment. For example, students who take the NAEP cognitive assessment also complete a survey, and the association between survey responses for items or scales and student achievement provides concurrent validity evidence. This relationship with achievement is one of the main criteria for item and topic inclusion, as it is in international assessments (Hooper, 2021).

For this reason, each concurrent validity evidence section begins by noting this concurrent relationship seen in NAEP and other large-scale studies. When the variables were measured in NAEP, we conducted such analysis ourselves using the NAEP Date Explorer. The relationships between the target constructs and educational outcomes were also examined by summarizing results for meta-analysis.

Knowing the concurrent relationships between each construct and student achievement sets the backdrop for examining the predictiveness of each construct. Concurrent relationships are often reported in large-scale assessment reports (Mullis et al., 2017; Mullis et al., 2020; OECD, 2019), but they lack longitudinal evidence; the value added by this publication is that it also identifies the predictiveness of these constructs.

In synthesizing the literature on predictive relationships, our focus was on large-scale longitudinal studies, ideally with data that are representative of the population of interest. For this reason, much of the work synthesizes papers that analyze NCES's large-scale surveys, such as HSLS:09, the Education Longitudinal Study of 2002 (ELS:2002), and the National Education Longitudinal Study of 1988 (NELS:88), as well as other large-scale longitudinal surveys, both within the United States (e.g., the Longitudinal Study of American Youth, the Youth in Transition study) and internationally (e.g., the German National Educational Assessment, the Longitudinal Study of Young People in England). It should be noted that representative longitudinal research was not always available in large supply for some of the constructs; therefore, nonrepresentative samples were also incorporated into some of the reviews.

While we focused our literature review on the predictiveness of constructs measured in high school or late middle school (e.g., eighth grade) and outcomes measured in college, data for these specific grade levels was sometimes limited; in these instances, we included a wider variety of longitudinal studies at other grade levels in our analysis.

Analyzing HSLS:09 data to measure predictors of preparedness

Our analysis examined how each of the measures that were included in the first two waves of HSLS:09 were related to college enrollment.

Of the 14 measures examined in the report, data were collected for 10 of them in the first two waves of the study, and some items were collected across both the first wave, when students were 9th-graders, and the second wave, when most students were 11th-graders. If items in the construct were asked across the two first waves, the items in the first wave were analyzed because we wanted to maximize the time between the measure of the survey and the secondary outcome.

When possible, we attempted to measure each construct with a number of items, as is generally considered to be best practice (Crocker & Algina, 2008; Devellis, 2012; Hooper, 2021). Certain chapters, however, necessitated using stand-alone items to measure a construct. For example, for Chapter 13: Extracurricular Participation and Educational Outcomes, we measured each extracurricular activity (e.g., sports, band, art) separately. When a latent factor was measured, a correlation was expected between the indicator items. As students only have limited time to participate in extracurricular activities, such a correlation was not expected, so each item was measured separately.

Our outcome variable is whether students were enrolled in a 4-year college in 2016, 3 years after graduation. As such, this research strives to measure both enrollment and perseverance in 4-year colleges. Students classified as enrolled would be those who were in a 4-year college at that time or who had already graduated from a 4-year college (37 percent of the cohort). Students who were attending a 2-year college or a certificate program or who had graduated from such a program but were not currently enrolled in a 4-year college (19 percent of the cohort) were not included in the analytic sample for our analysis as preliminary analyses suggested that the predictive validity measures were very different for 4- and 2-year college enrollment. The comparison group was participants who were not enrolled in a postsecondary program in 2016 and had not graduated from a postsecondary program (43 percent of the cohort).

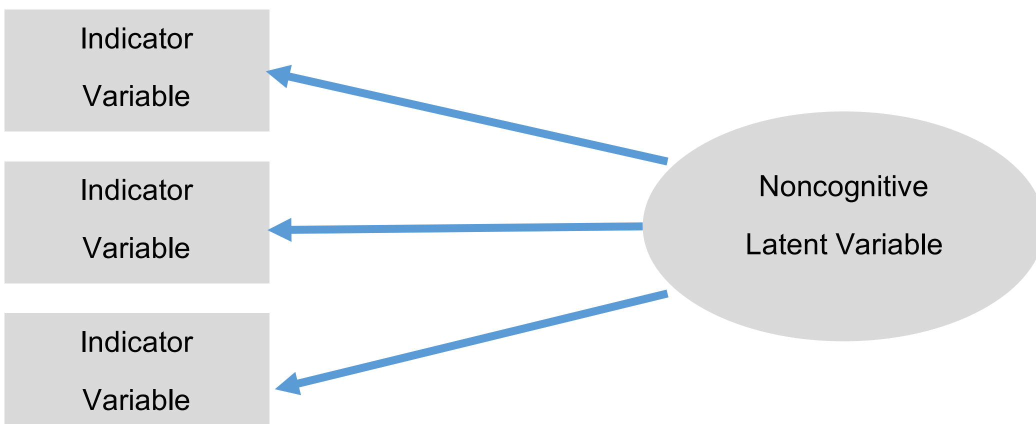
Students participating in HSLS:09 took an algebra assessment for each of the first two waves in addition to the survey. The ninth-grade algebra assessment was found to explain 70 percent of the variance in 12th-grade NAEP mathematics scores and the 11th-grade algebra assessment was found to explain 75 percent of the variance (Ogut et al., 2019). Given the strong relationship with NAEP achievement, these algebra measures can be used as a proxy for achievement on NAEP and other large-scale assessments.[1]

Structural equation model details

The analysis follows a structural equation modeling approach.

For each latent construct, we first examined the fit of the measurement model. As can be seen in Figure 2-a, a measurement model includes a number of items that represent a latent construct.

Figure 2-a. Measurement model



For each measurement model, standardized loadings and fit statistics were examined. We expected a model with a good fit to have acceptable fit statistics and loadings over .6. With a few exceptions, the measurement models had a good fit. For example, for school belonging, we originally included the variable "9th-grader feels that school is a waste of time," but poor fit statistics suggested the model could be improved by deleting this item and continuing with the remainder of the items.

After examining the measurement model, a simple model was analyzed regressing 4-year college enrollment outcomes on each latent variable. Probit regression was used because the

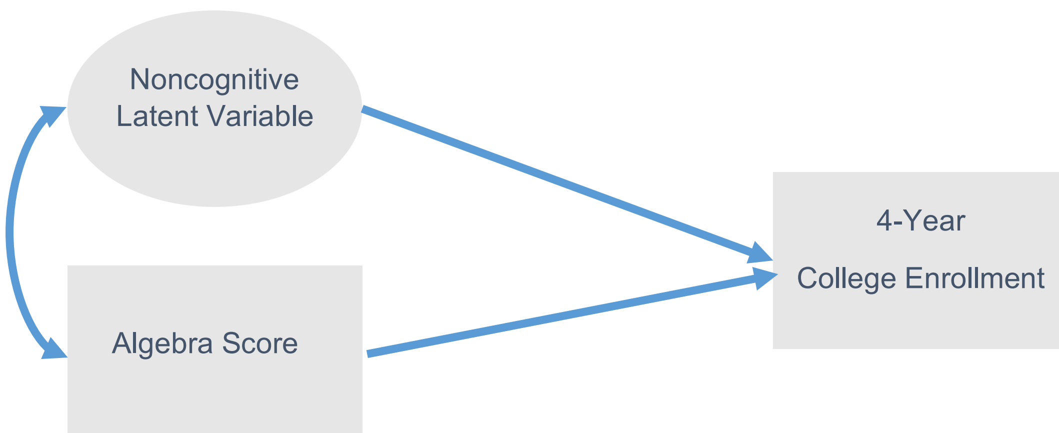
[1] As only some HSLS:09 students also participated in NAEP, a number of previous studies, such as Ogut et al. (2021), imputed NAEP scores for members of their analytic sample who did not take NAEP.

outcome variable is binary; it was coded as 1 if the student was enrolled and 0 if the student was not enrolled.

For these analyses, a practical significance level of a standardized coefficient of .1 was used. Given the large sample size with HSLS, it was our expectation that many variables would be found to be statistically significant with effect sizes so low they would have little practical value. A standardized value 0.1 was chosen as the threshold for practical significance as a correlation of 0.1 is generally considered the lower bound of a small effect size.

When the relationship reached our practical significance level of 0.1, we re-ran the analysis with our full structural equation model (Figure 2-b), which includes the covariate of students' algebra score. When a ninth-grade noncognitive variable was analyzed, the ninth-grade algebra score was employed as the covariate, and when an 11th-grade noncognitive variable was analyzed, an 11th-grade algebra score was added as the covariate. For this model, the relationship between the noncognitive variables and the 4-year college enrollment option was also assessed using a practical significance level of 0.1.

Figure 2-b. Structural equation model of the relationship between noncognitive latent variable and 4-year college enrollment (indicators for the non-cognitive latent variable not shown)



Technical details

The HSLS:09 sample was selected using a complex stratified design, and as is the case in many longitudinal studies, there was some attrition over time, with students participating in the first wave not always participating in subsequent waves.

To ensure a representative sample, given this stratified design and sample attrition, the HSLS:09 dataset includes a number of different sets of weights. The weights vary not only on initial probability of student selection but also based on poststratification reweighting. As this analysis uses data from the first, second, and fourth waves of HSLS:09, we used the W4W1W2W3 weight, which includes only students who participated in all four waves, with the data reweighted so that the demographic composition is similar to that of the original sample.

The analysis was conducted in Mplus using the W4W1W2W3 weight. To ensure a robust estimation of standard errors, the replicate weights provided by HSLS:09 were employed in the analysis through the jackknifing approach. All standard errors for the path coefficients were estimated through this jackknife approach. However, when jackknifing is employed, Mplus is unable to estimate model fit statistics. For this reason, the fit statistics reported were estimated without employing the replicate weights.

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Chapter 3: Academic Interest

Introduction

Academic interest refers to one's liking, and having interest in, a subject and is a key foundational aspect of intrinsic motivation—the inner drive that gives the energy to engage in and complete tasks (Deci & Ryan, 1985; Wigfield et al., 2016). Intrinsic motivation represents our interest and enjoyment of a topic area or task and how this interest and enjoyment gives us the energy to take action (Petscher, 2010; Schiefele et al., 2012).

Given the similarities between academic interest and intrinsic motivation, they are often reviewed together (e.g., Wigfield et al., 2016), as is done in this chapter.

Intrinsic motivation differs from extrinsic motivation, which represents students' propensity to take action based on external rewards such as praise, good grades, and future career opportunities (Wang & Guthrie, 2004).

Academic interest/intrinsic motivation can be general or subject-specific (Jacobs & Newstead, 2000; Schiefele et al., 1992). A student who has a great interest in mathematics does not necessarily have the same level of interest in science, reading, or art.

The causal directionality of the relationship between academic interest and academic outcomes is a matter of debate (Guo et al., 2015). It is likely a bidirectional relationship where successful performance leads to more interest and effort and, in turn, more effort leads to better performance.

Literature demonstrating concurrent validity evidence

Large-scale assessments and surveys in the United States, such as NAEP, have consistently shown that students who are interested in reading or mathematics have higher reading or mathematics scores. For example, the 2019 NAEP mathematics assessment shows that U.S. eighth graders who were classified as "high" on the students' interest/enjoyment in mathematics index had an average NAEP mathematics score of 292, which was 20 points higher than students classified as "low" on the index.[2]

Results from international assessments align with these findings. For instance, the 2015 Trends in International Mathematics and Science Study (TIMSS) results show that students who like learning mathematics tend to have higher fourth-and eighth-grade mathematics achievement (Mullis et al., 2016). Similar results were found for students who like learning science and science achievement (Martin et al., 2016).

[2] Analysis conducted using the NAEP Data Explorer: https://www.nationsreportcard.gov/ndecore/xplore/NDE.

Meta-analyses and other types of research syntheses have confirmed these results:

- Schiefele et al. (1992) reviewed 121 studies and found that the average correlation coefficients showing the relationship between academic interest in a subject and subject-specific achievement to be .31 across all subjects, with a correlation of .32 for mathematics and .35 for science.
- More recently, a meta-analysis by Cerasoli et al. (2014) found intrinsic motivation to have a similar relationship with performance, with correlations between .21 and .45 across different contexts (e.g., academics, work).

Similar concurrent relationships have been found between intrinsic motivation and college outcomes. For example, Komarraju et al. (2008) found a relationship between intrinsic motivation among undergraduates and college grade point average.

Literature demonstrating predictive validity evidence

There is also large-scale research examining the longitudinal relationship between academic interest in K-12 and later achievement and postsecondary outcomes.

- Bohrnstedt et al. (2020) analyzed data from the HSLS:09 and NAEP 2013 overlap sample and found that mathematics interest at grade 11 was not related to mathematics achievement at grade 12 after controlling for mathematics self-efficacy, mathematics identity, prior mathematics achievement, mathematics course-taking, student demographic factors, and educational expectations.
- Using longitudinal data of German students at the 7th, 10th, and 12th grades, Köller et al. (2001) found paradoxical results. They found that 7th-grade mathematics interest was not related to 10th-grade mathematics achievement after controlling for prior achievement. However, they found that 10th-grade mathematics interest was related to 12th-grade achievement even after controlling for 10th-grade mathematics achievement. The authors posit that because older students have more freedom and less structure, their liking of the subject is a more important predictor than it is earlier on in schooling.
- Taylor et al. (2014) analyzed the predictors of achievement for high school and college students in Canada and Sweden. They found general intrinsic motivation at one time point to be a significant predictor of achievement 1 year later, even after controlling for prior academic achievement.
- Guo et al. (2015) examined the five-wave Youth in Transition study, which tracked 2,213 males in the United States between 10th grade (in 1966) and 5 years after their expected high school graduation (in 1974). Their results only showed a small, yet significant, indirect effect between 10th- and 11th-grade general intrinsic motivation and later educational attainment, after controlling for academic achievement, extrinsic motivation, academic self-concept, and academic aspirations.

- Gottfried et al. (2013) analyzed data from the Fullerton Longitudinal Study to examine the longitudinal relationship of mathematics achievement and intrinsic mathematics motivation on educational attainment at age 29. Although there was an indirect relationship between intrinsic mathematics motivation and later educational attainment through course accomplishments (intrinsic motivation predicts course accomplishments), no direct relationship was found after controlling for mathematics achievement and course accomplishments. In other words, the relationship between mathematics motivation and later attainment was mediated by the math courses the students enrolled in.

In summary, these longitudinal studies showed mixed results. Two of the three studies examining the relationship between academic interest and later achievement showed a significant relationship. However, the two studies looking at postsecondary attainment did not show a direct relationship between academic interest and postsecondary attainment after adding controls, such as previous academic achievement or courses taken.

Analyzing academic interest using HSLS:09 measures

For these analyses, we used HSLS:09 academic interest items from the base-year survey, which was administered to ninth graders in 2009. As Table 3-a shows, the base-year survey included six items to measure students' interest in their mathematics courses and six items to measure students' interest in their science courses. The response options and coding are also noted in the table.

Table 3-a. HSLS:09 variables measuring mathematics and science interest

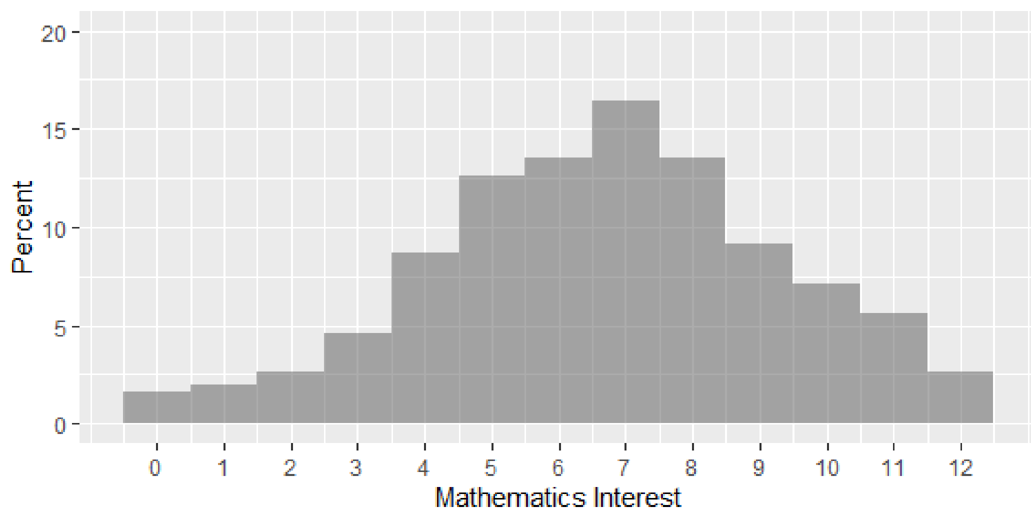
Mathematics interest	Science interest
9th-grader is enjoying fall 2009 math course very much *(Strongly agree = 3; Agree = 2; Disagree = 1; Strongly disagree = 0)*	9th-grader is enjoying fall 2009 science course very much *(Strongly agree = 3; Agree = 2; Disagree = 1; Strongly disagree = 0)*
9th-grader thinks fall 2009 math course is a waste of time *(Strongly agree = 0; Agree = 1; Disagree = 2; Strongly disagree = 3)*	9th-grader thinks fall 2009 science course is a waste of time *(Strongly agree = 0; Agree = 1; Disagree = 2; Strongly disagree = 3)*
9th-grader thinks fall 2009 math course is boring *(Strongly agree = 0; Agree = 1; Disagree = 2; Strongly disagree = 3)*	9th-grader thinks fall 2009 science course is boring *(Strongly agree = 0; Agree = 1; Disagree = 2; Strongly disagree = 3)*
9th-grader's favorite school subject is math *(If endorsed mathematics = 1; If endorsed other subject = 0)*	9th-grader's favorite school subject is science *(If endorsed science = 1; If endorsed other subject = 0)*
9th-grader's least favorite school subject is math *(If endorsed mathematics = 0; If endorsed other subject = 1)*	9th-grader's least favorite school subject is science *(If endorsed science = 0; If endorsed other subject = 1)*
9th-grader is taking fall 2009 math because he/she really enjoys math *(Yes = 1; No = 0)*	9th-grader is taking fall 2009 science because he/she really enjoys science *(Yes = 1; No = 0)*

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), Base Year: 2009.

As in the other chapters, the outcome variable for this chapter is whether students were enrolled in a 4-year college in 2016, 3 years after their expected graduation from high school.

In order to provide detail on the distribution of the measure, the scores for the six items were summed for each student to create a mathematics summative scale; the weighted distribution of the analytic sample is shown in Figure 3-a. The count for students with a score of 12 reflects the percentage of students who had the highest score on all six items. The histogram shows a relatively normal distribution, with a mode of 7.

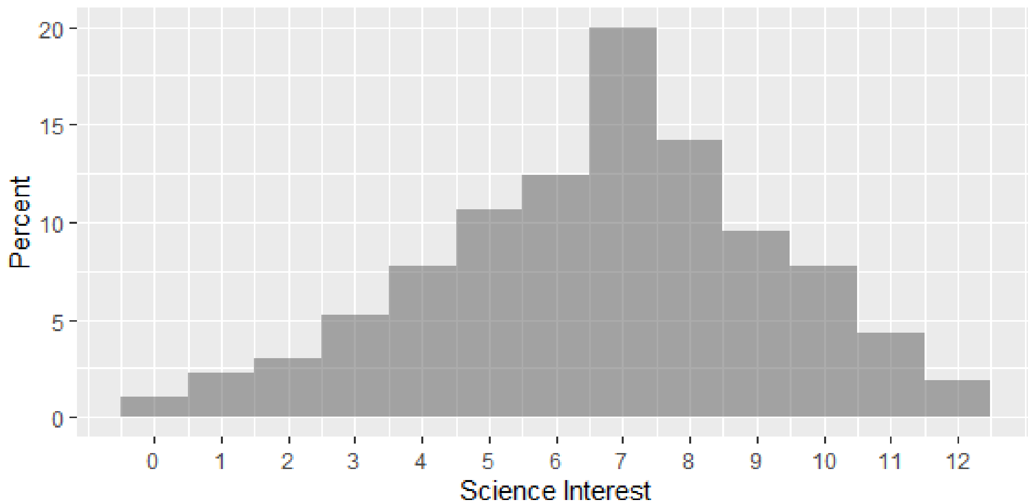
Figure 3-a. Distribution of mathematics interest measure



SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), Base Year: 2009.

A similar process was followed for the science interest scale (Figure 3-b), with the count for students with a score of 12 reflecting the percentage of students who have the highest score on all six items. The science interest histogram shows a relatively normal distribution, with a mode of 7.

Figure 3-b. Distribution of science interest measure



SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), Base Year: 2009.

The structural equation modeling analysis that follows was conducted using data from the individual items to measure mathematics interest and science interest as a latent variable, rather than by analyzing this summative scale variable.

Results

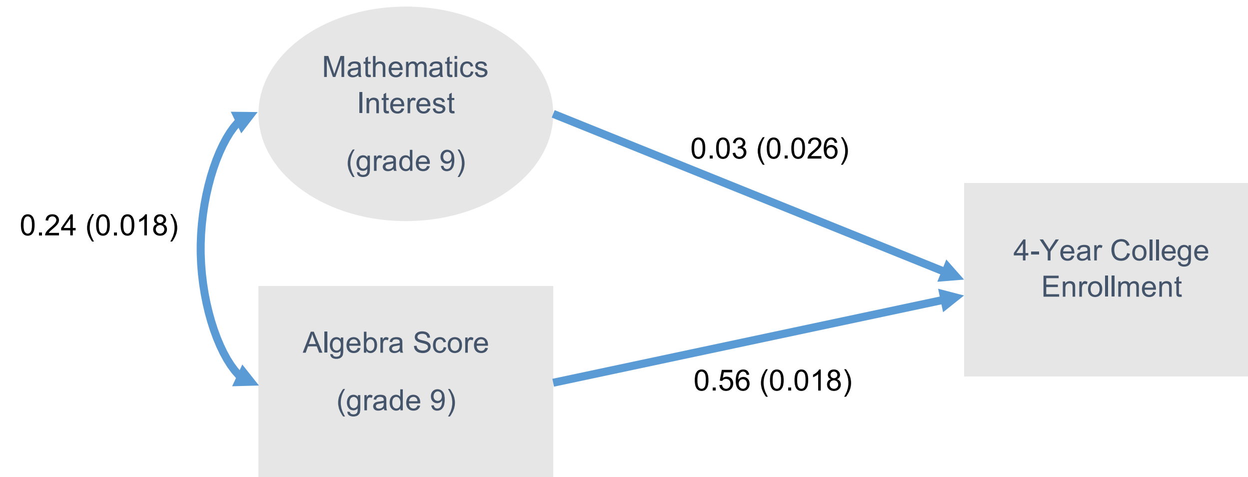
Analyses were conducted to examine the relationship between mathematics interest and enrollment in a 4-year college 3 years after high school graduation and, separately, the relationship between science interest and enrollment in a 4-year college.

Students' enrollment status at a 4-year college, 3 years after high school, was regressed on the academic interest latent variable using structural equation modeling, before and after controlling for ninth-grade algebra scores. A practical significance level is noted when the standardized regression coefficient had a value above 0.1.

For the initial analysis, 4-year enrollment was regressed on mathematics interest, without adding any control. A practically significant standardized regression coefficient of 0.16 was found between mathematics interest and enrollment in a 4-year college. However, the strength of this relationship fell to a nonsignificant 0.03 after controlling for ninth-grade algebra scores (Figure 3-c, Table 3-b).

Next, enrollment in a 4-year college was regressed on science interest, without adding any control. A practically significant standardized regression coefficient of 0.11 was found between science interest and enrollment in a 4-year college. However, the strength of this relationship fell to a nonsignificant 0.03 after controlling for ninth-grade algebra scores (Figure 3-d, Table 3-b).

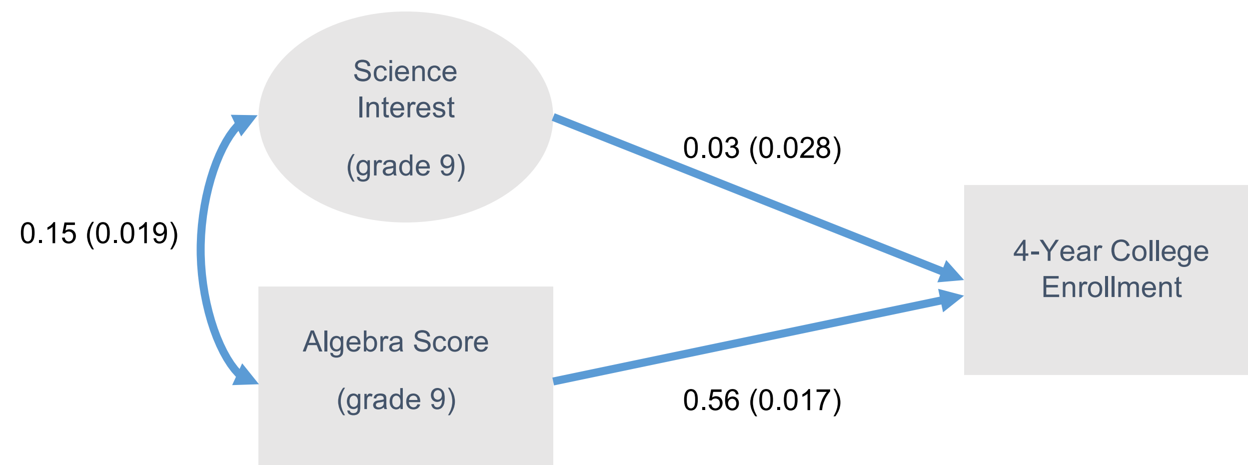
Figure 3-c. Structural equation model of relationship between mathematics interest and 4-year college enrollment



Mathematics Interest Coefficient		
Controlling for Algebra	Est.	SE
Before	0.16	(0.026)
After	0.03	(0.026)

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), Base Year to Second Follow-up: 2009-2016.

Figure 3-d. Structural equation model of relationship between science interest and 4-year college enrollment



Science Interest Coefficient		
Controlling for Algebra	Est.	SE
Before	0.11	(0.030)
After	0.03	(0.028)

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), Base Year to Second Follow-up: 2009-2016.

Table 3-b. Academic interest of 9th-graders: Structural equation model results

Items	Math interest: Standardized loadings	Math interest: SE	Science interest: Standardized loadings	Science interest: SE
Took fall 2009 course because really enjoys math/science	0.67	0.022	0.58	0.020
Enjoying fall 2009 course	0.83	0.011	0.83	0.012
Thinks fall 2009 course is a waste of time	0.73	0.019	0.82	0.012
Thinks fall 2009 course is boring	0.79	0.015	0.82	0.012
Favorite school subject is math/science	0.60	0.020	0.55	0.026
Least favorite school subject is math/science	0.64	0.018	0.60	0.023
Path coefficients	**Standardized coefficients**	**SE**	**Standardized coefficients**	**SE**
Math/science interest → 4-year college enrollment	0.03	0.026	0.03	0.028
9th-grade algebra → 4-year college enrollment	0.56	0.018	0.56	0.017
Math/science interest with 9th-grade algebra	0.24	0.018	0.15	0.019
Model fit		**Fit**		**Fit**
RMSEA	0.031		0.024	
CFI	0.970		0.983	
TLI	0.955		0.976	
Chi-squared	422.081		274.706	
DF	19		19	
P-value	<.01		<.01	

NOTE: Weight W4W1W2W3 was applied for the analysis.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), Base year to Second Follow-up: 2009-2016.

Conclusion

The results of these analyses align with those of prior research. While both the mathematics and science models show practically significant relationships between academic interest and 4-year college enrollment, these relationships dissipate after controlling for ninth-grade algebra test scores as a proxy for overall mathematical ability. The lack of direct effects aligns with the findings of Guo et al. (2015) and Gottfried et al. (2013), who did not find a direct relationship between academic interest and 4-year college enrollment in their research.

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Chapter 4: Enjoyment of Complex Problems

Introduction

Enjoyment of complex problems captures students' mindset toward learning and their liking of and engagement with academic challenges, such as completing complex tasks, thinking about creative solutions to problems, and participating in thoughtful activities (Bertling, 2014).

The framework for measuring enjoyment of complex problems in NAEP and other large-scale assessments stems from the concept of the need for cognition, which examines an individual's interest in intellectually stimulating material and an enjoyment of the thought process, as well as an openness to problem solving or learning (Bertling, 2014; Cacioppo & Petty, 1982; Cohen et al., 1955; OECD, 2013).

Enjoyment of complex problems is often included in measures of intellectual engagement. For example, the Typical Intellectual Engagement (TIE) scale (Goff & Ackerman, 1992) measures an individual's ability to "engage and understand their world" as well as "their preference for a complete understanding of a complex topic or problem" (p. 539). The TIE scale consists of 59 items, including questions that capture the measurement of enjoyment of complex problems (e.g., "You enjoy thinking out complicated problems"; "Thinking is not my idea of fun"). This scale has been found to be strongly correlated with the Need for Cognition (NFC) scale, which consists of 18 items (Cacioppo & Petty, 1982; Woo et al., 2007).

There are several factors that influence students' enjoyment of academic challenges. First, students' intellectual engagement is associated with several aspects of intrinsic motivation. Research demonstrates that students' interests, both broadly and task-specific, as well as their personal value of learning, are important factors in predicting engagement with challenging materials and the enjoyment of learning (Farrington et al., 2012; Inoue, 2007; Tulis & Fulmer, 2013).

Additionally, some evidence suggests that self-efficacy beliefs are related to the need for cognition in students, meaning that individuals who perceive themselves as able to complete academic tasks are more likely to choose and enjoy challenging academic material (Boggiano et al., 1988; Elias & Loomis, 2002).

Finally, it is posited that students' engagement in complex problems may be a malleable trait. Research demonstrates that students are more likely to enjoy learning and persevere at challenging tasks when teachers have high expectations of students and invest more time in them (Dweck et al., 2014). Furthermore, it has been found that clear and organized instruction is related to higher levels of need for cognition in university classes (Wang et al., 2015).

Literature demonstrating concurrent validity evidence

National large-scale assessments demonstrate the relationship between the enjoyment of challenging academic tasks and academic outcomes. NAEP measures the enjoyment of complex problems using four items that capture students' perceptions toward activities that challenge them (e.g., I like complex problems more than easy problems; I like activities that challenge my thinking abilities; I enjoy situations that require thinking about something new; I enjoy thinking about new solutions to problems). The results from a derived index of these questions demonstrate that students with a higher degree of enjoyment of complex problems have higher average scores on the assessment. For example, using the index, students taking the 12th-grade 2019 mathematics assessment who had a high degree of enjoyment of complex problems had an average score of 163, which was significantly higher than the scores of students who had a moderate degree of enjoyment (150) and a low degree of enjoyment (137).[3]

International large-scale assessments support these conclusions. PISA 2012 included a five-question index regarding openness to problem solving or handling challenging tasks (e.g., I like to solve complex problems). Within the OECD countries, these questions accounted for 12 percent of the variation in mathematics performance; across 44 countries, a 1-point increase in the five-question index was related to a 20-point[4] or greater increase in mathematics scores for 15-year-olds (OECD, 2013).

Additionally, a study using a nationally representative subsample of ninth-graders (n=7,207) from the 2012 German National Educational Assessment, a German large-scale assessment comparable to NAEP, found a strong association between intellectual engagement—a concept measured using an adopted TIE scale containing several questions measuring the enjoyment of complex problems (e.g., I like to think about challenging puzzles; I avoid complex problems)—and achievement in mathematics and science while controlling for demographic factors. However, this effect decreased when interest and fluid intelligence were added to the model (Schroeders et al., 2015).

Meta-analyses and other systematic reviews confirm these results:

- Von Stumm et al. (2011) completed a meta-analysis of studies that utilized the TIE scale to examine the relationship between intellectual engagement and academic achievement. They found that intellectual engagement, intelligence, and conscientiousness (a personality trait measuring academic effort) were all direct predictors of academic performance.

[3] Analysis conducted using the NAEP Data Explorer: https://www.nationsreportcard.gov/ndecore/xplore/NDE.

[4] The openness to problem-solving task index was scaled to have 1 point equal to 1 standard deviation across countries. The PISA mathematics trend scale was set in 2003 to have a mean of 500 and a standard deviation of 100 points across the 30 OECD countries participating in PISA that year.

- Cacioppo et al. (1996), examining more than 100 empirical studies, found that the need for cognition was associated with efforts such as the ability to recall more information and have more knowledge about topics in general. The need for cognition was also related to GPA both in high school and college as well as motivational constructs, such as intrinsic motivation.

Literature demonstrating predictive validity evidence

There are several studies examining the longitudinal relationship between measures such as the TIE scale and the NFC scale—both of which include indicators of the enjoyment of complex academic challenges—in K-12 and later measures of academic achievement and other outcomes.

- Van Rooij et al. (2017) measured enjoyment of complex problems as a part of intellectual engagement, along with academic interest, in a longitudinal study investigating the effect of high school engagement on academic achievement and adjustment (i.e., student's feelings towards school) in postsecondary institutions among students in the Netherlands (n=669). The 18-item NFC scale (e.g., I would prefer simple to complex problems) was administered in high school along with measures of academic motivation and self-efficacy. Students with high intellectual, cognitive, and behavioral engagement in grade 12 were significantly more likely to become well-adjusted to college than disengaged students, controlling for GPA and educational expectations. Students who had scored lower on the NFC scale and had less academic interest earned significantly fewer credits in their first year of college than students who scored higher in NFC and interest.
- In a longitudinal study of British university students (n=104) over 3 years, Chamorro-Premuzic et al. (2006) used the 59-item TIE scale, which includes items about one's enjoyment and engagement in various academic subjects and complex tasks, to examine the relationship between intellectual engagement, measured in the first semester of university, and academic performance, which was measured throughout the next 3 years, while controlling for personality traits and intelligence. They found that intellectual engagement was significantly related to all four measures of academic achievement (test scores, essay scores, final projects, and continuous assessment) and was more strongly associated with test and essay scores than either personality traits or intelligence.
- Furnham et al. (2009) examined the impact of intellectual engagement, using the TIE scale—which measures the enjoyment of complex problems, along with personality traits and learning style—to predict academic performance 10 months later using a sample of 212 British secondary students. They found that while intellectual engagement held only a small relationship with exam scores after controlling for intelligence, it did account for some variance in test scores after controlling for both personality traits and learning styles.

Conclusion

In summary, the enjoyment of complex problems has been defined and measured in a variety of different ways. Using measures such as the NFC scale and the TIE scale, a moderate, positive relationship between engagement in academic challenges and both academic and postsecondary outcomes has been established in large-scale assessments and meta-analyses as well as longitudinal studies. However, it is important to note that while these two scales capture the measurement of the enjoyment of complex problems, the NFC and TIE scales typically include a larger number of items (18 and 59, respectively) that measure other elements of intellectual engagement, such as abstract thinking and information seeking (Goff & Ackerman, 1992). Future research should be conducted examining the relationship more specifically between the enjoyment of complex problems and later academic and postsecondary outcomes.

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Chapter 5: Academic Identity

Introduction

Academic identity refers to how individuals perceive themselves with respect to their role as students (Bohrnstedt et al., 2020; Stets & Burke, 2000). Individuals' academic identities guide their behavior, with identities that are more prominent or important being more influential (Burke & Reitzes, 1981; Stets et al., 2017). For example, a student who identifies as a science person would be more likely to take advanced science courses, confirming their science identity to themselves and others. Recognition from significant others (e.g., teachers, peers, parents) as well as performance, competence, and interest in a subject contribute to the formation and development of subject-specific academic identities (e.g., writer) (Carlone & Johnson, 2007; Hazari et al., 2010).

Academic identity is closely related to academic self-concept, which describes an individual's views about the academic domains (Shavelson et al., 1976). People have multiple identities, some of which they value more than others (McCall & Simmons, 1978; Stets & Burke, 2003). This hierarchical collection of identities makes up the self (McCall & Simmons, 1978; Stryker, 1980) and structures one's self-concept (Gecas, 1982). Given the similarities between academic identity and self-concept, academic self-concept research is also included in this review.

Academic identity is distinct from academic self-efficacy, which refers to individuals' beliefs about their capabilities to execute an academic task (Bandura, 1997; Ferla et al., 2009). While both constructs are associated with academic motivation, self-efficacy focuses on task-specific beliefs rather than broader self-reflections (Ferla et al., 2009).

While an academic identity can be general or content specific, recent research has focused on content-specific identities, providing insight into academic achievement and occupational outcomes (Chemers et al., 2011; Hazari et al., 2010; Stets et al., 2017).

Literature demonstrating concurrent validity evidence

International assessments have found academic identity to be related to academic achievement. Lee and Stankov (2018) analyzed the relationship between noncognitive variables and student mathematics achievement using data from the 2003, 2007, and 2011 Trends in International Mathematics and Science Study (TIMSS) and the 2003 and 2012 Program for International Student Assessment (PISA). They found that mathematics self-concept was correlated with mathematics achievement for eighth-graders in TIMSS[5] (r=.25) and 15-year-olds in PISA (r=.26).

[5] The TIMSS "confidence in learning mathematics" scale includes similar items to the PISA self-concept in mathematics scale. These items are often used to measure self-concept (Abu-Hilal et al., 2013; Lee & Stankov, 2018).

The results from research within the United States align with these findings. For example, Prince & Nurius (2014) evaluated cross-sectional data from the State of Washington Beyond High School Study, which surveyed 9,658 high school seniors. They found that academic identity was associated with GPA as well as educational aspirations, after controlling for sociodemographic factors, school climate, and parental support.

Meta-analyses focusing on academic self-concept also demonstrate similar results. Möller et al. (2020) reviewed 118 datasets looking at domain-specific academic self-concept and achievement (measured as grades or standardized test scores). They found average path coefficients of .57 between mathematics self-concept and mathematics achievement and .46 between verbal self-concept and verbal achievement.

Literature demonstrating predictive validity evidence

There is limited large-scale research examining the longitudinal relationship between academic identity in K-12 and later achievement.

- Bohrnstedt et al. (2020) analyzed data from a sample of about 3,230 students who participated in both HSLS:09 and NAEP 2013 and found that mathematics identity as measured in HSLS:09 in grade 11 was positively correlated with grade 12 NAEP mathematics scores, after controlling for mathematics self-efficacy, mathematics interest, previous mathematics achievement, mathematics coursetaking, and student contextual factors.
- Stets et al. (2017) examined a sample of 966 students from *TheScienceStudy*, which tracked underrepresented students in STEM fields from college through post-graduation employment. Their results show that having a science identity in college is positively associated with entering a STEM occupation, after controlling for GPA, self-efficacy, goal orientations, behavioral intentions, and student demographic factors.

However, there is a considerable amount of existing longitudinal research examining the relationship between academic self-concept and future outcomes.

- Huang (2011) conducted a meta-analysis using 39 longitudinal samples evaluating self-concept (global, academic, and subject-specific) and academic achievement. Mean observed correlations between previous self-concept and later academic achievement ranged from .20 to .27, while mean observed correlations between previous academic achievement and later self-concept ranged from .19 to .25.
- Marsh and O'Mara (2008) analyzed the five-wave Youth in Transition study, which followed 2,213 males in the United States from 10th grade through 5 years after their expected high school graduation. They found reciprocal effects between academic self-concept and school grades: prior school grades were predictive of later academic self-concept, while academic self-concept was predictive of future school grades. In addition, academic self-concept in 11th grade was related to educational attainment 1 year after high school graduation.

- Guo et al. (2015) analyzed data from the Longitudinal Study of Australian Youth extension of PISA 2003, which followed 10,370 15-year-old students from 2003 through 2013. They found that mathematics self-concept at age 15 was positively related to university entry and majoring in a STEM field. However, these relationships were mediated by mathematics course selection in high school and tertiary entrance rank.
- Parker et al. (2012) examined the Longitudinal Study of Young People in England, which tracked 15,995 14-year-old students until just after high school. They found students' mathematics self-concept and English self-concept at age 14 were statistically significant predictors of university entry, but after controlling for achievement, mathematics self-concept was no longer significant.

While there is limited longitudinal research focusing on academic identity, the existing longitudinal research demonstrates a positive relationship between academic self-concept and future outcomes. The research also suggests that there is a reciprocal relationship between academic self-concept and academic achievement. However, some studies focusing on college entry find that prior academic achievement mediates the relationship between academic self-concept and college entry.

Analyzing academic identity using HSLS:09 measures

HSLS:09 included two student survey items at the ninth grade to measure students' mathematics identity and two student survey items to measure students' science identity (Table 5-a). The survey items measure how individuals perceive themselves as well as how they believe others perceive them with respect to academic subjects.

In the current analysis, the data from student responses to these items were used as indicators for latent variables measuring students' mathematics and science identities. The response categories associated with the statements were "Strongly agree," "Agree," "Disagree," and "Strongly disagree." The data were coded so that the scores ranged from 3, for "Strongly agree," to 0, for "Strongly disagree," in each subject. As such, a positive score on the scale represents having a stronger sense of academic identity.

Table 5-a. HSLS:09 variables measuring mathematics and science identities

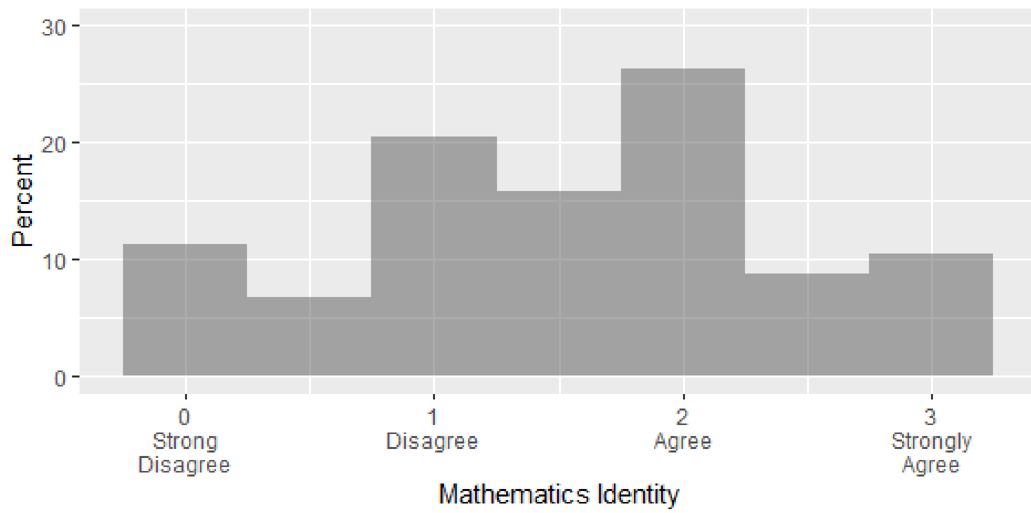
Mathematics identity	Science identity
9th-grader sees self as a math person	*9th-grader sees self as a science person*
Others see 9th-grader as a math person	*Others see 9th-grader as a science person*

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), Base Year: 2009.

As in the other chapters, the outcome variable for this chapter is whether students are enrolled in a 4-year college in 2016, 3 years after their expected graduation from high school.

In order to provide detail on the distribution of the measure, students' scores on the two items were averaged for each student to create a mathematics identity summative scale; the weighted distribution of the analytic sample is shown in Figure 5-a. The count for students with a score of 3 reflects the percentage of students who strongly agree to both items. The histogram shows that over 25 percent of the students have a score of 2, reflecting that on average they agree with being considered a math person.

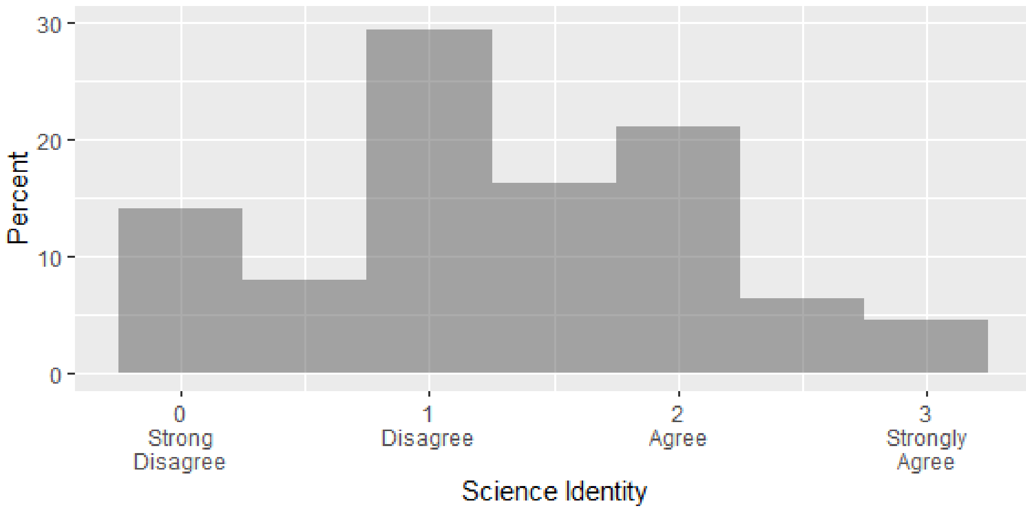
Figure 5-a. Distribution of mathematics identity measure



SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), Base Year: 2009.

A similar process was followed for the science identity scale (Figure 5-b), with the count for students with a score of 3 reflecting the percentage of students who have the highest score on both items. The histogram shows that nearly 30 percent of the students have a score of 1, reflecting that on average they disagree with being considered a science person.

Figure 5-b. Distribution of science identity measure



SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09) Base Year: 2009.

The structural equation modeling analysis that follows was conducted using data from the individual items to measure mathematics identity and science identity as a latent variable rather than by analyzing this summative scale variable.

Results

Analyses were conducted to examine the relationship between mathematics identity in ninth grade and enrollment in a 4-year college 3 years after students' expected high school graduation; the same analyses were run separately to examine the relationship between science identity in ninth grade and enrollment in a 4-year college.

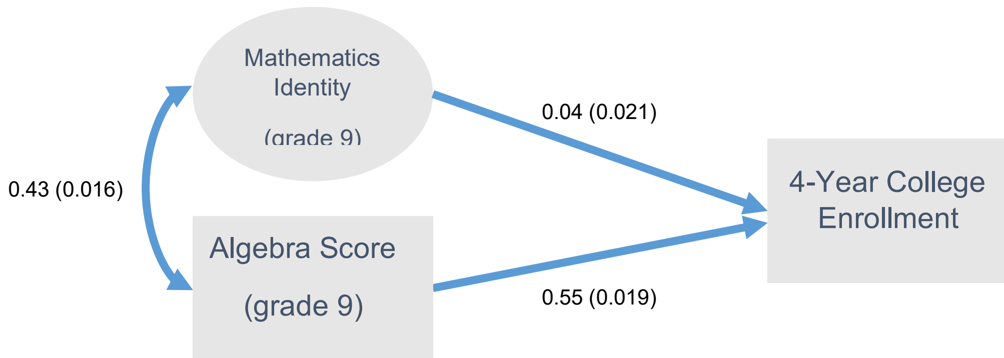
The enrollment status of HSLS:09 students at a 4-year college, 3 years after most had graduated from high school, was regressed on the academic identity latent variable using structural equation modeling, before and after controlling for ninth-grade algebra scores, which are used as a proxy for previous mathematics achievement. A practical significance level is noted when standardized regression coefficients had values at or above 0.1.

For the initial analysis, 4-year enrollment was regressed on mathematics identity, without adding any control. A practically significant standardized regression coefficient of 0.27 was found between mathematics identity and enrollment in a 4-year college. However, the strength of this relationship fell to a nonsignificant 0.04 after controlling for ninth-grade algebra scores (Figure 5-c, Table 5-b).

Next, enrollment in a 4-year college was regressed on science identity without adding any control. A practically significant standardized regression coefficient of 0.28 was found between science identity and enrollment in a 4-year college. The coefficient remained practically significant but decreased to 0.13 after controlling for ninth-grade algebra scores (Figure 5-d, Table 5-b).

Science identity may have remained significantly related to 4-year college enrollment while mathematics identity did not because the correlation between the ninth-grade algebra score and science identity is 0.27, substantially lower than its correlation with mathematics identity (0.43).

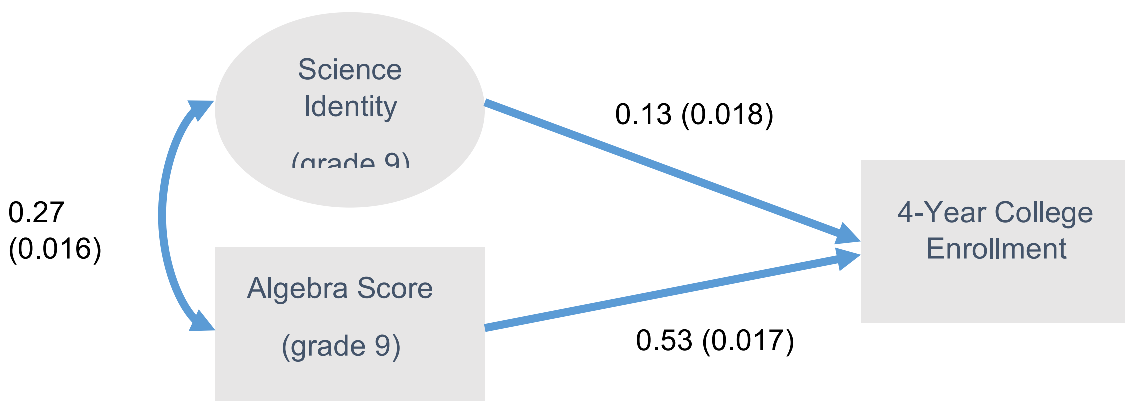
Figure 5-c. Structural equation model of the relationship between mathematics identity and 4-year college enrollment



Mathematics Identity Coefficient		
Controlling for Algebra	Est.	SE
Before	0.27	(0.020)
After	0.04	(0.021)

NOTE: Weight W4W1W2W3 was applied for the analysis.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), Base Year to Second Follow-up: 2009-2016.

Figure 5-d. Structural equation model of the relationship between science identity and 4-year college enrollment



Science Identity Coefficient		
Controlling for Algebra	Est.	SE
Before	0.28	(0.019)
After	0.13	(0.018)

NOTE: Weight W4W1W2W3 was applied for the analysis.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), Base Year to Second Follow-up: 2009-2016.

Table 5-b. Academic identity of 9th-graders: Structural equation model results

	Math identity		Science identity	
Items	**Standardized loadings**	**SE**	**Standardized loadings**	**SE**
9th-grader sees self as a math/science person	0.85	0.016	0.83	0.022
Others see 9th-grader as a math/science person	0.93	0.018	0.95	0.025
Path coefficients	**Standardized coefficients**	**SE**	**Standardized coefficients**	**SE**
Math/science identity → 4-year college enrollment	0.04	0.021	0.13	0.018
9th-grade algebra → 4-year college enrollment	0.55	0.019	0.53	0.017
Math/science identity with 9th-grade algebra	0.43	0.016	0.27	0.016
Model fit	**Fit**		**Fit**	
RMSEA	0.008		0.000	
CFI	1.000		1.000	
TLI	0.999		1.000	
Chi-squared	2.486		0.103	
DF	1		1	
P-value	0.115		0.748	

NOTE: Weight W4W1W2W3 was applied for the analysis.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), Base Year to Second Follow-up: 2009-2016.

Conclusion

The results of these analyses align with prior research. Both the initial mathematics and science analyses show sizable relationships between academic identity and 4-year college enrollment. However, after controlling for ninth-grade algebra test scores as a proxy for previous mathematics achievement, the relationship between mathematics identity and 4-year college enrollment dissipates; the relationship between science identity and 4-year college enrollment substantially decreases in strength but remains above the level established for practical significance. These findings are consistent with those of Guo et al. (2015) and Parker at al. (2012), who found that the relationship between academic self-concept and college entry was largely mediated by prior academic achievement.

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Chapter 6: Academic Self-Efficacy

Introduction

Academic self-efficacy refers to individuals' belief in their ability to complete an academic task or achieve an academic goal (Bandura, 1997; Bohrnstedt et al., 2020; Rosen et al., 2010). Academic self-efficacy is fostered through previous successes, observing others succeed, encouragement from others, and one's physical and emotional state (Bandura, 2012).

Self-efficacy is measured at the task-specific level. Therefore, academic self-efficacy is evaluated by asking students about their perceived ability to complete a certain task or multiple tasks within a subject. It is primarily focused on how students believe they will perform in the future, rather than by reflecting upon their past performance (Bandura, 1986; Ferla et al., 2009; Gutman & Schoon, 2013).

Several studies distinguish academic self-efficacy from other noncognitive measures closely tied to academic motivation, such as academic self-concept. Academic self-concept is an individual's perceived overall competence in an academic subject based upon prior performance and feedback (Bong & Skaalvik, 2003; Ferla et al., 2009; Rosen et al., 2010). Whereas self-concept relies heavily on information from previous experiences and sources of social comparison to reflect on general proficiency in a subject (Bong & Skaalvik, 2003; Ferla et al., 2009), self-efficacy refers to one's perceived proficiency in achieving a particular task.

Academic self-efficacy is one of the main components of motivation. Specifically, in the expectancy-value theory (Wigfield & Eccles, 2000), students' expectations for success and their perceived value of academic tasks for achieving goals directly influence their motivation. Therefore, students with a greater degree of self-efficacy see more value in completing a task and are more motivated to do so (Wigfield, 1994).

Literature demonstrating concurrent validity evidence

Large-scale assessments illustrate the relationship between academic self-efficacy and academic outcomes. NAEP measures mathematics self-efficacy through questions in the student questionnaire that ask about students' confidence in their ability to complete specific mathematics tasks (e.g., dividing 42 stickers among 6 students). NAEP's derived confidence in mathematics index demonstrates that students with a higher degree of mathematics self-efficacy receive higher average scores on the assessment. For example, using the index, students taking the 4th-grade 2019 mathematics assessment who had a high degree of confidence in their mathematics knowledge/skills had an average score of 256, which was significantly higher than the scores of students who had a medium (236) or low (219) degree of confidence.[6]

International large-scale assessments also support this conclusion. The Program for International Student Assessment (PISA) measured mathematics self-efficacy in 2003 and 2012 (when mathematics was the major domain) by asking 15-year-old students how confident they were in their ability to complete task-specific mathematics items (e.g., solving an equation like 3x + 5 = 17). In both years, there was a moderate to strong relationship between mathematics self-efficacy and mathematics performance in most countries. On PISA 2012, in the OECD countries, a one-standard-deviation increase in the self-efficacy index was associated with a 49-point average increase in mathematics scores (OECD, 2013).[7]

Meta-analyses and other systematic reviews confirm these results:

- Multon et al. (1991), in an examination of 38 samples from 36 studies analyzing the influence of self-efficacy on academic achievement and persistence, found a positive relationship between self-efficacy and both academic performance and persistence. Self-efficacy explained 14 percent of the variation in academic performance, with an effect size of 0.38, and explained 12 percent of the variation in persistence, with an effect size of 0.34.
- Honicke and Broadbent (2016) performed a meta-analysis using 53 studies to explore the relationship between academic self-efficacy and academic outcomes among university students. They found a correlation of 0.33 between the two constructs. However, there were some differences in estimates across studies that they associated with variations in measuring the concept of self-efficacy.

Literature demonstrating predictive validity evidence

Large-scale studies have also examined the longitudinal relationship between academic self-efficacy in K-12 and later educational outcomes, such as achievement, enrollment, and attainment.

- Using data from the Education Longitudinal Study of 2002 (ELS:2002), Peguero and Shaffer (2015) examined the relationship between academic self-efficacy and dropping out of high school, separately for both males and females (n=11,820), controlling for student characteristics such as academic achievement, school involvement, and misbehavior. This dataset measured self-efficacy at a broad, rather than at a task-specific, level, asking students how confident they were in their ability to master skills, complete tests, and comprehend material (e.g., I am confident I can do an excellent job on my math test).

[6] Analysis conducted using the NAEP Data Explorer: https://www.nationsreportcard.gov/ndecore/xplore/NDE.
[7] The PISA mathematics trend scale was set in 2003 to have a standard deviation of 100 points across the 30 OECD countries participating in PISA that year.

- They did not find the relationship between academic self-efficacy and dropping out of high school to be significant at the α=.05 level for either boys or girls after controlling for prior achievement, demographic characteristics, and school characteristics. However, they did find a negative relationship between academic self-efficacy and dropping out of high school for both genders at the α=0.1 level, after adding the control.
- The relationship between academic self-efficacy and dropping out of high school was also examined using ELS:2002 data (n=16,194) by Fan and Wolters (2014). They found that both mathematics self-efficacy and English self-efficacy decreased the likelihood of dropping out of school, with effect sizes of β =-.07 and β =-.09, respectively. However, one's educational expectations mediated both relationships, and after including educational expectations in the model, the direct relationship between academic self-efficacy and dropping out of high school was no longer significant.
- Wood et al. (2015) analyzed ELS:2002 longitudinal data (n=212,703 weighted students) and found that, after controlling for high school GPA, mathematics self-efficacy in high school was associated with several measures of academic integration for Black males in community college, such as discussing academics with faculty, meeting with advisors, and accessing course resources. However, English self-efficacy was not found to be significantly associated with academic integration.

In summary, the results for the self-efficacy studies analyzing longitudinal data have been mixed, with some showing nonsignificant results at the α=.05 level after controlling for other factors (e.g., prior achievement, educational expectations), and others showing relationships with postsecondary outcomes, such as job outcomes and academic integration in college.

The current study presents an opportunity to examine the relationship between ninth-grade academic self-efficacy and college enrollment, before and after controlling for ninth-grade mathematics achievement.

Analyzing academic self-efficacy using HSLS:09 measures

In the base-year survey of 2009, HSLS:09 included four student survey items to measure students' mathematics self-efficacy and four items to measure students' science self-efficacy (Table 6-a). Students' responses to the items were used as indicators to measure the mathematics self-efficacy and science self-efficacy latent variables. The response categories associated with the statements were "Strongly agree," "Agree," "Disagree," and "Strongly disagree." The data were coded so that the scores ranges from 3, for "Strongly agree," to 0, for "Strongly disagree," in each subject. As such, a positive score on the scale represents having more self-efficacy.

These items have been used to measure self-efficacy in a number of reports (Fan & Wolters, 2014; Peguero & Shaffer, 2015; Wood et al., 2015). They relate to activities specific to the courses that the students were taking at the time of the survey, such as "doing an excellent job on the science test for the course" or "doing an excellent job on mathematics items." It should be noted that the tasks are less specific than those measured in NAEP (e.g., dividing 42 stickers among 6 students).

The data from students' responses to these items were used as indicators for latent variables measuring mathematics and science self-efficacy.

Table 6-a. HSLS:09 variables measuring academic self-efficacy

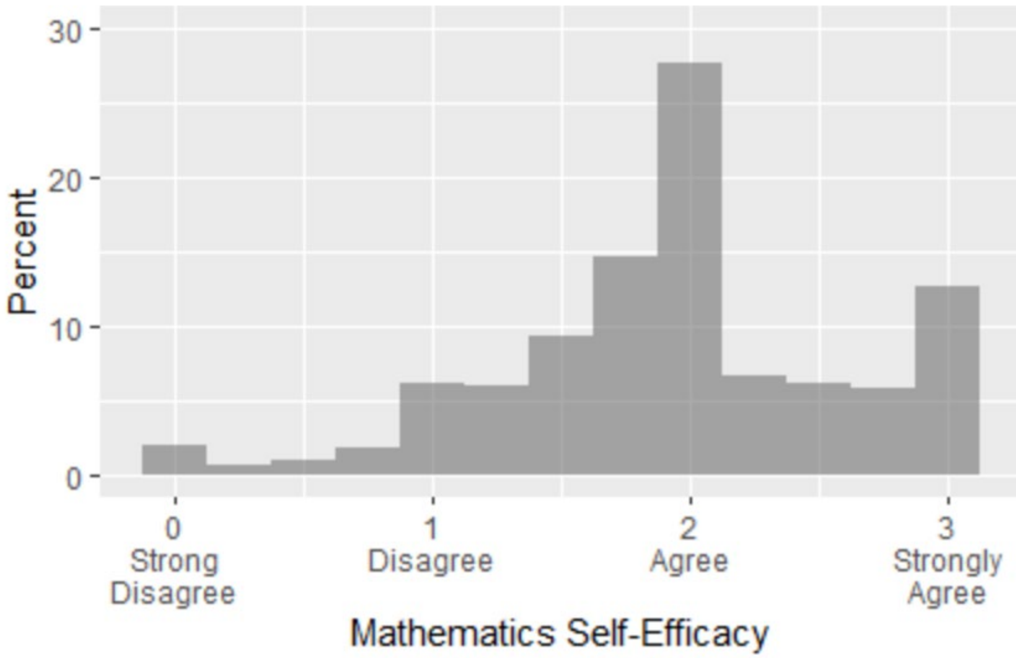
Mathematics Self-Efficacy	Science Self-Efficacy
9th-grader is confident can do excellent job on fall 2009 math tests	*9th-grader is confident can do excellent job on fall 2009 science tests*
9th-grader is certain can understand fall 2009 math textbook	*9th-grader is certain can understand fall 2009 science textbook*
9th-grader is certain can master skills in fall 2009 math course	*9th-grader is certain can master skills in fall 2009 science course*
9th-grader is confident can do excellent job on fall 2009 math assignments	*9th-grader is confident can do excellent job on fall 2009 science assignments*

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), Base Year: 2009.

As in the other chapters, our outcome variable for this chapter is whether students were enrolled in a 4-year college in 2016, 3 years after their expected graduation from high school.

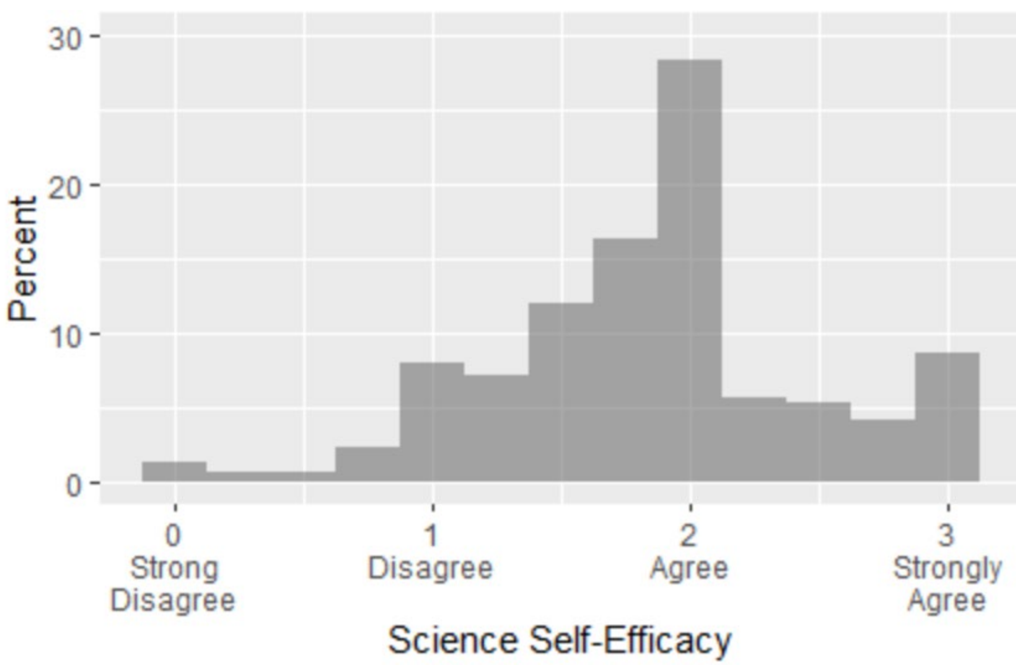
To describe the distribution of mathematics self-efficacy, the scores for the four items were averaged together for each student to create a summative scale. The weighted distribution of the analytic population is shown in Figure 6-a. A similar process was followed for science self-efficacy, with the results shown in Figure 6-b. For both scales, the count for students with a score of 3 reflects the percentage of students who responded that they "Strongly agree" to all four items. The mode of the histogram is 2, reflecting the response pattern of students who on average responded that they "Agree" to all four items.

Figure 6-a. Distribution of the mathematics self-efficacy measure



SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), Base Year: 2009.

Figure 6-b. Distribution of the science self-efficacy measure



SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), Base Year: 2009.

The structural equation modeling analyses that follow were conducted using data from the individual items to measure mathematics and science self-efficacy as latent variables rather than by analyzing the summative scale variables.

Results

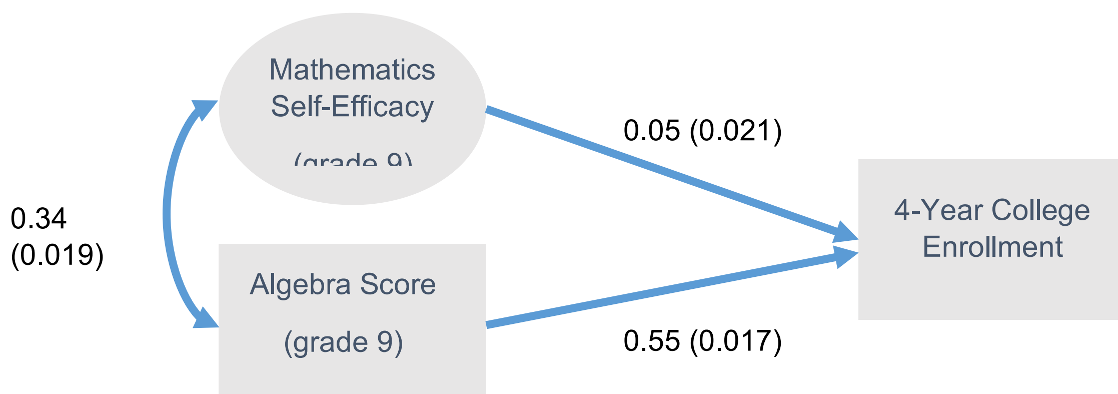
Analyses were conducted to examine the relationship between mathematics self-efficacy and enrollment in a 4-year college 3 years after most HSLS:09 students had graduated from high school as well as the relationship between science self-efficacy and enrollment in a 4-year college.

Students' enrollment status at a 4-year college, 3 years after expected high school graduation, was regressed on the academic self-efficacy latent variable using structural equation modeling, before and after controlling for ninth-grade algebra scores. A practical significance level is noted when the standardized regression coefficient had a value at or above 0.1.

For the initial analysis, 4-year enrollment was regressed on mathematics self-efficacy without adding any control, producing a significant standardized regression coefficient of 0.23. However, the strength of this relationship decreased to a nonsignificant 0.05 after controlling for ninth-grade algebra scores (Figure 6-c, Table 6-b).

Next, enrollment in a 4-year college was regressed on science self-efficacy, without adding any control, producing a significant standardized regression coefficient of 0.21. Again, the strength of this relationship decreased to a nonsignificant 0.07 after controlling for ninth-grade algebra scores (Figure 6-d, Table 6-b).

Figure 6-c. Structural equation model of the relationship between mathematics self-efficacy and 4-year college enrollment



Mathematics Self-Efficacy Coefficient		
Controlling for Algebra	Est.	SE
Before	0.23	(0.021)
After	0.05	(0.021)

NOTE: Weight W4W1W2W3 was applied for the analysis.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), Base Year to Second Follow-up: 2009-2016.

Figure 6-d. Structural equation model of the relationship between science self-efficacy and 4-year college enrollment

Science Self-Efficacy Coefficient		
Controlling for Algebra	Est.	SE
Before	0.21	(0.025)
After	0.07	(0.026)

NOTE: Weight W4W1W2W3 was applied for the analysis.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), Base Year to Second Follow-up: 2009-2016.

Table 6-b. Math/science self-efficacy of 9th-graders: Structural equation model results

	Math self-efficacy		Science self-efficacy	
Items	**Standardized loadings**	**SE**	**Standardized loadings**	**SE**
9th-grader is confident can do excellent job on fall 2009 math/science tests	0.91	0.009	0.88	0.008
9th-grader is certain can understand fall 2009 math/science textbook	0.85	0.008	0.83	0.010
9th-grader is certain can master skills in fall 2009 math/science course	0.89	0.012	0.88	0.010
9th-grader is confident can do excellent job on fall 2009 math/science assignments	0.92	0.007	0.89	0.008
Path coefficients	**Standardized coefficients**	**SE**	**Standardized coefficients**	**SE**
Math/science self-efficacy → 4-year college enrollment	0.05	0.021	0.07	0.026
9th-grade algebra → 4-year college enrollment	0.55	0.017	0.55	0.018
Math/science self-efficacy with 9th-grade algebra	0.34	0.019	0.25	0.017
Model Fit	Fit		Fit	
RMSEA	0.026		0.026	
CFI	0.998		0.997	
TLI	0.996		0.995	
Chi-squared	137.351		130.346	
DF	8		8	
P-value	<.01		<.01	

NOTE: Weight W4W1W2W3 was applied for the analysis.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), Base Year to Second Follow-up: 2009–2016.

Conclusion

The results of these analyses offer new insights into the relationship between academic self-efficacy and college enrollment. While both the mathematics and science models demonstrate a significant relationship between academic self-efficacy and 4-year college enrollment before controlling for academic achievement, neither relationship is significant after controlling for ninth-grade algebra test scores. These findings are supported by the literature, which has also shown nonsignificant relationships between academic self-efficacy and academic outcomes, such as high school dropout status (Fan & Wolters, 2014; Peguero & Shaffer, 2015), after controlling for other factors. The results suggest that the relationship between self-efficacy, as measured in high school, and college enrollment may be mediated by mathematics ability.

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Chapter 7: Utility Value

Introduction

Utility value is the perceived value of a task for current or future goals. In the case of schooling, it is measured by determining how students relate a particular task, subject, or school itself to objectives outside of their own enjoyment (Wigfield & Eccles, 1992). The construct stems from the expectancy-value model of motivation, in which Eccles et al. (1983) proposes that ability beliefs, expectancies for success, and subjective task value all influence students' academic motivation and performance. Utility value is one the four constructs of subjective task value, along with intrinsic value, attainment value, and cost (Wigfield & Eccles, 1992).

Utility value is similar to a construct defined in the self-determination theory of motivation, extrinsic motivation, which measures the motivation to perform a task for an outcome other than the enjoyment of the task itself (Ryan & Deci, 2000a; Wigfield & Eccles, 2000). In this theory, both intrinsic and extrinsic motivation contribute to the effort one applies to a task. Although research demonstrates a stronger relationship between intrinsic motivation and educational outcomes, all elements of subjective task value are demonstrated to be essential aspects of the theory of motivation (Cerasoli et al., 2014; Ryan & Deci, 2000b; Wigfield & Eccles, 1992).

Utility value for schooling is measured by asking students about the perceived usefulness of academic or subject-specific tasks. The measurement of utility value can be at a broad level, such as the usefulness of school itself, or at a subject-specific level, such as the usefulness of mathematics. Questions can also ask about the overall utility of the subject or connect it to a specific future goal, such as future career aspirations (Wigfield & Eccles, 1992; Zhang & Bae 2020).

Literature demonstrating concurrent validity evidence

Large-scale national assessments have demonstrated inconsistent evidence of a relationship between utility value and academic achievement. When 12th-grade students participating in the NAEP 2019 mathematics assessment were asked if they felt they "learned something I can use in daily life" in school, the average score for students who marked "never or hardly ever" (143) was not significantly different from those who marked "all or most of the time" (142). However, when the same set of students was asked to react to the statement, "Math will help me even when not in school," those who said it sounded "not at all like me" (132) had significantly lower scores on average than those who said it sounded "a little bit like me" (149), "somewhat like me" (149), "quite a bit like me" (159), and "exactly like me" (159).[8]

[8] Analysis conducted using the NAEP Data Explorer: https://www.nationsreportcard.gov/ndecore/xplore/NDE.

Additionally, Andersen and Ward (2014) examined the relationship between expectancies for success, subjective task value, and persistence in the STEM field (i.e., occupational aspirations within the field or plans to take advanced STEM coursework) by race/ethnicity using a subsample of students from HSLS:09 (n=21,444). Among students who scored in the top 10 percent on a ninth-grade mathematics assessment, mathematics and science utility value were related to occupational aspirations or plans for coursework in the STEM field for Hispanic students, but not for White or Black students. Also, utilizing data from the Education Longitudinal Study of 2002 (ELS:2002), Fan (2011) explored whether social relationships, ability beliefs, task values, and educational expectations were related to academic engagement (measured by academic effort and persistence) for both boys and girls in 10th grade (n=16,252). Out of the motivational constructs examined, the utility value of school showed the strongest relationship with academic engagement for both boys and girls.

International assessments have also produced inconclusive findings. Lee (2016) analyzed data from all countries participating in the Program for International Student Assessment (PISA) mathematics assessments in 2003 (n=41 countries) and 2012 (n=64 countries) and the PISA 2009 (n=65 countries) reading assessment to examine the relationship between students' attitudes toward the usefulness of school and academic outcomes at the age of 15. She found no direct relationship between students' attitudes toward the usefulness, or utility value, of school and mathematics and reading achievement after controlling for teacher-student relations and self-efficacy. In addition, in an analysis of the German student sample of 15-year-olds from PISA 2009 in the German national supplementary study (n=9,461), Schoor (2016) found a positive bivariate relationship between students' utility value in reading and reading achievement on PISA 2009. However, reading behavior fully mediated this relationship, and the indirect effect from utility value through reading behavior fell to β=.01 after controlling for intrinsic task value.

Using data from the Trends in International Mathematics and Science Study (TIMSS), researchers have found a positive relationship between utility value and academic achievement. Guo et al. (2015b) utilized data from Hong Kong eighth-grade students who participated in the 1999 (n=5,179), 2003 (n=4,972), and 2007 (n=3,470) waves of TIMSS to examine the relationships between self-concept and mathematics intrinsic and utility task value and a set of educational outcomes. They found a significant relationship between mathematics utility value and both mathematics achievement and educational aspirations, after controlling for demographic characteristics, mathematics self-concept, and mathematics intrinsic value. Similarly, Liou (2017) examined the relationship between motivational beliefs, including science utility value, and science achievement using data from 26 countries that participated in TIMSS 2011. Although the relationship differed in significance for each individual country, on average science utility held a small relationship with science achievement (β=0.03) across countries.

In a systematic review examining motivational factors influencing science achievement on TIMSS, Zhang & Bae (2020) examined studies that looked at motivational factors, including four studies examining utility value. The authors concluded there was a weak positive relationship between utility value and science achievement, and the strength of the relationship varied across countries. Among the four studies examined, utility value was less predictive of science achievement than either self-concept or intrinsic value.

Literature demonstrating predictive validity evidence

A number of studies have examined the longitudinal relationship between utility value in K-12 and later achievement and postsecondary outcomes, yielding mixed results.

- Guo et al. (2015a) utilized the Youth in Transition study—a five-wave longitudinal study that followed boys from 10th grade in 1966 to 5 years after high school graduation in 1974 (n=2,213)—to examine the relationship between aspects of the expectancy-value theory, educational aspirations, and educational attainment. The preliminary analysis showed correlations between student reports on the utility value of school, measured in high school, and later educational attainment. However, after controlling for other motivational factors, and occupational and educational aspirations, no effect was found between school utility value, measured in high school, and later educational attainment.
- Lauermann et al. (2017) analyzed the relationship between constructs within the expectancy-value theory, STEM career aspirations, and math-related career attainment using the Childhood and Beyond study, which tracked 980 children from three cohorts from elementary school to adulthood in Michigan. Utility value in mathematics was measured in grades 9 and 12, along with self-concept, interest, and career aspirations. Math-related career attainment was measured 15 years after high school graduation. The initial analysis found a bivariate positive correlation between mathematics utility value in high school and math-related career attainment; however, after controlling for career aspirations, no direct effect was found between utility value measured in grades 9 or 12 and job attainment in a math-related field.
- Petersen and Hyde (2017) tracked 288 students through middle and high school to investigate whether changes in perceived mathematics utility value, interest, and ability were related to mathematics performance in high school. Using the Wisconsin Study of Families, motivational constructs were measured after the fifth, seventh, and ninth grades. Data were also collected from 10th-grade Wisconsin state standardized tests. After controlling for prior mathematics performance, utility value in fifth grade was not significantly related to achievement in 10th grade, nor was the rate of change in utility value from 5th to 9th grade related to achievement in the 10th grade.

- Weidinger et al. (2020) used a sample of German high school students (n=476) from the highest German academic track to examine the relationship between students' intrinsic motivation, attainment, and utility value in mathematics and academic outcomes. They measured the three task values four times in 3 years and collected students' grades over the same 3 years. After controlling for prior achievement, student characteristics, and the other task values, a weak positive relationship was found between prior measures of utility value and subsequent measures of students grades in grades 11, 12, and 13.

In conclusion, the findings from the research literature do not show strong support for a positive longitudinal relationship between utility value and educational outcomes, after controlling for other factors. While Weidinger et al. (2020) observed a weak positive association between utility value and academic achievement, Petersen and Hyde (2017) did not find a significant relationship. After controlling for prior academic performance and other motivational variables, neither Guo et al. (2015a) or Lauermann et al. (2017) found a significant relationship between utility value and later postsecondary outcomes (i.e., educational and occupational attainment).

Analyzing utility value using HSLS:09 measures

HSLS:09 includes three student survey items, measured in ninth grade, in both mathematics and science to evaluate students' mathematics utility value and science utility value (Table 7-a).

In our analysis, we used the data from student responses to these items as indicators for a latent variable measuring utility value. The response categories associated with the statements were "Strongly agree," "Agree," "Disagree," and "Strongly disagree." The data were coded so that the scores ranged from 3, for "Strongly agree," to 0, for "Strongly disagree," in each subject. Therefore, a positive score on the scale represents having a greater degree of utility value.

Table 7-a. HSLS:09 variables measuring utility value

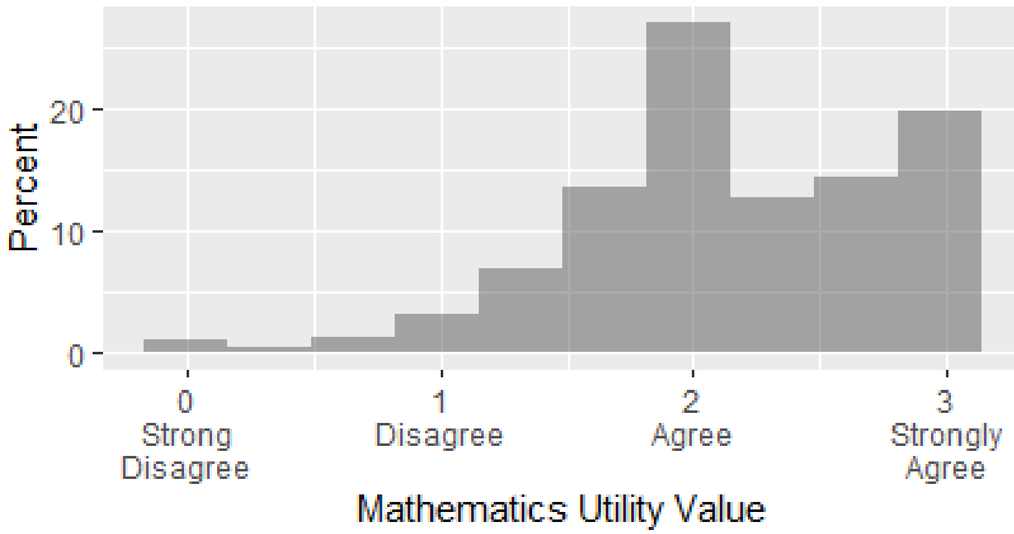
Mathematics Utility Value	Science Utility Value
9th-grader thinks fall 2009 math course is	*9th-grader thinks fall 2009 science course is*
…useful for everyday life	*…useful for everyday life*
…useful for college	*…useful for college*
…useful for future career	*…useful for future career*

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), Base Year: 2009.

As in the other chapters, our outcome variable for this chapter is whether students were enrolled in a 4-year college in 2016, 3 years after their expected graduation from high school.

To provide detail on the distribution of the mathematics utility measure, the scores for the three mathematics utility items were averaged for each student to create a summative scale. The weighted distribution for the analytic population is shown in Figure 7-a. The count for students with a score of 3 reflects the percentage of students who "Strongly agree" to all three items. The mode of the histogram is 2, reflecting the response pattern of students who on average "Agree" to two of the items. Note that the distribution is almost bimodal, with another peak at around 3.

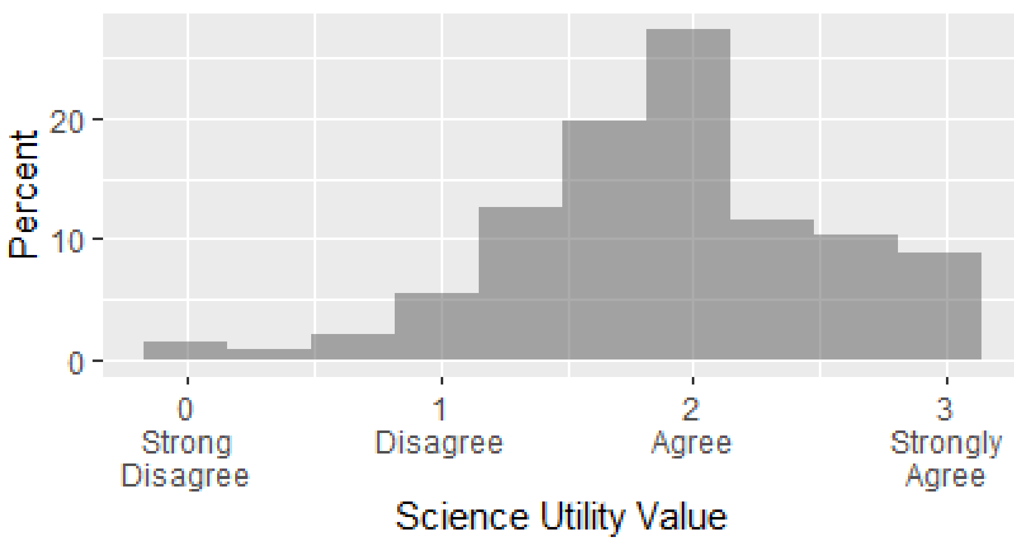
Figure 7-a. Distribution of mathematics utility value measure



SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), Base Year: 2009.

A similar process was followed to create a histogram to show the distribution of the three science utility items when combined into a summative scale (Figure 7-b). The mode of this histogram is 2. Compared with the mathematics utility distribution, the science utility distribution seems closer in shape to a normal distribution, although there is a positive skew.

Figure 7-b. Distribution of science utility value measure



SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), Base Year: 2009.

The structural equation modeling analyses that follow measure utility value in mathematics and science as latent variables using data from the individual items rather than from the summative scale variables.

Results

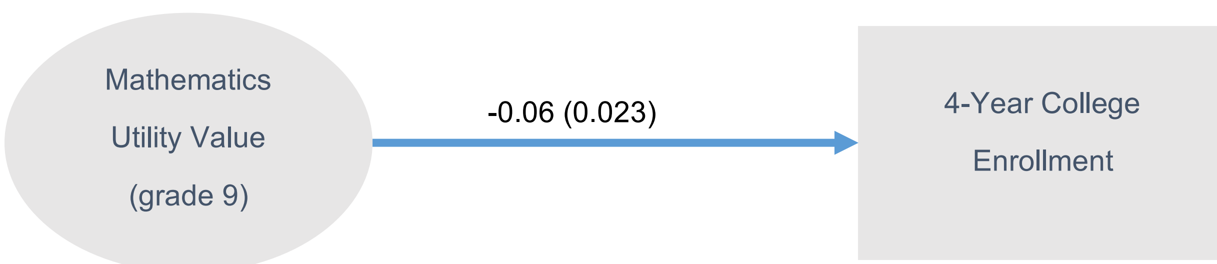
We conducted analyses to examine the relationship between mathematic utility value and enrollment in a 4-year college 3 years after high school graduation as well as science utility value and enrollment in a 4-year college. Students' enrollment status at a 4-year college, 3 years after high school, was regressed on the mathematics and science utility value latent variables using structural equation modeling. A practical significance level is noted when the standardized regression coefficient had a value above 0.1.

For the initial analysis, 4-year enrollment was regressed on mathematics utility value without adding any controls. A nonsignificant standardized regression coefficient of -0.059 was found between mathematics utility value and enrollment in a 4-year college (Figure 7-c, Table 7-b).

Next, enrollment in a 4-year college was regressed on science utility value without adding any control. A nonsignificant standardized regression coefficient of 0.078 was found between science utility value and enrollment in a 4-year college (Figure 7-d, Table 7-b).

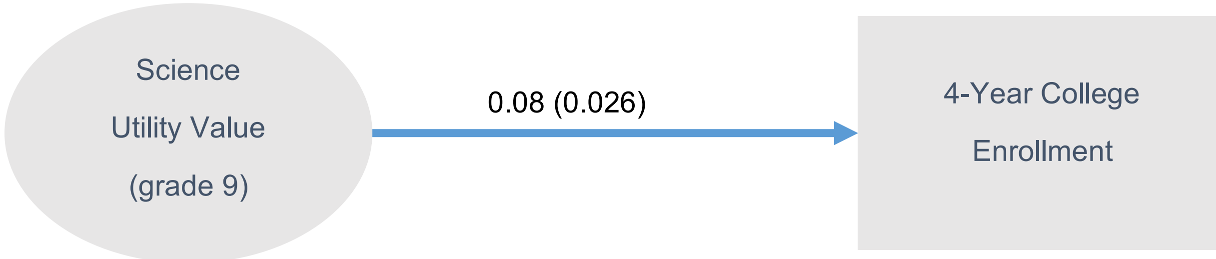
Given that the zero-order correlation was less than the practical significance level for both mathematics and science utility value, we did not do follow up these initial analyses by controlling for algebra achievement.

Figure 7-c. Structural equation model of the relationship between mathematics utility value and 4-year college enrollment



NOTE: Weight W4W1W2W3 was applied for the analysis.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), Base Year to Second Follow-up: 2009-2016.

Figure 7-d. Structural equation model of the relationship between mathematics utility value and 4-year college enrollment



NOTE: Weight W4W1W2W3 was applied for the analysis.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), Base Year to Second Follow-up: 2009-2016.

Table 7-b. Mathematics and science utility value of 9th-graders: Structural equation model results

	Mathematics utility value		Science utility value	
Items	**Standardized loadings**	**SE**	**Standardized loadings**	**SE**
9th-grader thinks fall 2009 math/science course is…useful for everyday life	0.75	0.017	0.70	0.017
9th-grader thinks fall 2009 math/science course is…useful for college	0.80	0.014	0.80	0.016
9th-grader thinks fall 2009 math/science course is…useful for future career	0.90	0.014	0.84	0.015
Path coefficients	**Standardized coefficients**	**SE**	**Standardized coefficients**	**SE**
Math/science utility value → 4-year college enrollment	-0.06	0.023	0.08	0.026
Model Fit	**Fit**		**Fit**	
RMSEA	0.037		0.015	
CFI	0.995		0.999	
TLI	0.986		0.996	
Chi-squared	61.712		11.861	
DF	2		2	
P-value	<.01		<.01	

NOTE: Weight W4W1W2W3 was applied for the analysis.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), Base Year to Second Follow-up: 2009-2016.

Conclusion

In conclusion, our analysis failed to produce evidence of a significant relationship between either mathematics or science utility value and 4-year college enrollment 3 years after expected high school graduation. The previous literature has shown mixed results on the association between utility value and measures of K-12 academic achievement. However, the two longitudinal studies (Guo et al., 2015a; Lauermann et al., 2017) in our review that examined the relationship between utility value and attainment found null effects after controlling for other factors. The results from our analyses align with these two studies. However, in contrast, our results show a null relationship even before controlling for other factors. That said, it is important to note that unlike most studies, we are testing for practical significance instead of statistical significance. If we were measuring for statistical significance ($p<0.05$), math utility value would have a negatively significant relationship, and science utility value would have a positively significant value.

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Chapter 8: Growth Mindset

Introduction

A growth mindset is the belief that one's intelligence, skills, and ability are malleable and that it is possible to develop them. It is the opposite of a fixed mindset, believing those characteristics are relatively stable, fixed, or absolute (Dweck, 2000; Farrington et al., 2012). While a growth mindset is the idea that any individual's intelligence can be developed, it does not suggest that all individuals are equally able to learn new knowledge or develop new skills (Dweck, 2000).

Growth mindset theory stems from research examining implicit beliefs that individuals hold regarding their own intelligence. Research demonstrates that some individuals hold entity beliefs, believing their intelligence is static and leading to a fixed mindset regarding their own intellect, while others hold incremental beliefs, deeming their intelligence malleable and leading to a growth mindset (Dweck, 2000; Costa & Faria, 2018; Sternberg, 1985).

Literature on growth mindset focuses on two primary avenues of research. Some research focuses on learning whether students believe one's intelligence can be developed and whether that belief has a positive influence on students' educational outcomes (Sternberg, 1985). Other studies use experimental designs employing growth mindset as an intervention to test whether having a growth mindset can improve one's performance and how large the effect of having a growth mindset is (Sisk et al. 2018; Yeager et al., 2019).

Literature demonstrating concurrent validity evidence

International assessments demonstrate a positive relationship between having a growth mindset and academic outcomes. In 2018, PISA measured growth mindset by asking 15-year-old students if "intelligence is something about you that you can't change very much." Controlling for socioeconomic background, students who strongly agreed or agreed with the statement had, on average, scores on the reading assessment that were 32 points[9] lower than students who strongly disagreed or disagreed. Additionally, students who displayed a growth mindset were more likely to be motivated and to aspire to complete a postsecondary degree (Schleicher, 2019).

[9] The PISA reading trend scale was set in 2000 to have a mean of 500 and a standard deviation of 100 points across the 28 OECD countries participating in PISA that year. Thus, 32 points is over a quarter of a standard deviation.

Meta-analyses and other research syntheses have mainly supported these findings:

- In order to understand the relationship between mindset and academic achievement, Sisk et al. (2018) conducted two meta-analyses examining both the association between mindset and academic performance (n=365,915) and the impact of growth mindset interventions on academic performance (n=57,155). They found a weak relationship for all students between having a growth mindset and measures of academic achievement (on average, r=.10). They also found that the relationship between mindset interventions and academic achievement only existed for students who were at a higher academic risk or of a lower socioeconomic status.
- In a meta-analysis on implicit beliefs concerning one's own intelligence, Costa and Faria (2018) looked at 46 studies (n=412,022) that examined the influence of both fixed and growth mindsets on academic outcomes. They found that incremental intelligence beliefs (i.e., having a growth mindset) were related to higher levels of overall academic achievement as well as higher grades in verbal and quantitative subjects.

Literature demonstrating predictive validity evidence

There is also a substantial amount of research examining the longitudinal relationship between growth mindset and later achievement outcomes. Some studies examine the relationship between implicit beliefs on intelligence, including both incremental (i.e., growth mindset) and entity views (i.e., fixed mindset), and academic outcomes, while others focus on the effects of growth mindset interventions on academic performance.

- In two studies, Blackwell et al. (2007) examined the relationship between growth mindset and academic outcomes. First, they measured four waves of seventh-grade students (n=373) over their 2 years of middle school to examine the relationship between mindsets surrounding intelligence and academic performance. They found a relationship between holding a growth mindset and the change in mathematics grades over the next 2 years (β=.53). The second study utilized a separate sample of seventh-grade students (n=91). Lessons were given to an intervention group of 48 students to teach them about growth mindset, or incremental beliefs, while the control group received other lessons on memory and other brain-related topics. They found a significant positive effect of the intervention on changes in mathematics grades from the fall (pre-intervention) of seventh grade to the spring (post-intervention) of seventh grade.
- Cury et al. (2006) explored the relationship between implicit beliefs, or mindsets, and academic achievement using students ages 12-14 in France (n=463). A survey questionnaire administered in the beginning of the term measured both incremental (i.e., growth mindset) and entity (i.e., fixed mindset) theories of intelligence in students, perceived competence, and achievement-related goals. The dependent variable, mathematics grades, was collected at the end of the term. They found incremental beliefs to be positively related to grades in mathematics and entity beliefs to be negatively related to grades in mathematics, controlling for prior performance.

- Zhu et al. (2019) used the National Study of Learning Mindsets to determine the impact of a growth mindset intervention on academic performance and attitudes. This study included a nationally representative sample of ninth-grade students (n=11,888) who were randomly assigned to receive the intervention—which consisted of two online modules that helped students learn about growth mindset and its importance—or the control, which were online modules that had nothing to do with growth mindset. Information was collected on students' beliefs, attitudes, motivation before and after the intervention, and end-of-year GPA, and prior GPA as well as preintervention mindsets were controlled for. They found that the intervention effectively increased students' reports of their growth mindset as well as their willingness to complete challenging academic tasks and was associated with a small (.04 effect size) increase in average end-of-year GPA.
- Yeager et al. (2019) also utilized the National Study of Learning Mindsets to investigate the influence of growth mindset on academic achievement. Specifically focusing on lower achieving students (n=6,320), the growth mindset intervention was positively related to GPA (β=0.10). Additionally, the growth mindset intervention was positively associated with a 3-percentage-point increase in the probability of being enrolled in an advanced mathematics course in 10th grade.
- In order to examine the impact of a growth mindset intervention on incoming college students' performance, Broda et al. (2018) assigned students either to a mindset intervention, a school belonging intervention, or the control group (n=7,686). The interventions were administered during a summer orientation, prior to the start of the students' first semester. The growth mindset intervention group read and reflected upon an article about the malleability of brains, the school belonging intervention consisted of a panel of current students discussing their experiences, and the control group focused on information about the school. Outcome variables measured included fall, spring, and cumulative GPA; course credits attempted and completed; and enrollment status. Initial achievement measures (e.g., high school GPA, ACT score) and initial mindset and belonging measures were controlled for, as were demographic characteristics (e.g., Pell eligibility). The analysis found a positive association between Latino students receiving the growth mindset intervention and their GPA throughout the year. No significant effects were found for other subgroups or across all students.
- Li and Bates (2020) examined the relationship between growth mindset and grades over the course of enrollment in a 4-year college for a sample of undergraduate students in the United Kingdom (n=586). Growth mindset was measured in their first semester, and GPA was collected at the end of every year. The analysis found that growth mindset was not associated with end-of-year grades for any of the 4-year students enrolled at the university, controlling for prior GPA.

In conclusion, the literature mainly establishes a positive relationship between holding a growth mindset and later measures of academic achievement in K-12, particularly among lower-achieving or disadvantaged students in secondary schools. There was also a positive relationship between growth mindset and other K-12 outcomes (e.g., enrollment in advanced mathematics course, willingness to complete challenging tasks). However, research has failed to show a relationship between growth mindset and academic achievement for students enrolled in postsecondary institutions. Largely absent from the current literature is longitudinal research examining the association between students' mindsets in K-12 and later postsecondary outcomes. The current analysis can help expand our understanding of this relationship.

Analyzing growth mindset using HSLS:09 measures

The second wave of HSLS:09 at Wave 2 included two student survey items to measure students' growth mindset (Table 8-a). Each item each had four response categories: "Strongly agree," "Agree," "Disagree," and "Strongly disagree." For the analysis, they were coded sequentially ranging from "0" for "Strongly disagree" to "3" for "Strongly agree." As such, a positive score on the scale represents having more of a growth mindset.

Table 8-a. HSLS:09 variables measuring growth mindset

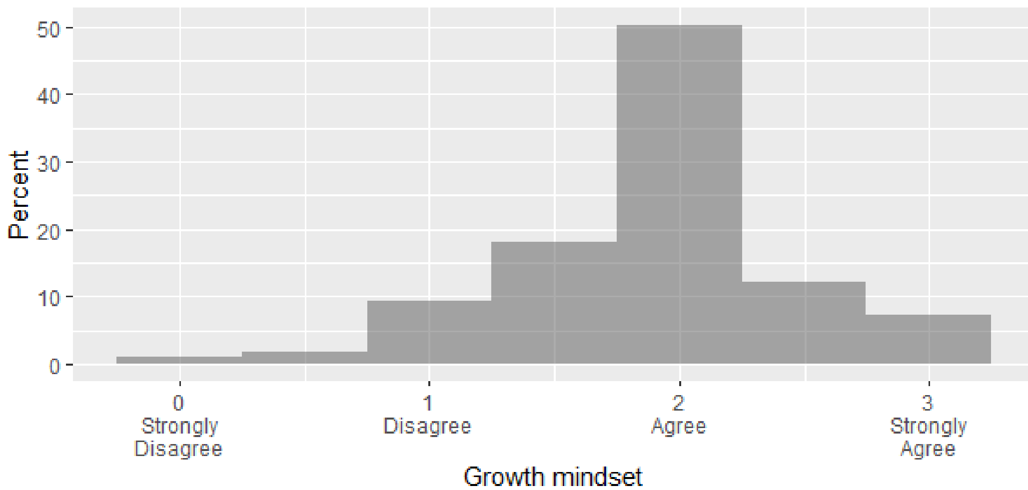
Growth mindset
Most people can learn to be good at math
Most people can learn to be good at science

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), First Follow-up: 2012.

As in the other chapters, the outcome variable is whether students were enrolled in a 4-year college in 2016, 3 years after their expected graduation from high school.

To provide detail on the distribution of the measure, the scores for each item were averaged to create a summative scale; the weighted distribution of the analytic population on this scale is shown in Figure 8-a. The count for students with a score of 3 reflects the percentage of students who responded that they "Strongly agree" with both items. The mode of the histogram is 2, reflecting the responses of students who on average responded that they "Agree" with both items.

Figure 8-a. Distribution of growth mindset measure



SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), First Follow-up: 2012.

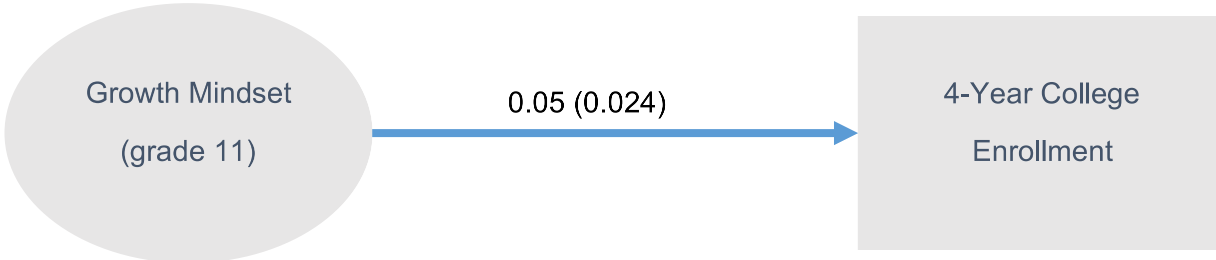
The structural equation modeling analysis that follows was conducted using data from the individual items to measure growth mindset as a latent variable rather than by using the summative scale.

Results

We conducted analyses to examine the relationship between growth mindset and enrollment in a 4-year college 3 years after high school graduation. Students' enrollment status at a 4-year college, 3 years after high school, was regressed on the growth mindset latent variable using structural equation modeling. A practical significance level is noted when the standardized regression coefficient had a value above 0.1.

As can be seen in Figure 8-b, the standardized regression coefficient was 0.05, below the practical significance level of 0.1 (Figure 8-b, Table 8-b). Given that the zero-order relationship was below the practical significance level, we did not follow up with analyses that included algebra achievement in the model as a control.

Figure 8-b. Structural equation model of the relationship between growth mindset and 4-year college enrollment



NOTE: Weight W4W1W2W3 was applied for the analysis.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), First Follow-up to Second Follow-up: 2012-2016.

Table 8-b. Growth mindset of 11th-graders: Structural equation model results

	Growth mindset	
Items	**Standardized loadings**	**SE**
Most people can learn to be good at math	0.48	0.055
Most people can learn to be good at science	0.94	0.086
Path coefficients	**Standardized coefficients**	**SE**
Growth mindset → 4-year college enrollment	0.05	0.024

NOTE: Weight W4W1W2W3 was applied for the analysis. Fit statistics were not estimated as there were zero degrees of freedom.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), First Follow-up to Second Follow-up: 2012-2016.

Conclusion

In conclusion, the results of our analyses failed to show a positive relationship between growth mindset and eventual enrollment in a 4-year college 3 years after expected high school graduation. The differences between these results and those of the studies included in the literature review could be attributable to differences in the outcome measures, as those studies focused primarily on the relationship between growth mindset and academic achievement measures in K-12 schooling (Blackwell et al., 2007; Cury et al., 2006; Tang et al., 2019). However, studies like ours that have examined the relationship between growth mindset and academic achievement in postsecondary institutions have also found nonsignificant relationships (Broda et al., 2018; Li & Bates, 2020).

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Chapter 9: Perseverance

Introduction

Academic perseverance refers to the extent to which students work through and overcome difficulties or setbacks to successfully complete academic tasks and learn course material (Farrington et al., 2012; Shechtman et al., 2018). Persistence in the face of obstacles, delayed gratification, and the discipline to resist distractions and temptations all fall under the meaning of perseverance (Farrington et al., 2012; Wanzer et al., 2019.)

Perseverance is frequently seen as a dimension of grit (Farrington et al., 2012), where grit is defined as “perseverance and passion for long-term goals” (Duckworth et al., 2007, p. 1087). Duckworth and colleagues developed and validated the Grit Scale and an abridged version known as the Short Grit Scale (Table 9-a), with both versions consisting of two subscales: (1) consistency of interest; and (2) perseverance of effort (Duckworth et al., 2007; Duckworth & Quinn, 2009). The consistency of interest subscale measures the passion dimension of grit (e.g., “New ideas and new projects sometimes distract me from previous ones”), while the perseverance of effort subscale captures persistence (e.g., “Setbacks don’t discourage me”).

While Duckworth explicitly emphasizes the long-term nature of grit, only one of the six items in the perseverance of effort dimension of the original Grit Scale focuses on long-term persistence (“I have achieved a goal that took years of work”), and this item was excluded from the Short Grit Scale.

NAEP measures grit/perseverance using a four-item persistence in learning index (Bertling, 2014), which is comparable to Duckworth’s perseverance of effort subscale (Table 9-a). Both scales include the item “I finish whatever I begin,” and some of the other NAEP items (e.g., “I keep working hard even when I feel like quitting”) are similar to Duckworth’s items (e.g., “I am a hard worker”).

Table 9-a. Items in Duckworth's Grit Scale, Duckworth's Short Grit Scale, and the NAEP Persistence in Learning Index

Duckworth's Grit Scale	Duckworth's Short Grit Scale	NAEP Persistence in Learning Index
Perseverance of Effort Subscale		
I finish whatever I begin.	*I finish whatever I begin.*	*I finish whatever I begin.*
Setbacks don't discourage me.	*Setbacks don't discourage me.*	*I try very hard even after making mistakes.*
I am a hard worker.	*I am a hard worker.*	*I keep working hard even when I feel like quitting.*
I am diligent.	*I am diligent.*	*I keep trying to improve myself, even when it takes a long time to get there.*
I have achieved a goal that took years of work.		
I have overcome setbacks to conquer an important challenge.		
Consistency of Interest		
I often set a goal but later choose to pursue a different one.	*I often set a goal but later choose to pursue a different one.*	
I have been obsessed with a certain idea or project for a short time but later lost interest.	*I have been obsessed with a certain idea or project for a short time but later lost interest.*	
I have difficulty maintaining my focus on projects that take more than a few months to complete.	*I have difficulty maintaining my focus on projects that take more than a few months to complete.*	
New ideas and projects sometimes distract me from previous ones.	*New ideas and projects sometimes distract me from previous ones.*	
My interests change from year to year.		
I become interested in new pursuits every few months.		

SOURCE: Duckworth, A. L., & Quinn, P. D. (2009). Development and validation of the Short Grit Scale (GRIT–S). *Journal of personality assessment*, *91*(2), 166–174; and U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. National Assessment for Educational Progress 2019 Student Questionnaire.

In addition, grit—particularly the perseverance dimension—is closely linked to one of the Big Five personality traits: conscientiousness (Schmidt et al., 2018). Conscientiousness describes an individual's reliability, work ethic, and self-control (Duckworth et al., 2007; Shechtman et al., 2018). Empirically, grit and conscientiousness are highly correlated, and as a result, there is debate over whether grit should be considered a distinct construct or part of conscientiousness (Credé, 2018; Ponnock et al., 2020; Schmidt et al., 2018).

Literature demonstrating concurrent validity evidence

Large-scale assessments and surveys in the United States, such as NAEP, have shown that students who score higher in its measure of perseverance earn higher reading and mathematics scores. For example, the 2019 NAEP mathematics and reading assessments indicate that U.S. eighth-graders classified as high on the students' persistence in learning index had an average NAEP mathematics score of 287 and a reading score of 268, 19 and 17 points higher than students classified as low on the index for mathematics and reading, respectively.[10]

Results from international assessments align with these findings. For example, PISA 2012 measured students' perseverance through an index that includes items such as "When confronted with a problem, I give up easily" (OECD, 2013). Across OECD countries, a one-standard-deviation increase in the perseverance index was associated with nearly a 21-point average increase in mathematics performance for 15-year-olds.[11] In addition, the perseverance index accounted for about 6 percent of the variation in student mathematics performance.

Meta-analyses have confirmed the positive relationship between grit and academic attainment:

- Credé et al. (2017) conducted a meta-analysis on grit and its relationship with academic and nonacademic outcomes using 88 samples representing nearly 67,000 individuals. They found that grit was significantly correlated with academic performance (r=.18) as well as retention (r=.16). In addition, the perseverance subscale of grit was even more strongly correlated with academic performance (r=.26) and even accounted for additional variance in performance when both conscientiousness and the consistency of interest subscale were controlled for.
- Lam & Zhou (2019) also conducted a meta-analysis of the relationship between grit and academic achievement based on 44 studies involving 60,133 students ranging from elementary school through higher education. Like Credé et al. (2017), they found a significant correlation between overall grit and academic achievement (r=.16) and a stronger correlation between the perseverance subscale of grit and academic achievement (r=.21) based on 31 of the 44 studies.

However, other studies have found contrasting results. For example, Wanzer et al. (2019) analyzed the relationship between noncognitive factors and current GPA using a sample of 2,229 high school students from a majority Hispanic, low-income district in California. Academic perseverance was measured using both the perseverance of effort subscale of the Short Grit Scale and as well as a self-control scale. Academic perseverance was not significantly positively related to current GPA for students in either grade when taking into account other noncognitive factors, such as academic mindsets, social skills, and learning strategies.

Likewise, Rimfeld et al. (2016) evaluated a sample of 4,642 16-year-olds within the United Kingdom Twins Early Development Study and found that grit added very little to the prediction of academic achievement when conscientiousness and other personality traits were already being taken into account. They conclude that grit is closely related to these personality traits and thus has little additional power to predict academic achievement when they are included in the model.

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[10] Analysis conducted using the NAEP Data Explorer: https://www.nationsreportcard.gov/ndecore/xplore/NDE.

[11] The PISA mathematics trend scale was set in 2003 to have a standard deviation of 100 points across the 30 OECD countries participating in PISA that year.

Literature demonstrating predictive validity evidence

Large-scale research examining the longitudinal relationship between perseverance in K-12 and later outcomes focuses on later academic achievement and college and workplace retention, rather than enrollment in a 4-year college—the focus of this analysis. Most research uses some variation of Duckworth's Grit Scale to measure grit and its perseverance of effort dimension to measure perseverance.

Studies focusing on the relationship between grit/perseverance and measures of academic performance in adolescence and among college students have shown mixed results.

- Using a sample of 2,430 public elementary and middle school students in the southeastern United States, Usher et al. (2019) looked at the relationship between grit at the start of the year and achievement at the end of the year. Grit was measured using adapted items from the Values in Action Strength Survey for Children, which included some items that were similar to those in Duckworth's Grit Scale (e.g., "I am a hard worker"; "I keep trying after I fail"), while achievement was measured using standardized test scores in reading and mathematics. They found a weak, negative relationship between grit and reading achievement and no relationship between grit and mathematics achievement while controlling for contextual factors and prior achievement.
- Tang et al. (2019) used a sample of 2,018 students from the longitudinal Mind-the-Gap study, which followed Finnish students in grades 6-9. They found that perseverance in eighth grade, measured by the perseverance of effort subscale of Duckworth's Short Grit Scale, was significantly related to ninth-grade GPA, controlling for contextual factors and prior achievement using seventh-grade GPA.
- Duckworth and Quinn (2009) analyzed a sample of 279 7th- through 11th-grade students from a diverse public school. They found that grit, measured with the Short Grit Scale, was positively related to GPA 1 year later and was negatively related to hours of television watched 1 year later.
- Using a sample of 938 undergraduate students from Bowling Green State University, Bowman et al. (2015) looked at the relationship between grit in the spring semester and GPA in the fall semester of the following academic year. Using the Short Grit Scale, they found that the perseverance of effort subscale was a positive predictor of later GPA, controlling for demographic factors and prior GPA.

Other studies focus on the relationship between grit/perseverance and retention in various settings such as high school, college, and the workplace.

- Analyzing a sample of 4,813 high school juniors from Chicago Public Schools, Eskreis-Winkler et al. (2014) found that grit, measured by an abridged version of the Short Grit Scale, was a significant predictor of high school graduation after controlling for demographic and contextual variables, conscientiousness, motivation, and prior achievement using standardized test scores.
- In a second study using 442 sales representatives at a vacation ownership corporation, Eskreis-Winkler et al. (2014) found that grit, measured using the Short Grit Scale, was significantly related to workplace retention 6 months later. Grit remained a significant predictor of retention after controlling for demographic variables, conscientiousness, weeks employed, and prior number of years working in sales.
- Gross et al. (2018) evaluated a sample of 2,188 students from the Tennessee Project STAR and Beyond Survey. Using data from a Project STAR teacher survey reporting on fourth-grade student behavior, they developed a five-item grit scale comparable to Duckworth's Short Grit Scale. Controlling for demographic factors (e.g., gender, years of free-lunch eligibility, ethnicity), classroom characteristics, and class size, they found that students with higher grit scores in fourth grade were more likely to take a college entrance exam such as the ACT or SAT and more likely to graduate from high school on time. In addition, grit in fourth grade was significantly related to fourth- and eighth-grade test scores.
- Saunders-Scott et al. (2018) evaluated 165 undergraduate students from all 4 years of college. Students at various stages of college initially completed the Short Grit Scale, and retention was measured 1½ years later. They found that grit was not a statistically significant predictor of college retention for the overall sample of college students. However, grit was a statistically significant predictor of retention when the sample was restricted to first-year students, who made up 68 of the 165 students in the original sample.
- Farruggia et al. (2018) also analyzed first-year undergraduate students using a sample of 1,603 participants. They measured perseverance at the end of students' first semester in college using the perseverance of effort dimension from Duckworth's Short Grit Scale. Controlling for academic performance, they found no direct association between first-year perseverance and retention from the first to the second year. However, there was an indirect association mediated through academic performance.

In summary, most studies indicate that grit and perseverance are associated with future academic performance and retention in school and the workplace. All but one of the longitudinal studies reviewed that focused on academic performance showed a positive relationship between perseverance and performance, the exception being Usher et al.'s (2019) one-year elementary and middle school study. Similarly, three of the five longitudinal studies showed a relationship with retention or attainment; the two exceptions were Saunders-Scott et al. (2018) and Farruggia et al. (2018). However, Saunders-Scott et al. (2018) still showed a relationship among first-year students, and although Farruggia et al. (2018) did not find a direct effect between perseverance and retention, they did find an indirect association through academic performance. None of the reviewed studies examined the relationship between persistence measured in high school and college enrollment, as we report on below.

Analyzing perseverance using HSLS:09 measures

HSLS:09 includes two student survey items (one in math and one in science) to measure students' perseverance in completing a very difficult assignment for their mathematics and science courses during 11th grade (Table 9-b). Because of this, the items are much more specific and less representative of the construct than the measures used in Duckworth's short and long grit scales and the NAEP student questionnaire measure. This limitation should be taken into account when interpreting the findings. For example, it is possible that students' perseverance on the assignments for these courses is not representative of their general perseverance. Indeed, for these particular items, it is unclear how a student who does not find assignments in this particular course (e.g., algebra, geometry) to be difficult would respond.

Despite these limitations, in our analysis we used the student responses to both items as indicators of a latent variable measuring perseverance. The response categories for these items are "Never," "Less than half of the time," "Half of the time," "More than half of the time," and "Always." The data were coded so that the scores ranged from 4, for "Never," to 0, for "Always." As such, a positive score on the scale represents having a greater tendency to persevere.

Table 9-b. HSLS:09 variables measuring perseverance

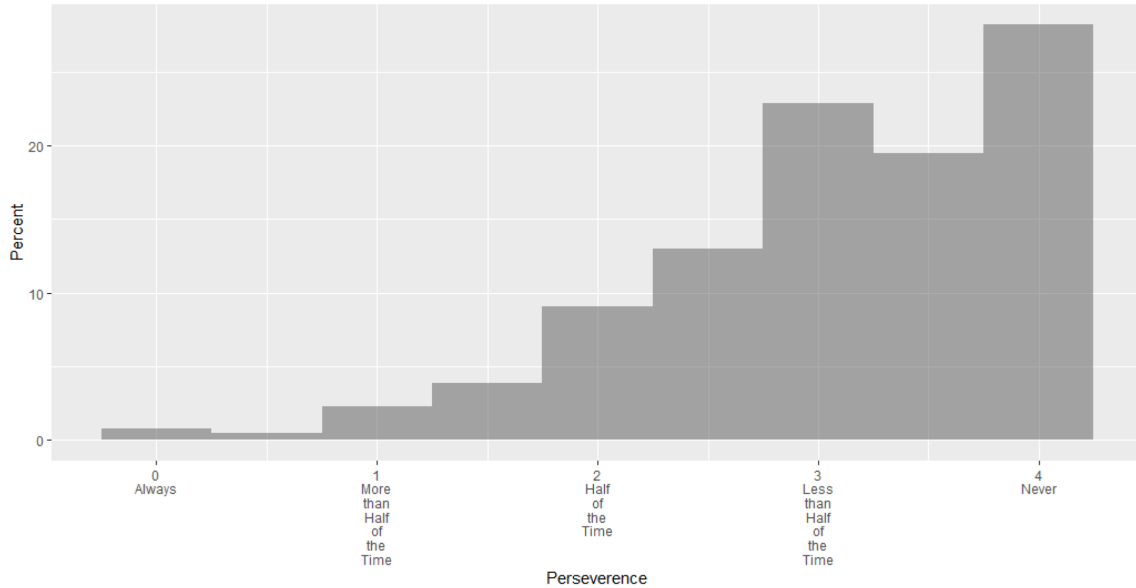
Perseverance
When an assignment is/was very difficult, how often student stopped trying
...In spring 2012 math course
...In spring 2012 science course

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, High School Longitudinal Study of 2009 (HSLS:09), First Follow-up: 2012.

As in the other chapters, our outcome variable for this chapter is whether students were enrolled in a 4-year college in 2016, 3 years after their expected graduation from high school.

To provide detail on the distribution of the measure, the scores on the two items were averaged for each student to create a summative scale; the weighted distribution is shown in Figure 9-a. The count for students with a score of 4 reflects the percentage of students who reported "Never" to both items. The distribution has a positive skew, suggesting that most students reported a high level of perseverance when faced with difficult assignments in their mathematics and science courses.

Figure 9-a. Distribution of perseverance measure



SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), First Follow-up: 2012.

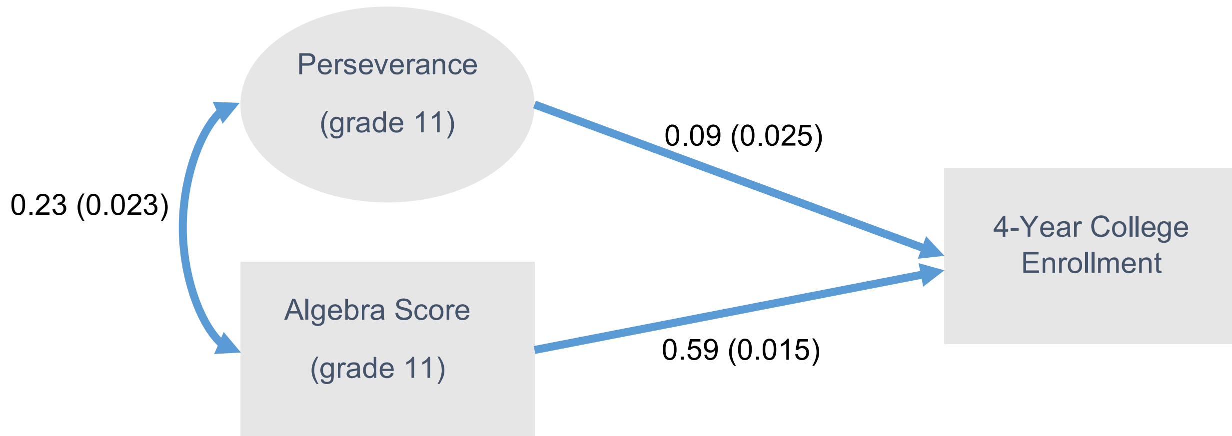
The structural equation modeling analyses that follow were conducted using data from the individual items to measure a perseverance latent variable.

Results

Analyses were conducted to examine the relationship between the latent measure of perseverance and enrollment in a 4-year college 3 years after most HSLS:09 students' high school graduation. Students' enrollment status was regressed on the perseverance latent variable using structural equation modeling, before and after controlling for 11th-grade algebra scores, which were used as a proxy for previous mathematics achievement. A practical significance level was noted when the standardized regression coefficient had a value equal to or above 0.1.

As Figure 9-b shows, a practically significant standardized regression coefficient of 0.23 was found between perseverance and enrollment in a 4-year college without the control for 11th-grade algebra achievement. However, the strength of the relationship fell to a nonsignificant 0.09 after adding this control (Figure 9-b, Table 9-c.)

Figure 9-b. Structural equation model of the relationship between academic perseverance and 4-year college enrollment



Perseverance Coefficient		
Controlling for Algebra	Est.	SE
Before	.23	(0.029)
After	.09	(0.025)

NOTE: Weight W4W1W2W3 was applied for the analysis.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), First Follow-up to Second Follow-up: 2012-2016.

Table 9-c. Academic perseverance of 11th-graders: Structural equation model results

	Perseverance	
Items	**Standardized Loadings**	**SE**
When an assignment is/was very difficult, how often student stopped trying in spring 2012 math course	0.79	0.075
When an assignment is/was very difficult, how often student stopped trying in spring 2012 science course	0.64	0.046
Path Coefficients	**Standardized Coefficients**	**SE**
Perseverance → 4-year college enrollment	0.09	0.025
11th-grade algebra → 4-year college enrollment	0.59	0.015
Perseverance with 11th-grade algebra	0.23	0.023
Model Fit	**Fit**	
RMSEA	0.006	
CFI	1.000	
TLI	0.998	
Chi-squared	1.683	
DF	1	
P-value	0.1946	

NOTE: Weight W4W1W2W3 was applied for the analysis.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), First Follow-up to Second Follow-up: 2012-2016.

Conclusion

The results of these analyses provide evidence that after accounting for academic ability, perseverance as measured by HSLS:09 in high school is not a significant predictor of students' enrollment at a 4-year college, 3 years after expected high school graduation. While the initial model shows a sizable relationship between academic perseverance and eventual 4-year college enrollment, this relationship dissipates after controlling for 11th-grade algebra test scores. These findings complement the previous literature, which has also shown mixed results on the relationship between perseverance and educational outcomes (e.g., Eskreis-Winkler et al., 2014; Gross et al., 2018; Saunders-Scott et al., 2018), with the current findings aligning with Farruggia et al. (2018), who found that academic performance mediated the relationship between perseverance at the beginning of college and college retention. This study expands on the current literature by demonstrating that academic performance also may mediate the relationship between perseverance in high school and enrollment in a 4-year college.

It is important to keep in mind that HSLS:09 used two very specific items (one in mathematics and one in science) to measure students' perseverance through a difficult assignment in a particular course. Thus, the results may not be generalizable to students' overall level of perseverance. Future studies should examine the same longitudinal question using more robust measures of perseverance.

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Chapter 10: Educational Expectations

Introduction

Educational expectations (also referred to as academic expectations) are students' beliefs and aspirations about their future educational attainment. Student educational expectations are based on how individuals perceive their academic and cognitive abilities as well as future goals and are developed through contextual factors, such as parental expectations, past academic performance, and sociodemographic influences (DesJardins et al., 2019; Hauser et al., 1983; Morgan, 1998; Sewell et al., 1970).

Academic socialization, the process through which parents communicate their expectations and values surrounding academic endeavors and educational achievement to their children (Taylor et al., 2004; Zimmerman, 2020), is an important factor in shaping students' own educational expectations (McCarron & Inkelas, 2006; Woelfel & Haller, 1971). Prior academic performance also influences individual expectations for educational attainment; however, the degree to which changes in academic performance can influence one's educational expectations is contested (Andrew & Hauser, 2011; DesJardins et al., 2019; Karlson, 2015). Finally, race, ethnicity, gender, and socioeconomic status have been shown to be related to one's educational expectations (Andres et al., 2007; Schneider & Saw, 2016), and the relationship between academic performance and expectations can differ by socioeconomic status (Bozick et al., 2010).

Literature demonstrating concurrent validity evidence

Large-scale assessments and surveys in the United States have demonstrated a relationship between educational expectations and academic outcomes. However, the directionality of the relationship is unclear, and there is little evidence that the relationship is causal in nature.

Using the base-survey year from HSLS:09, a positive relationship between educational aspirations, measured in ninth grade, and ninth-grade algebra scores was established in several studies (e.g., Sharpe & Marsh, 2018). Additionally, the Early Childhood Longitudinal Study, Kindergarten Class of 1998-99 (ECLS-K) examined academic expectations in eighth grade as well as enrollment in eighth-grade algebra. Of students enrolled in algebra or higher, 49 percent expected to receive an advanced degree, compared to 28 percent of students not enrolled in algebra. In addition, only 7 percent of students enrolled in algebra or higher expected to receive less than a 4-year degree, compared to 17 percent of students not enrolled in algebra (Walston & McCaroll, 2010).

Results from international assessments support these findings. The 2015 Program for International Student Assessment (PISA) 2015, which assesses 15-year-olds, included questions asking students what level of education they expected to complete. Across countries, on average, 70 percent of students who were top performers on all three assessments (reading, mathematics, and science) expected to receive a university degree,[12] while only 20 percent of students who were low performers on all assessments expected to receive a university degree (OECD, 2017). Additionally, results from the 2015 Trends in International Mathematics and Science Study (TIMSS) in Australia demonstrated that eighth-grade students who had higher average scores on the mathematics and science assessments aspired to go further in their education (Thomson et al., 2017).

Meta-analyses and other types of research syntheses have mainly confirmed these results:

- Pinquart and Ebeling (2020) conducted a meta-analysis of 261 studies on the relationship between students' expected and actual academic achievement, including 97 studies that explicitly examined this relationship. They found a bidirectional relationship as well as a longitudinal relationship between academic expectations and academic achievement, and these results were consistent across all measures of students' expectations, including future educational attainment and other measures of academic performance.
- In a literature review examining the relationship between student and parent aspirations, attitudes and behaviors, and educational outcomes, Gorard et al. (2012) found that student educational aspirations have been associated with academic achievement in a large number of studies. However, like others, they caution that the directionality of the relationship between achievement and educational expectation is unclear, and evidence is lacking that the relationship is causal.

Literature demonstrating predictive validity evidence

There is substantial large-scale research examining the longitudinal relationship between academic expectations in K-12 and later achievement and postsecondary outcomes.

- Jacob and Wilder (2010) explored longitudinal data from the High School and Beyond Longitudinal Study (HS&B) of 1980 (n=11,498), the National Education Longitudinal Study of 1988 (NELS:88) (n=11,857), and the Education Longitudinal Study of 2002 (ELS:2002) (n=12,174) as well as the Monitoring the Future Survey from the National Institute on Drug Abuse to evaluate students' academic expectations and their relationship to postsecondary outcomes over time. They found that expectations of students for educational attainment have increased since 1980 and that educational expectations have been consistently strongly related to educational attainment throughout time as well as positively related to others measures of academic performance, such as GPA, controlling for individual and school-level characteristics.

[12] PISA classifies students into one of six proficiency levels. Using these proficiency levels, PISA defines top performers as those who are proficient at Levels 5 or 6 of their scale and low performers as those who score below level 2.

- Bozick and Ingels (2008), using ELS:2002 (n=9,460), explored factors associated with mathematics coursetaking and achievement in high school, including students' educational expectations, controlling for students' background variables. They found that 10th-grade students who expected to receive a college degree had, on average, higher scores on mathematics assessments in 10th and 12th grades and took more advanced courses throughout their last 2 years of high school than those with lower educational expectations.
- Zaff et al. (2017) performed a literature review outlining factors that promote high school graduation and found educational expectations to be positively related to staying enrolled in and graduating from high school. Additionally, they note that this relationship can differ based upon an individual's race or ethnicity and that academic expectations can also influence academic engagement and other noncognitive factors related to academic performance, such as persistence.
- Fan and Wolters (2014) used data from ELS:2002 (n=16,194) to examine the relationship between grade 10 measures of mathematics and English self-efficacy and intrinsic value, and educational expectations, and high school dropout status 2 years later, controlling for demographic variables. They found that the further students expected to go in their education, the less likely they were to drop out of high school ($\beta=-.18$) and that educational expectations fully mediated the relationship between both mathematics and English self-efficacy and dropout status.
- Beal and Crockett (2010) investigated the association between students' expectations for the future, high school activities, and educational attainment by analyzing 7 years of longitudinal data from 317 students in a rural school district, with the first wave of data collection occurring when the students were in grades 9–11. They found that educational expectations were associated with involvement in later high school academic and extracurricular activities, controlling for demographic variables and GPA, and that extracurricular activities somewhat mediated the relationship between educational expectations and actual attainment.
- Andres et al. (2007) employed longitudinal data from the Paths on Life's Way Project of British Columbia, Canada (n=1,055), to explore the relationship between educational expectations and educational attainment 10 years after high school for students graduating in 1988. They found that students' educational expectations measured at the end of high school had a strong, consistent relationship to postsecondary attainment 1, 5, and 10 years after graduation and were more closely associated with educational attainment than both parental socioeconomic status and gender.

- Jung et al. (2018), utilizing the Longitudinal Study of American Youth, which examined 2,829 10th-grade and 3,116 7th-grade students from 1987 to 1994, explored the relationship between students' and parental educational expectations, postsecondary outcome, and life satisfaction, controlling for demographic factors. They found that students' educational expectations were directly related to parental educational expectations (β=.42), self-esteem (β=.15), and actual educational attainment (β=.31), but not to later life satisfaction.

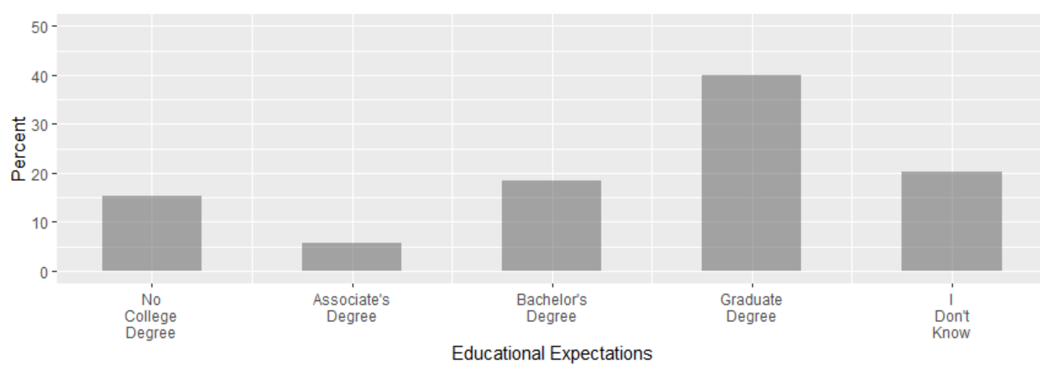
In summary, most previous research has demonstrated a relationship between educational expectations and measures of high school and postsecondary academic outcomes. Educational expectations have been found to be positively related to academic performance and postsecondary educational attainment and negatively related to dropout status in high school. Studies also demonstrate a relationship between educational expectations and other noncognitive factors, such as self-esteem and persistence.

Analyzing educational expectations using HSLS:09 measures

For these analyses, we analyzed HSLS:09 data from the 2009 base-year survey, when students were freshmen in high school. We examined student responses to an item that asked them how far in school they think they will go. Responses were recoded into four categories: does not expect to complete college, expects to complete an associate's degree, expects to complete a bachelor's degree, and expects to complete a graduate degree.

The weighted distribution of the analytic population is shown in Figure 10-a. Forty percent of the students expected their highest degree to be a graduate degree, 18 percent of students planned on receiving a bachelor's degree, 6 percent an associate's degree, and 15 percent did not expect to complete a college program. Twenty percent of the students responded that they did not know how far they would go in school. Students who responded "I don't know" were not included in the subsequent analysis.

Figure 10-a. Distribution of the educational expectations measure



SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), Base Year: 2009.

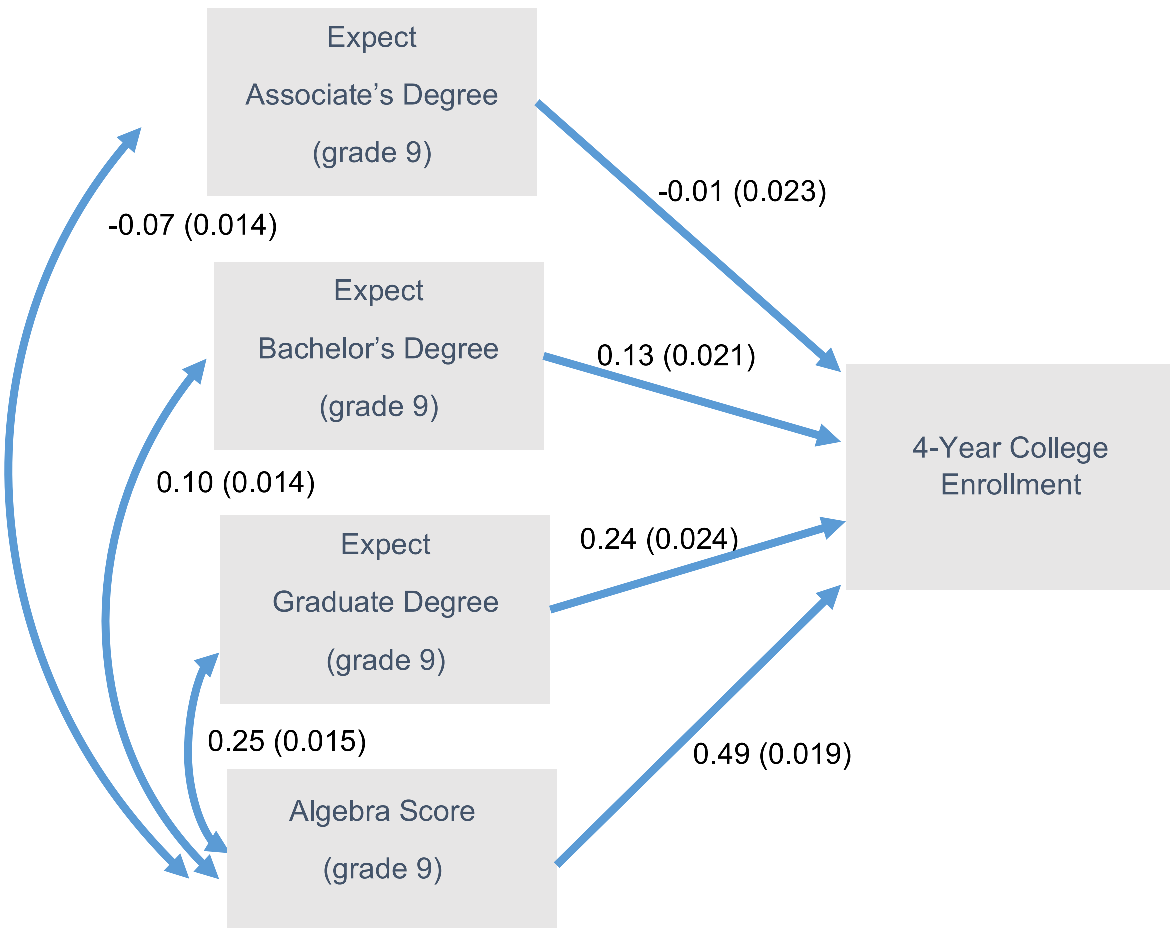
Results

An analysis was conducted to examine the relationship between educational expectations and enrollment in a 4-year college, 3 years after most HSLS:09 students had graduated from high school.

Students' enrollment status at a 4-year college, 3 years after high school, was regressed on dummy variables representing expectations of an associate's degree, bachelor's degree, and graduate degree, before and after controlling for 11th-grade algebra scores. Not expecting to complete a college degree was the reference category for the analysis. A practical significance level is noted when the standardized regression coefficient had a value at or above 0.1.

For the initial analysis, enrollment in a 4-year institution was regressed on students' educational expectations, without adding any control. A significant standardized regression coefficient of 0.65 was found for the path between expecting a bachelor's degree and enrollment in a 4-year college, and a coefficient of 0.85 was found for the path between expecting a graduate degree and enrollment in a 4-year college. After controlling for 11th-grade algebra scores, the strength of these relationships decreased, but remained significant, with a standardized regression coefficient of 0.13 for expecting a bachelor's degree and 0.24 for expecting a graduate degree (Figure 10-b, Table 10-b). A practically significant relationship was not found between expecting an associate's degree and 4-year enrollment, before or after controlling for the algebra score.

Figure 10-b. Structural equation model of the relationship between educational expectations and 4-year college enrollment



Educational Expectations Coefficients						
Coefficient	Expect Associate's		Expect Bachelor's		Expect Graduate	
Controlling for Algebra	Est.	SE	Est.	SE	Est.	SE
Before	0.07	(0.092)	0.65	(0.052)	0.85	(0.047)
After	-0.01	(0.023)	0.13	(0.021)	0.24	(0.024)

NOTE: Weight W4W1W2W3 was applied for the analysis.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09),) Base Year to Second Follow-up: 2009-2016.

Table 10-a. Educational expectations of 9th-graders: Structural equation model results

	Educational expectations	
Path coefficients	Standardized coefficients	SE
9th-grader expects to complete associate degree → 4-year college enrollment	-0.01	0.023
9th-grader expects to complete bachelor's degree → 4-year college enrollment	0.13	0.021
9th-grader expects to complete graduate degree → 4-year college enrollment	0.25	0.024
9th-grade algebra → 4-year college enrollment	0.49	0.019
Expect associate's degree with 9th-grade algebra	-0.07	0.014
Expect bachelor's degree with 9th-grade algebra	0.10	0.014
Expect postgraduate degree with 9th-grade algebra	0.25	0.015

NOTE: Weight W4W1W2W3 was applied for the analysis. There were 0 degrees of freedom, so fit statistics were not reported.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), Base Year to Second Follow-up: 2009-2016.

Conclusion

The results of this analysis align with previous research demonstrating a positive relationship between expecting a bachelor's or postgraduate degree and postsecondary outcomes. The initial analysis portrays a strong relationship between expecting a bachelor's or postgraduate degree and later 4-year college enrollment, and although this relationship decreases after controlling for 11th-grade algebra test scores, it remains substantial. This finding supports conclusions drawn from previous studies that establish a relationship between educational expectations and educational attainment while controlling for academic performance (Beal & Crockett, 2010; Jacob & Wilder, 2010).

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Chapter 11: Sense of School Belonging

Introduction

A sense of school belonging is the way in which students relate to their school environment, through their connection to and respect for school, as well as their feelings of acceptance and support in school (Goodenow & Grady, 1993). The construct has also been referred to as social connectedness, school bonding, and social bonds (Allen et al., 2018; Goodenow & Grady, 1993; Libbey, 2004; Osterman, 2000; Peguero et al. 2016; Robbins et al., 2006). Research describes many factors that shape students' sense of school belonging, including self-esteem, emotional stability, support from others, and school climate (Allen et al., 2018). The construct is associated with student engagement, motivation, and commitment to school (Farrington et al., 2012; Osterman, 2000). As sense of school belonging is closely related to classroom and school conditions (Farrington et al., 2012), including interpersonal relationships with school staff, it is somewhat malleable by teachers and other school staff members.

Generally, a sense of school belonging is based on reports of school-based relationships and experiences, such as student-teacher relations and students' general feelings about schools (Allen et al., 2018). There are several scales that have been developed to capture the construct, with items measuring, for example, students' feelings of social connectedness and happiness at their school (e.g., I feel like a part of the school, students/teachers like me at school, people at this school are friendly to me) (Gillen-O'Neel & Fuligni, 2013; Goodenow, 1993; OECD, 2019).

Literature demonstrating concurrent validity evidence

Beginning in 2017, NAEP started to survey students on their feelings about their schools. Questions include whether students feel awkward or out of place at school, feel happy at school, and feel they learned something useful for daily life at school. The 2019 NAEP mathematics assessment results show that U.S. eighth-graders who "never or hardly ever" feel awkward or out of place at school had an average score of 284 points, which was significantly higher than the score of 270 points for students who feel awkward or out of place "all or most of the time."[13]

International large-scale studies yield similar findings. The 2018 Program for International Student Assessment (PISA) measured school belonging and found, on average, that a one-unit increase on the sense of school belonging index was associated with a 4-point increase on the reading assessment across Organization for Economic Cooperation and Development (OECD) schools for 15-year-olds. Additionally, controlling for other factors, higher scores on the sense of school belonging index were related to higher individual educational expectations (OECD,

[13] Analysis conducted using the NAEP Data Explorer: https://www.nationsreportcard.gov/ndecore/xplore/NDE.

2019).[14] Similarly, the 2015 Trends in International Mathematics and Science Study (TIMSS) found that eighth-grade students across all countries assessed with a high sense of school belonging had an average score of 492 on the mathematics assessment, while students with a low sense of school belonging had an average score of 458 (Mullis et al., 2016).[15]

Meta-analyses and other types of research syntheses have confirmed these results:

- Moallem (2013) conducted a meta-analysis examining 27 studies that explored the relationship between students' sense of school belonging and academic performance. The overall effect size (r=0.220) showed a positive relationship between school belonging and measures of academic outcomes. Effect sizes varied depending upon the way the two constructs were operationalized.
- Korpershoek et al. (2019) examined 82 studies to perform a meta-analysis investigating the association between students' sense of school belonging, noncognitive factors such as motivation, and academic outcomes. Students who had a higher sense of school belonging scored higher on measures of engagement, self-efficacy and self-concept, motivation, and academic achievement.
- In a literature synthesis, Osterman (2000) explored studies related to a sense of school belonging, including literature examining school connectedness, school membership, and school relatedness. A sense of school belonging was consistently associated with higher levels of student motivation and engagement as well as a commitment to the learning process, factors that have been demonstrated to be related to academic performance and education quality.

Literature demonstrating predictive validity evidence

Longitudinal research is lacking on the focus of our analysis—the relationship between a sense of school belonging measured in high school and postsecondary enrollment and outcomes. However, a number of large-scale studies have examined the longitudinal relationship between a sense of school belonging and later achievement, either within the K-12 or the college context. Reviewing such studies—including those examining social connectedness, school bonding, and social bonds to school—reveals inconsistent findings in terms of the positive association between school belonging and various academic and postsecondary outcomes, particularly after controlling for prior achievement or other variables, like motivational attitudes.

[14] The PISA reading trend scale was set in 2000 to have a standard deviation of 100 points across the 28 OECD countries participating in PISA that year.
[15] The TIMSS mathematics trend scale was set in 1995 to have a standard deviation of 100 points across the countries participating in TIMSS that year at the eighth grade.

Several studies measured the relationship between a sense of school belonging and college retention:

- Morrow and Ackermann (2012) examined whether school belonging and motivational attitudes, measured after students' first year of college, were associated with the intention to persist and actual second-year retention for 156 first-year undergraduates. Measures of a sense of school belonging included perceived peer support, classroom comfort, isolation, and faculty support. Of these measures, faculty support was significantly related with the intent to persist in school, and peer support was significantly related with second-year retention. The measures of classroom comfort and perceived isolation were not significant. None of the school belonging measures were significant when motivational attitudes for attending college (i.e., intrinsic value, instrumental value, personal development, extrinsic pressure, and no better opinion) were entered in the model.
- Allen et al. (2008) examined data from a sample of 6,872 students from 23 universities and colleges to study how first-year academic performance, motivation, and school belonging, which they called social connectedness, were related to third-year retention, transfer, and dropout behavior. They included first-year GPA as a mediator between the constructs measured and third-year enrollment status. Their findings indicated that college commitment and social connectedness had positive and significant direct effects on students' dropout behavior, controlling for demographic variables and their university; however, the effects were small compared to first-year GPA.
- Robbins et al. (2006) conducted a large-scale study, including 14,464 college students from 48 institutions, to examine the effects of psychosocial factors, including the construct of school belonging, termed social connection, on first-year college academic performance and retention. Among other factors, social connection measured at the beginning of the year was found to be related to retention after the first semester and first year of college at 4-year institutions, even after controlling for other variables, like academic self-discipline, commitment to college, and emotional control.

Other studies have focused on the relationship between a sense of school belonging and measures of academic performance and engagement in adolescence:

- Knifsend and Graham (2012) analyzed a sample of 864 students from urban, diverse, Title I schools in a larger longitudinal study to examine the relationship between extracurricular activities, school belonging, and academic engagement and performance in the 11th and 12th grades. They found that a sense of school belonging in 11th grade was significantly related to 12th-grade academic engagement, controlling for demographic variables. A sense of school belonging in 11th grade also partially mediated the curvilinear relationship between activities in high school and academic engagement in 12th grade. When school belonging was added to the model, the strength of the relationship between activities in high school and academic engagement in 12th grade declined but was still significant.

- Liu and Lu (2011) examined the relationship between school belonging and academic achievement, measured through assessment scores, during the first year of high school for a sample of 567 10th-grade students in China, using a growth mixture model. No relationship was found between school belonging, measured at the beginning of the school year and then throughout the year, and changes in academic achievement.
- Using data from the Education Longitudinal Study of 2002 (ELS:2002) (n=10,426), Bryan et al. (2012) investigated the relationships between demographic variables, a sense of school belonging, and 12th-grade mathematics assessment scores. A sense of school belonging, referred to by authors as school bonding, was measured in 10th grade and was comprised of four components: school attachment, teacher attachment, school commitment, and school involvement. Without controlling for prior academic achievement, they found each component to be positively associated with academic performance. Once prior academic achievement and school delinquency were added to the model, two components of school bonding, attachment to school and involvement in school, remained significant.
- Peguero et al. (2016) utilized ELS:2002 data (n=11,670) to explore the relationship between student race and ethnicity, a sense of school belonging in 10th grade, and dropout status 4 years later. School belonging was described as social bonds to school and was defined through measures of school attachment, school involvement, school commitment, and school belief. They found that school attachment, school involvement, and school commitment were all significantly negatively related to dropping out of high school. The relationship between one measure of school belonging—school attachment—and dropping out of high school was stronger for minority student groups than for White student groups.
- Hawkins et al. (2001) used school bonding as a measure of school belonging. The Seattle Social Development Intervention, a longitudinal study of students from elementary school to adulthood (n=643), was explored to examine the relationship between a sense of school belonging and behavioral outcomes in students. The analysis found that students who increased their sense of school belonging from ages 13 to 18 had higher health and behavior outcomes at age 18. Increasing levels of school bonding were positively associated with GPA and academic achievement at the end of high school and negatively associated with misbehavior and crime at age 18.

In summary, the available large-scale studies focus on two types of longitudinal relationships: one within K-12 and one within college. These studies demonstrate that school belonging, measured either in high school or college, is related to student retention within the same context (K-12 or college). However, there is little consensus within the literature regarding the relationship between a sense of school belonging and academic performance. Some research shows a positive predictive association between school belonging and later academic outcomes, while other studies do not find evidence of a significant relationship. Differences may stem from the various populations measured, the operationalization of school belonging, or the other variables included in the models, such as prior achievement and motivational attitudes. Nevertheless, longitudinal research on the relationship between students' sense of school belonging in K-12 and later postsecondary outcomes is missing, but this analysis will begin to fill that gap.

Analyzing a sense of school belonging using HSLS:09 measures

HSLS:09 includes three student survey items to measure students' sense of school belonging in the base-year survey of ninth grade (Table 11-a). Ninth grade is an opportune time to measure students' sense of school belonging, given their recent transition to high school in most U.S. school districts (Farrington et al., 2012).

In our analysis, we used the data from the student responses to these items as indicators for a latent variable measuring school belonging. The response categories associated with the items were "Strongly agree," "Agree," "Disagree," and "Strongly disagree," and the data were coded so that the scores ranged from 3 ("Strongly agree") to 0 ("Strongly disagree"). As such, a positive score on the scale represents having a more positive sense of school belonging.

Table 11-a. HSLS:09 variables measuring sense of school belonging

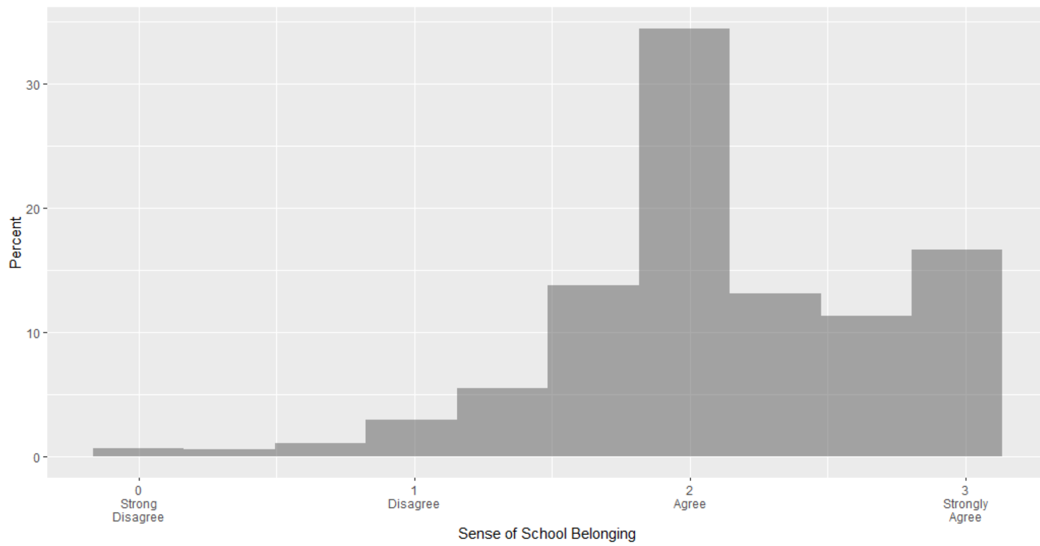
Sense of school belonging
9th-grader feels safe at school
9th-grader is proud to be part of school
9th-grader has a teacher/adult in school he/she can talk to about problems

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), Base Year: 2009.

As in the other chapters, the outcome variable for this chapter is whether students were enrolled in a 4-year college in 2016, 3 years after their expected graduation from high school.

To provide detail on the distribution of the measure, the scores for all three items were averaged for each student to create a summative scale; the weighted distribution of the analytic population on the scale is shown in Figure 11-a. The count for students with a score of 3 reflects the percentage of students who "Strongly agree" with all three items. The mode of the histogram of 2 reflects the responses of students who on average "Agree" with all three items.

Figure 11-a. Distribution of sense of school belonging measure



SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), Base Year: 2009.

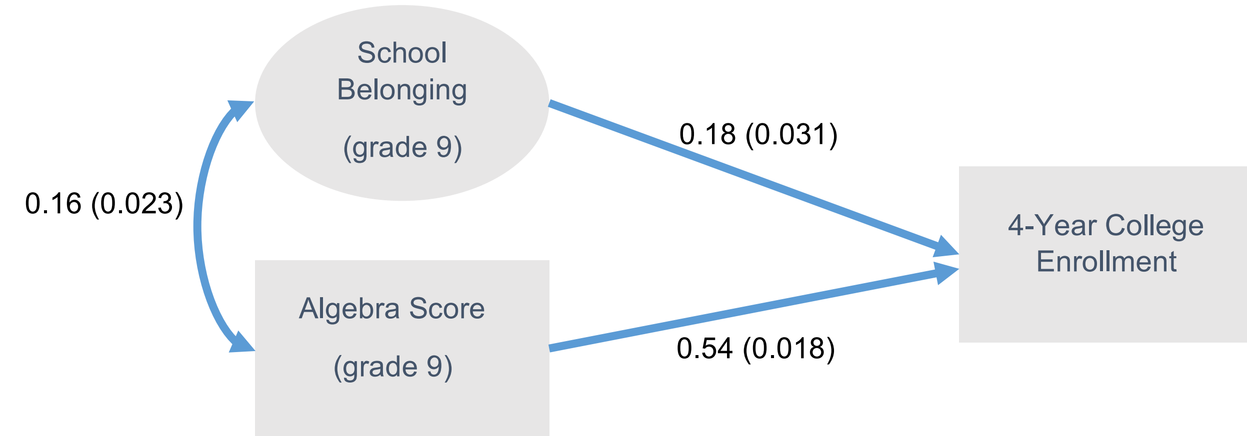
The structural equation modeling analyses that follow were conducted using data from the individual items to measure school belonging as a latent variable rather than by analyzing the summative scale variables.

Results

We conducted analyses to examine the relationship between school belonging and enrollment in a 4-year college, 3 years after high school graduation. Students' enrollment status at a 4-year college, 3 years after high school, was regressed on the school belonging latent variable using structural equation modeling, before and after controlling for ninth-grade algebra scores. A practical significance level was noted when the standardized regression coefficient had a value above 0.1.

For the initial analysis, we regressed 4-year enrollment on school belonging without adding any control. As can be seen in Figure 11-b, a practically significant standardized regression coefficient of 0.26 was found between school belonging and enrollment in a 4-year college. The strength of this relationship fell to 0.18 but remained significant after controlling for ninth-grade algebra scores (Figure 11-b, Table 11-b).

Figure 11-b. Structural equation model of the relationship between school belonging and 4-year college enrollment



School Belonging Coefficient		
Controlling for Algebra	Est.	SE
Before	0.26	(0.032)
After	0.18	(0.031)

NOTE: Weight W4W1W2W3 was applied for the analysis.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), Base-year to Second Follow-up: 2009-2016.

Table 11-b. School belonging of 9th-graders: Structural equation model results

	School belonging	
Items	**Standardized loadings**	**S.E.**
9th-grader feels safe at school	0.80	0.014
9th-grader is proud to be part of school	0.85	0.019
9th-grader has an adult in school he/she can talk to about problems	0.64	0.02
Path coefficients	**Standardized coefficients**	**S.E.**
School belonging → 4-year college enrollment	0.18	0.031
9th-grade algebra → 4-year college enrollment	0.54	0.018
School belonging with 9th-grade algebra	0.16	0.023
Model fit	**Fit**	
RMSEA	0.025	
CFI	0.994	
TLI	0.984	
Chi-squared	58.416	
DF	4	
P-value	<.01	

NOTE: Weight W4W1W2W3 was applied for the analysis.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), Base Year to Second Follow-up: 2009-2016.

Conclusion

The results of our analyses provide evidence that a sense of school belonging measured in high school is associated with students' college enrollment at a 4-year college, 3 years after expected high school graduation. While the base model shows a sizable relationship between school belonging and eventual 4-year college enrollment, after controlling for ninth-grade algebra test scores, a proxy for overall mathematical ability, the association between school belonging and performance drops but remains practically significant. These findings align with longitudinal studies showing a positive relationship between a sense of school belonging measured in high school and high school retention (Peguero et al., 2016) and a sense of belonging at the beginning of college and later college outcomes (Allen et al., 2008; Robbins et al. 2006). This study, however, breaks ground as it expands upon these findings to show that school belonging, measured in ninth grade, also predicts postsecondary outcomes.

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Chapter 12: Academic Behavior

Introduction

Academic behavior refers to the collection of behaviors typically associated with being a successful student (Farrington et al., 2012; Snipes & Tran, 2017). Through academic behavior, students demonstrate behavioral engagement, describing the extent to which students participate and are involved in their learning (Appleton et al., 2006; Fredricks et al., 2004).

Positive conduct, such as being prepared for class and completing assignments, reflects higher engagement, while negative conduct, such as absenteeism, tardiness, and disruptiveness, demonstrates lower engagement or disengagement (Nguyen et al., 2016). Academic behavior facilitates students' learning of course content and allows students to showcase their knowledge to teachers, while misbehavior has the opposite effect (Farrington et al., 2012).

Academic behavior is typically measured using self-reported surveys or teacher ratings of student conduct and participation within the classroom (Fredricks et al., 2004).

Literature demonstrating concurrent validity evidence

Large-scale assessments and surveys in the United States have shown that academic behavior is related to student achievement. NAEP measures student work habits through an academic self-discipline index (e.g., I started working on assignments right away rather than waiting until the last minute; I paid attention and resisted distractions), which is fairly similar to measures of academic behavior used in other studies. In 2019, U.S. 12th-graders classified as high on the academic self-discipline index had an average mathematics score of 154, which was 10 points higher than students classified as low on the index.[16]

Other studies within the United States find similar results. Analyzing a sample of 24,894 ninth-grade students in Chicago Public Schools, Allensworth & Easton (2007) found that academic behavior—absences and self-reported study habits—accounted for an additional 34 percent of variation in grades beyond prior achievement and demographic characteristics.

Results from international assessments align with these findings. For example, the Program for International Student Assessment (PISA) found that across Organization for Economic Cooperation and Development (OECD) countries, there was a score difference in mathematics performance of 27 points associated with arriving late to school and 37 points associated with skipping classes or days of school in the 2 weeks prior to the assessment for 15-year-old students in 2012 (OECD, 2013).[17]

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[16] Analysis conducted using the NAEP Data Explorer: https://www.nationsreportcard.gov/ndecore/xplore/NDE.

[17] The PISA mathematics trend scale was set in 2003 to have a standard deviation of 100 points across the 30 OECD countries participating in PISA that year.

Other research has confirmed these results. For example, Lei et al. (2018) conducted a meta-analysis on student engagement and achievement using 69 samples. Among other results, they found that behavioral engagement—the extent to which students demonstrate involvement in their learning—was positively correlated with academic achievement (r=.35).

Literature demonstrating predictive validity evidence

There is considerable research examining the longitudinal relationship between academic behavior in K-12 and later achievement and other postsecondary outcomes.

- Using data from the Beginning School Study, which tracked 790 Baltimore students from first grade through 2 years after expected high school graduation, Alexander et al. (1997) found that negative behaviors (i.e., absences, not completing assignments, externalizing behaviors) in first grade were significantly correlated with later dropout. However, only absences remained statistically significant after controlling for academic performance measures.
- Romero (2015) evaluated a sample of 10,585 students from the Education Longitudinal Study of 2002 (ELS:2002) and found that frequency of misbehavior (defined as getting into trouble, cutting class, suspension, or probation) in 10th grade was negatively related to outcomes in 12th grade, including GPA, highest mathematics course taken, graduation status, and postsecondary education plans.
- Analyzing a sample of 2,728 students from Tennessee's Project STAR, Finn and Zimmer (2012) found that teacher ratings of students' academic engagement (e.g., paying attention, completing assignments) in both fourth grade and eighth grade were significantly related to high school completion, even after controlling for academic achievement and contextual factors.
- Analyzing a sample of 11,827 seventh-, eighth-, and ninth-grade students in Quebec, Archambault et al. (2009) found that self-reports of behavioral disengagement (e.g., missed school without a valid reason, disrupted the class on purpose) was significantly predictive of dropout within the next 2 years.
- Stephan et al. (2015) evaluated a sample of 32,564 students in Indiana and found that absences throughout high school were negatively related to measures of early college success, including the likelihood of finishing all attempted course credits during the first year of college and of continuing onto the second year.
- Segal (2013) analyzed a sample of 9,335 males from the National Education Longitudinal Study of 1988 (NELS:88) and found that misbehavior (a composite of tardiness, absence, disruptiveness, inattentiveness, and not completing homework) in eighth grade was associated with lower educational attainment, controlling for eighth-grade test scores and family contextual factors. In addition, misbehavior in eighth grade was associated with lower future earnings, controlling for educational attainment.

- Based on a sample of 7,656 students from NELS:88, Lleras (2008) looked at teacher reports of student habits and postsecondary outcomes. Teacher reports of tardiness and homework completion in 10th grade were significantly related to educational attainment 8 years after expected high school graduation, controlling for achievement and contextual factors. Homework completion was also significantly related to wages 8 years after expected high school graduation, but this relationship was no longer significant after controlling for educational attainment.

Overall, longitudinal research tends to indicate a positive relationship between academic behavior and future outcomes, including later achievement, high school completion, educational attainment, and wages, even when controlling for academic achievement.

Analyzing academic behavior using HSLS:09 measures

In the 2009 base-year survey, HSLS:09 included student survey items to measure students' academic behavior (Table 12-a).

Student responses to the ninth-grade items were used as indicators to measure academic behavior as a latent variable. Academic behavior is treated as an unobservable noncognitive trait that represents students' level of academic responsibility, which assesses a tendency to be present and prepared for class. Such an approach has precedence, as academic behavior has been treated as a latent trait in other studies, such as Romero (2015).

The ninth-grade survey items measure how frequently students engage in negative behaviors, including being late to class, attending class without proper materials, and skipping homework assignments. The response categories associated with the items were "Never," "Rarely," "Sometimes," and "Often." The data were coded so that the desirable behavior, "Never" (e.g., for skipping homework), had a score of 3, "Rarely" a 2, "Sometimes" a 1, and "Often" a 0. As such, a positive score on the scale represents being more prepared and present in class.

Table 12-a. HSLS:09 variables measuring academic behavior

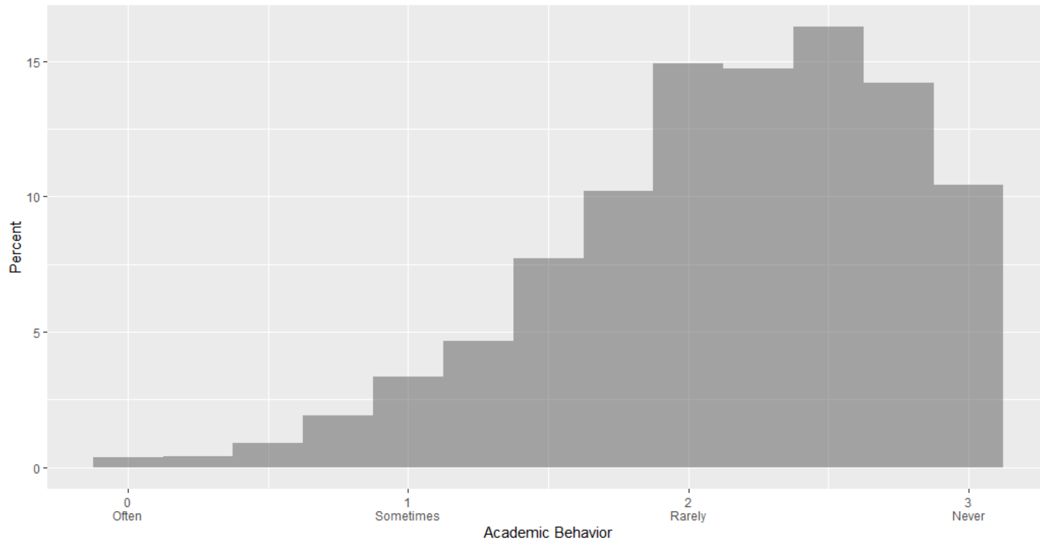
Academic Behavior
How often 9th-grader goes to class…without homework done
How often 9th-grader goes to class…without pencil or paper
How often 9th-grader goes to class…without books
How often 9th-grader goes to class…late

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), Base Year: 2009.

As in the other chapters, our outcome variable for this chapter is whether students were enrolled in a 4-year college in 2016, 3 years after their expected graduation from high school.

To describe the distribution of academic behavior, the scores for all four items were averaged for each student to create a summative scale; the weighted distribution of the analytic population on the scale is shown in Figure 12-a. The count for students with a score of 3 reflects the percentage of students who responded "Never" to all four items. The mode of the histogram is 2.5, reflecting the response pattern of students who on average responded “Rarely” to two of the items and “Never” to the other two items.

Figure 12-a. Distribution of academic behavior measure



SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), Base Year: 2009.

The structural equation modeling analysis that follows was conducted using data from the individual items to measure academic behaviors as a latent variable rather than by analyzing the summative scale variable.

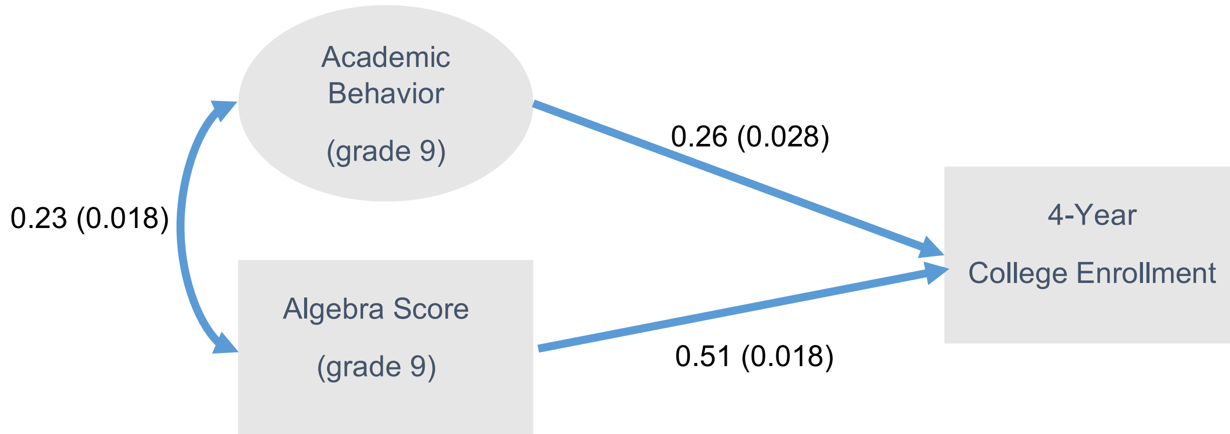
Results

Analyses were conducted to examine the relationship between academic behavior in grade 9 and enrollment in a 4-year college, 3 years after expected high school graduation.

Students’ enrollment status at a 4-year college, 3 years after most HSLS:09 students had graduated from high school, was regressed on the academic behavior latent variable using structural equation modeling, before and after controlling for ninth-grade algebra scores, where ninth-grade algebra scores are used as a proxy for previous mathematics achievement. A practical significance level is noted when the standardized regression coefficient had a value at or above 0.1.

For the initial analysis, 4-year enrollment was regressed on academic behavior, without adding any controls. A practically significant standardized regression coefficient of 0.38 was found between academic behavior and enrollment in a 4-year college, suggesting that students who tend to be more prepared and present in class are more likely to be enrolled. The coefficient decreased to 0.26 but remained practically significant after controlling for ninth-grade algebra scores (Figure 12-b, Table 12-b).

Figure 12-b. Structural equation model of the relationship between academic behavior and 4-year college enrollment



Academic behavior Coefficient		
Controlling for Algebra	Est.	SE
Before	0.38	(0.027)
After	0.26	(0.028)

NOTE: Weight W4W1W2W3 was applied for the analysis.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), Base-year to Second Follow-up: 2009-2016.

Table 12-b. Academic behavior of 9th-graders: Structural equation model results

	Construct	
Items	**Standardized loadings**	**SE**
How often 9th-grader goes to class…without homework done	0.659	0.015
How often 9th-grader goes to class…without pencil or paper	0.717	0.015
How often 9th-grader goes to class…without books	0.725	0.016
How often 9th-grader goes to class…late	0.518	0.021
Path coefficients	**Standardized coefficients**	**SE**
Academic behavior → 4-year college enrollment	0.259	0.028
9th-grade algebra → 4-year college enrollment	0.508	0.018
Academic behavior with 9th-grade algebra	0.233	0.018
Model Fit	**Fit**	
RMSEA	0.032	
CFI	0.971	
TLI	0.945	
Chi-squared	194.879	
DF	8	
P-value	<.01	

NOTE: Weight W4W1W2W3 was applied for the analysis.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), Base Year to Second Follow-up: 2009-2016.

Conclusion

The results of our analyses align with prior research. The initial analyses show sizable relationships between academic behavior and later 4-year college enrollment. After controlling for ninth-grade algebra test scores as a proxy for previous mathematics achievement, the relationship between academic behavior and 4-year college enrollment decreases in strength but remains well above the level established for practical significance. These findings are consistent with previous large-scale research, including that of Segal (2013) and Romero (2015), who found a relationship between academic behavior in high school and later educational attainment, even after controlling for prior academic achievement.

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Chapter 13: Extracurricular Participation and Educational Outcomes

Introduction

Extracurricular participation refers to any activities that are outside a school's regular curriculum. Such activities range from academic clubs (e.g., science club, debate team, student government) to art, theater, band, and sports teams.

Extracurricular activities are measured primarily by examining measures of student participation, including what activities they participate in, how much time they spend per week on them, and how many they are involved in (Latimore et al., 2018; Crispin et al., 2017). Others have focused on students' psychological engagement—the extent to which they perceive extracurriculars to be important or relevant (Adachi & Willoughby, 2014; Bundick, 2011; Bohnert et al., 2010; Weiss et al., 2005).

Literature demonstrating concurrent validity evidence

Data has not been collected by NAEP, or other large-scale assessments, in recent years about student extracurricular participation. However, for the 2019 NAEP mathematics assessment, students were asked about their participation in mathematics study groups. Nationally, U.S. eighth-graders who participated in a study group had an average score of 278, which was significantly lower than the score of 283 for nonparticipants. The lower achievement may be partially explained by the fact that mathematics study groups are sometimes formed so that struggling students receive additional support.

Shulruf (2010) conducted a meta-analysis of 29 studies examining the relationship between extracurricular activities and a wide range of junior high and high school outcomes. He generally found that extracurricular participation, including sports participation, was related to positive outcomes, although effect sizes were generally quite small (Cohen's $d < 0.2$). Larger effect sizes (Cohen's $d > 0.3$) were found for academic clubs/journalism and when analyzing the relationship between participation in student council and GPA.

Descriptive analyses of the National Education Longitudinal Study of 1988 (NELS:88) showed that 12th-graders who participated in a wide range of extracurriculars tend to have higher grade point averages and educational expectations (O'Brien & Rollefson, 1995). The authors also acknowledge that students of lower socioeconomic status tend to participate less in extracurriculars.

The NCES *Condition of Education 2012* (Aud et al., 2012) reported descriptive analyses from the Monitoring the Future study showing that in 2010, seniors who planned to attend college had higher extracurricular participation than those who did not plan to attend. Evaluating the data by extracurricular participation, 43 percent of those planning to attend college played high school sports, compared to 25 percent of those not planning to attend. Similarly, of those planning to attend college, 25 percent participated in musical or performing arts extracurriculars, 17 percent participated in academic clubs, and 11 percent participated in student government, compared with 14, 5, and 2 percent, respectively, for those not planning to attend.

Literature demonstrating predictive validity evidence

Several studies have examined the association between breadth and intensity of extracurricular participation and students' educational outcomes using longitudinal surveys.

- Gardner et al. (2008) analyzed NELS:88 data (n=11,029) and found that youth participation in extracurriculars for 2 years in high school was positively related to later educational attainment, as was the number of hours per week they participated.
- Morris (2015) analyzed the Education Longitudinal Study of 2002 (ELS:2002) data (n=12,893) and found that the relationship between sophomore year extracurricular participation and senior year educational achievement varied by socioeconomic background. Students from disadvantaged backgrounds showed gains in academic achievement at the 12th grade based on their 10th-grade extracurricular participation, but high-SES students did not show such gains.
- Haghighat and Knifsend (2019) also analyzed data from ELS:2002 (n=11,720) and found a positive relationship between the number of activities that 10th-grade students reported being involved in and educational attainment 8 years after college, with this relationship being partially mediated by educational expectations. Similarly, Haghighat and Knifsend (2019) found a positive relationship between the total amount of time each week that students were involved in extracurriculars and their future educational attainment.
- Denault and Poulin (2019) examined the time spent in organized activities for 390 students from ages 14 to 20 over a 10-month period each year, categorizing different trajectories of participation in extracurricular activities during and after high school. They found that youth who had high participation in organized activities, such as extracurriculars, early in high school and a trajectory of increasing participation after high school had higher educational outcomes (e.g., pursuing postsecondary education) at age 21.
- Hwang et al. (2016) analyzed data from NELS:88 (n=12,144) and found that such positive relationships do not always hold for sports participation. They examined the relationship between students' sports involvement in high school and their highest postsecondary degree attained 8 years after high school and found no direct relationship; however, they did find a small indirect relationship with the relationship between sports participation and educational attainment mediated by academic identity.

Previous research has demonstrated that extracurricular participation, by and large, has a positive relationship with students' future educational outcomes. However, these results are nuanced by Morris's (2015) finding that the relationship with achievement is positive only for socioeconomically disadvantaged students and Hwang et al.'s (2016) nonsignificant finding for the relationship between sports participation and educational attainment in NELS:88. It is important to note that NELS:88 began more than 20 years before HSLS:09, the data for which we analyze below.

Analyzing extracurricular participation using HSLS:09 measures

In this section, we analyze HSLS:09 data to examine (1) the relationship between the number of hours spent on extracurriculars measured at ninth grade (using data from the base-year study) and 4-year college enrollment; (2) the relationship between participation in selected mathematics and science extracurricular activities measured at ninth grade and 4-year college enrollment; and (3) the relationship between items from the first follow-up in 2012 measuring the scope of extracurricular participation since 2009 and 4-year college enrollment (Table 13-a).

To examine the relationship between the number of hours spent on extracurriculars measured at ninth grade and enrollment in a 4-year college, we analyzed students' responses to the predictor, "hours spent on extracurriculars on a typical day." which had six response categories: less than 1 hour (selected by 33 percent of the analytic sample), 1 to 2 hours (selected by 23 percent), 2 to 3 hours (24 percent), 3 to 4 hours (10 percent), 4 to 5 hours (4 percent), and 5 or more hours (7 percent). The number of hours spent on extracurriculars was treated as a continuous variable.

To examine participation in selected mathematics and science extracurricular activities measured at ninth grade, we analyzed students' responses to four mathematics extracurricular items and four science extracurricular items from the base-year survey. For mathematics, students were asked whether they participated in a math camp, math club, math competition, or math study group or tutoring since fall 2008 (when they were in 8th grade); a similar set of items was presented for science. For our analysis, we examined whether students' reports of participating in any of the mathematics extracurricular activities were related to 4-year college enrollment and, separately, whether students' reports of participating in any of the science extracurricular activities were related to 4-year enrollment. Eleven percent of students reported participating in at least one of the mathematics activities, and 7 percent reported participating in at least one of the science activities.

From the first follow-up in 2012, we analyzed the relationship between students' reports of the extracurricular activities they had participated in since 2009 and 4-year college enrollment. . The predictors were student questionnaire items where students answered "Yes" or "No" about their participation in extracurriculars focused on art (20 percent in the analytic sample answered "Yes"), music or dance (36 percent), theater or drama (14 percent), organized sports (49 percent), and scouting or another group or club activity (22 percent). By reporting their participation since fall 2009, the timeframe included their freshman, sophomore, and junior years for students who had progressed one grade level per year.

As in the other chapters, the outcome variable is whether students were enrolled in a 4-year college in 2016, 3 years after their expected graduation from high school. In contrast with the previous analyses, this analysis does not use latent variables as predictors. Extracurricular participation was not considered a latent construct since participation in one extracurricular (e.g., sports) may mean you cannot participate in other extracurriculars (e.g., band).

Table 13-a. HSLS:09 variables measuring extracurricular participation collected through base-year and first follow-up student questionnaires

Base Year: Grade 9 in 2009	First Follow-up in 2012
Hours 9th-grader spent on extracurriculars in a typical weekday during the school year • *Less than 1 hour* • *1 to 2 hours* • *2 to 3 hours* • *3 to 4 hours* • *4 to 5 hours* • *5 or more hours*	*Teenager participated in activity outside of school since fall 2009* ○ *Art* ○ *Music or dance* ○ *Theater or drama* ○ *Organized sports* ○ *Scouting or another group or club activity*
9th-grader participated in [math/science] activity since fall 2008 ○ *Math/ science camp* ○ *Math/ science club* ○ *Math/ science competition* ○ *Math/ science study group/tutoring*	

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), Base Year to First Follow-up: 2009-2012.

Results

The initial exploratory analyses examined the relationship between each extracurricular variable and enrollment in a 4-year college before adding the algebra score as a covariate. A bivariate probit regression was conducted, with the outcome being enrollment in a 4-year college in 2016 (3 years after expected high school graduation) and the predictors being student responses to the items. The results in Table 13-b show that nearly all of the extracurricular variables that we tested predicted enrollment in a 4-year college above our practical significance level ($\beta \geq 0.1$). Strong predictors ($\beta \geq 0.4$) of 4-year college enrollment were participation in any science extracurricular activity in the 8th or 9th grade and participation in an organized sports or a club or scouting activity in the 9th, 10th, or 11th grades. Participating in an art extracurricular activity in the 9th, 10th, or 11th grades had a negative relationship (β=-0.13) with 4-year college enrollment and, therefore, will not be analyzed further.

Table 13-b. Bivariate regression analysis examining extracurricular activities predicting 4-year college enrollment

Item	Standardized coefficient	SE
9th-grader		
Time spent on extracurriculars (continuous)	0.20	0.022
9th-grader participated in...		
Any math extracurricular since fall 2008	0.33	0.070
9th-grader participated in...		
Any science extracurricular since fall 2008	0.48	0.079
11th-grader participated in...		
Scouting or another group/club activity since fall 2009	0.46	0.045
11th-grader participated in...		
Organized sports since fall 2009	0.57	0.040
11th-grader participated in...		
Music since fall 2009	0.18	0.039
11th-grader participated in...		
Drama since fall 2009	0.20	0.056
11th-grader participated in...		
Art since fall 2009	-0.13	0.049

NOTE: Weight W4W1W2W3 was applied for the analysis. There were 0 degrees of freedom so fit statistics are not reported.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), Base Year to Second Follow-up: 2009-2016.

Further analysis was conducted to examine the relationship between each of these variables, analyzed separately, and 4-year college enrollment after controlling for ninth-grade algebra scores. The results in Table 13-c show that time spent on extracurriculars predicts 4-year college enrollment ($\beta \geq 0.3$), even after controlling for grade 9 algebra achievement. Participation in mathematics or science extracurriculars is also predictive of 4-year college enrollment above the practical significance level ($\beta \geq 0.1$).

Table 13-c. Extracurriculars reported by 9th-graders predicting 4-year college enrollment: Regression analysis results after controlling for 9th-grade algebra scores

Item						
Regression coefficients	**Standardized coefficient**	**SE**	**Standardized coefficient**	**SE**	**Standardized coefficient**	**SE**
Time spent on extracurriculars	0.14	0.019				
Any math extracurricular			0.14	0.062		
Any science extracurricular					0.24	0.063
9th-grade algebra	0.56	0.015	0.57	0.016	0.57	0.016

NOTE: Weight W4W1W2W3 was applied for the analysis. There were 0 degrees of freedom so fit statistics are not reported.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), Base Year to Second Follow-up: 2009-2016.

A similar analysis was conducted using the first follow-up extracurricular variables, but this time controlling for 11th-grade algebra. The results in Table 13-d show that participation in scouting or another group/club activity, drama/theater, or organized sports predicts 4-year college enrollment, all with values above the practical significance level (β > 0.1). Only the relationship between music/dance and 4-year enrollment did not reach the practical significance level after controlling for 11th-grade algebra.

Table 13-d. Extracurriculars reported by 11th-graders predicting 4-year college enrollment: Results for path analysis

Item								
Path coefficient	Standardized coefficient	SE	Standardized coefficient	SE	Standardized coefficient	SE	Standardize d coefficient	SE
Scouting or other club	0.26	0.042						
Drama			0.11	0.048				
Music					0.08	0.034		
Sports							0.36	0.033
11th-grade algebra	0.60	0.015	0.61	0.014	0.61	0.014	0.58	0.014

NOTE: Weight W4W1W2W3 was applied for the analysis. There were 0 degrees of freedom, so fit statistics are not reported.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), First Follow-up to Second Follow-up: 2012-2016.

Conclusion

The literature review and analysis in this chapter generally show that extracurricular participation has a positive relationship with later college enrollment. Our results show that students who spend more time in extracurricular activities tend to be more likely to be enrolled in college 3 years after high school, even after controlling for grade 9 algebra achievement, aligning with results from other longitudinal studies (Gardner et al., 2008; Morris, 2015; Haghighat & Knifsend, 2019). Indeed, the current study found that most of the extracurricular activities were predictive of enrollment in 4-year colleges. Participation in mathematics and science activities at the ninth grade predicted 4-year college enrollment. At the 11th grade, scouting or other group/club activities, drama/theater, and organized sports predicted 4-year college enrollment. Only participation in art and music/dance extracurricular activities at the 11th grade did not predict eventual 4-year college enrollment.

The organized sports results stand out, as the positive relationship found in this analysis differs from the research conducted by Hwang et al. (2016). Using NELS:88 data, who they found little relation between sports participation and educational outcomes. Further research should examine whether differences in conclusions across these two studies are due to substantive changes in the relationships over time, with HSLS:09 collecting data around two decades later, or due to differences in the specified models, with Hwang et al. (2016) including numerous noncognitive controls, such as academic and athletic identity.

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Chapter 14: Collaborative Skills

Introduction

Collaborative skills refer to the social skills relevant for a group of two or more individuals to successfully work together to solve a problem (Evans, 2020; Fiore et al., 2017). These skills include communicating information and ideas, understanding and accommodating others' perspectives, managing interpersonal relationships, and coordinating roles, resources, and strategies (He et al., 2017; Hesse et al., 2015; O'Neil et al., 1997).

Collaboration is interdependent, meaning that individuals must work together to accomplish their shared goals. In contrast, cooperation is characterized by a division of labor, so individuals often work in parallel on separate parts of the problem (Dillenbourg, 1999; Lai, 2011).

Collaboration has been identified by researchers as a key "21st century skill" that is becoming increasingly important to success within the workplace (Griffin & Care, 2015; OECD, 2017a). In recent years, computerization and automation have led employers to place more value on interactive skills (Autor et al., 2003). Analyzing data from the National Longitudinal Survey of Youth 1979, Deming (2017) found an increase of 11.8 percentage points in the share of jobs in the U.S. workforce demanding advanced social skills from 1980 to 2012. In addition, during the same period, he found that wages had increased by 26 percent for jobs requiring high mathematics skills and high social skills but by less than 6 percent for jobs requiring high mathematics skills and low social skills.

Collaborative skills have been assessed through a variety of measures, including self-reports, "situational judgement tests, third-party evaluations, and observational tools" (Oliveri et al., 2017, p. 19). More recently, collaboration has been evaluated within standardized assessments through collaborative problem-solving tasks. The social aspects of collaborative problem solving separate it from traditional individual problem solving (Fiore et al., 2017; Neubert et al., 2015). Individuals are evaluated based on how effectively they interact with other agents (i.e., computer agents/avatars or people) to solve a problem (Graesser et al., 2017; OECD, 2017b). Notable collaborative problem-solving frameworks have been developed by the Assessment and Teaching of 21 Century Skills (ATC21S) and the Program for International Student Assessment (PISA) (Fiore et al., 2017).

The relationship between collaborative skills and educational outcomes

Collaboration is a relatively new and challenging-to-measure construct, so much of the research has focused on determining how to accurately evaluate these skills. Large-scale assessments in the United States, such as NAEP, have found collaborative learning in the classroom, as reported by teachers, to be associated with academic achievement. For example, Lubienski (2006) analyzed data from the 2000 NAEP and found that teacher emphasis on collaborative problem solving was significantly associated with mathematics achievement in both grade 4 and grade 8, but authors cautioned that “a measure of prior achievement is not available in NAEP, and the causal order of any relationships identified will be unclear (p. 24).”

In addition, Petway et al. (2016) analyzed data from the Mission Skills Assessment, which evaluated the noncognitive skills of 13,158 students in grades 6-8 from 65 schools throughout the United States. They found significant relationships between teacher ratings of student teamwork skills (e.g., this student works effectively with others) and standardized test scores in both quantitative and verbal subjects as well as between student ratings of teamwork skills (e.g., I work effectively with others) and quantitative test scores.

Smaller studies within the United States have also found a positive relationship between collaborative skills and academic achievement.

- Using a sample of 697 fourth- and fifth-graders from schools involved with the Los Angeles Better Educated Students for Tomorrow afterschool program, Huang et al. (2010) found that self-reported collaborative skills were associated with academic performance (combined scores across mathematics and English language arts).
- Ladd et al. (2014) analyzed a sample of 212 third- through fifth-grade students from schools in the southwestern United States and found that peer ratings of students’ collaborative skills were related to teacher ratings of academic achievement and peer enjoyment of working together.
- Looking at a sample of 159 high schoolers, Wang et al. (2009) also found that teacher-reported student teamwork skills (e.g., when working on a group goal or project, this student listens to others’ contributions) were correlated with academic grades in mathematics (r=.21), science (r=.30), and social studies (r=.27); however, teamwork skills measured through situational judgment tests were not correlated with grades.

Results from international assessments align with these findings. For example, PISA 2015 included a collaborative problem-solving dimension in which students work with a team of computer agents (avatars) to complete a task. Across the Organization for Economic Cooperation and Development (OECD) countries, the results demonstrated positive correlations between performance in collaborative problem solving and performance in science (r=.77), reading (r=.74), and mathematics (r=.70) for 15-year-old students. In addition, 55 percent of students who were top performers in all three core PISA subjects were also top performers in collaborative problem solving, while 83 percent of students who were low performers in the three core subjects were also low performers in collaborative problem solving (OECD, 2017a).[18]

Large-scale research is lacking on the predictive validity of collaborative problem solving. Given the importance of collaborative skills for college and career preparedness, future studies should

[18] PISA classifies students into one of six proficiency levels. Using these proficiency levels, PISA defines top performers as those who are proficient at Levels 5 or 6 of their scale and low performers as those who score below level 2.

examine the longitudinal relationship between collaborative skills as measured in K-12 and later achievement and postsecondary outcomes.

Conclusion

In summary, collaborative skills are recognized by employers as very important to success in the workplace. Research indicates a positive relationship between collaborative skills and academic achievement, but more research is needed on the longitudinal relationship between collaborative skills as measured in high school and postsecondary outcomes.

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Chapter 15: Civic Engagement

Introduction

Civic engagement is how people participate in improving and shaping their community (Adler & Goggin, 2005). Civic engagement includes community-focused activities, such as volunteering, fundraising, and joining a community organization as well as political activities, such as voting or advocating for policies (Adler & Goggin, 2005; Michelsen et al., 2002). Informal behaviors, such as reading the newspaper or discussing current events, have been included in definitions of civic engagement (Christens et al., 2016), particularly definitions of youth and adolescent civic engagement, since typical civic activities, such as voting, are inaccessible to younger age groups (Chan et al., 2014). Service learning, defined as a teaching method that incorporates organized community service and reflection, can also be included within civic engagement (Bringle et al., 2009; Prentice, 2007, as cited in Finley, 2011, p. 2).

Civic engagement is primarily evaluated using measures of participation, such as whether students participate in community service or political activities and how frequently they participate in these activities (Chan et al., 2014; Fredricks & Eccles, 2006; Schmidt et al., 2007).

Literature demonstrating concurrent validity evidence

Large-scale assessments and surveys in the United States, such as NAEP, have evaluated civic engagement and academic achievement. The 2018 NAEP civics assessment included survey items about how often students participated in the following civic activities: discuss current political events with others, read about current political events, and volunteer within a community. On average, eighth-grade students who discussed current events with others at least once a month and students who read about current events at least once a month scored higher on the civics assessment; however, the scores of students who volunteered at least once a month were not significantly different from those of students who never volunteered. Nonresponse for these items was at least 17 percent, so these results should be interpreted with caution.[19]

Results from survey data within the United States indicate a positive relationship between civic engagement and academic achievement. Schmidt et al. (2007) evaluated a sample of 4,306 high school students in the United States using data from the National Household Education Survey of 1999. Controlling for gender, race, type of school, and socioeconomic risk, they found that service participation was associated with an increase of 12 percent in student grades and a decrease of 15 percent in behavioral issues. This relationship held constant regardless of the number of service hours, meaning they did not find a relationship between service intensity and the outcomes. The authors also investigated whether there were differences in the

[19]Analysis conducted using the NAEP Data Explorer: https://www.nationsreportcard.gov/ndecore/xplore/NDE.

relationships with the outcomes between students who voluntarily participated in service and students required to do so by their school. They found no significant differences in outcomes between these two groups.

Scales et al. (2006) focused on community service and academic achievement gaps using data from the Search Institute Profiles of Student Life: Attitudes and Behavior Survey, which surveyed more than 217,000 U.S. students in grades 6-12 in 1999-2000. They found that students from a high socioeconomic background who participated in community service for at least one hour per week had higher grades than high socioeconomic students who did not participate in service and students from a lower socioeconomic background. Among students from a lower socioeconomic background, those participating in service for at least one hour per week had higher scores than those who did not participate.

Meta-analyses on service learning and student outcomes find similar results:

- Celio et al. (2011) conducted a meta-analysis using 62 studies involving 11,837 students from elementary school through college and professional school. They found that service-learning programs were associated with positive student outcomes, including attitudes about self, school and learning, social skills, and academic achievement. In particular, they found a mean effect size of .43 between service learning and academic achievement.
- Conway et al. (2009) also conducted a meta-analysis on service learning using 103 studies with students ranging from elementary school through college and adulthood. Nineteen studies focused on academic outcomes such as grades, cognitive outcomes, and academic motivation, demonstrating a moderate effect size (mean weighted d=.43).

Literature demonstrating predictive validity evidence

There is large-scale research examining the longitudinal relationship between civic engagement in K-12 and later achievement and postsecondary outcomes.

- Chan et al. (2014) analyzed an 854-person sample from the Chicago Longitudinal Study, which tracked low income-minority children from birth through adulthood. The level of civic engagement was measured in 10th grade as a composite score of student responses to five questions about involvement in school or religious organizations and keeping up with the news. They found that the level of 10th-grade civic engagement was positively related to educational attainment at age 28 after controlling for demographic and socioeconomic factors. Tenth-grade civic engagement was also related to other outcomes for young adults, such as higher life satisfaction, future civic participation, and lower rates of arrest.

- Fredricks and Eccles (2006) used a sample of 1,500 families from the Maryland Adolescent Development in Context Study, which followed students from seventh grade to one year after high school. Civic engagement was measured by examining whether students participated in volunteer service or civil rights activities in the past year. They found that 11th-grade civic engagement was significantly related to educational attainment one year after high school; however, after controlling for prior achievement using high school grade, civic engagement was no longer predictive of educational attainment.
- Eccles & Barber (1999) analyzed a sample of 1,259 students from the longitudinal Michigan Study of Adolescent Life Transitions, which began tracking sixth-grade students from 10 southeastern Michigan school districts. They measured prosocial activities, a term they used to describe the civic engagement of students in volunteer or religious activities. They initially found that participation in prosocial activities in 10th grade was positively related to GPA in 12th grade and college enrollment at age 21. However, after controlling for gender, maternal education, and prior academic ability, only the relationship between prosocial activities and 12th-grade GPA remained significant.
- Using data on 15,340 individuals from the National Education Longitudinal Study of 1988 (NELS:88), Dávila & Mora (2007) evaluated the relationship between civic engagement in high school and future educational attainment. Civic engagement was measured by examining whether students participated in community service or student government. They found that both measures of civic engagement in high school were related to staying in high school. In addition, high school civic engagement was significantly related to earning a 4-year college degree within 12 years of finishing eighth grade.
- Moorfoot et al. (2015) looked at adolescent volunteering using a sample of 2,648 Australian students from the International Youth Development Study. Controlling for demographic factors, commitment to school, ninth-grade academic achievement, and frequency of suspension, they found a significant relationship between frequency of volunteering in ninth grade and completing high school. Volunteering in ninth grade was also related to volunteering at age 21.

Conclusion

Civic engagement has been defined as and measured through individuals’ participation in various community-focused and political activities. The current literature demonstrates a positive relationship between civic engagement and academic achievement as well as a positive relationship between civic engagement in K-12 and postsecondary outcomes, such as high school completion, future civic participation, and educational attainment. However, some studies find that there is no longer a direct relationship between civic engagement and educational attainment after controlling for demographic factors and/or academic achievement.

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Chapter 16: Work Experiences in High School

Introduction

Work experiences for high school students can be paid or unpaid. Paid activities can include part-time jobs, full-time jobs, and paid internships. Unpaid activities can refer to forms of unpaid internships or apprenticeships that help students apply and learn important technical skills.

High school work experiences are typically measured by asking students to self-report their employment or internship status, the number of hours they work per week, and sometimes their wages (Keister & Hall, 2010). Studies have focused on the short- and long-term effect of working in high school (e.g., Buscha et al., 2012) as well as the implications of the number of hours students spend working per week (e.g., Hwang & Domina, 2017).

Literature demonstrating concurrent validity evidence

Large-scale assessments and other studies have sought to examine the relationship between student work experience and academic outcomes cross-sectionally. Findings from these and other cross-sectional studies have shown no relationship or a negative relationship. Post and Pong (2009a) analyzed eighth-grade data for 20 countries from the 1999 Trends in International Mathematics and Science Study (TIMSS), controlling for school effects and home-related resources. They found that work experience was negatively associated with girls' performance on the mathematics and/or science assessments in 11 of the 20 countries examined and boys' performance in 17 of the countries examined. Following up on these findings, Post and Pong (2009b) examined eight countries using 2003 TIMSS data and found significant, negative relationships between student employment and both mathematics and science assessment scores in five of the countries.

Using a sample of 3,752 students from the National Education Longitudinal Study of 1988 (NELS:88), Singh (1998) showed that hours worked in 10th grade were negatively associated with 10th-grade assessment scores and grades when controlling for previous achievement and demographics. However, also using NELS:88 (n=9,887), Buscha et al. (2012) did not find a relationship between 12th-grade working hours and 12th-grade mathematics and reading assessment scores for males—and only a small negative relationship between mathematic assessment scores and working hours for females—when controlling for the differences in assessment scores and working hours prior to measurement at 12th grade.

Two research syntheses have also in general found a negative relationship between student employment and academic outcomes:

- In a literature review examining research on youth employment, Loughlin and Barling (2001) reported a negative relationship between hours worked by students and their academic engagement as well as increased behavioral problems, such as drug use. These effects were particularly strong for students who were working more than 20 hours per week.
- Keister and Hall (2010), focusing on the relationship between the intensity of work and academic outcomes, also found that working in high school has negative effects on academic outcomes, but the relationship generally depends upon the intensity of the work. They explain that while studies have demonstrated that working a few hours per week does not negatively impact students' grades, working over 20 hours per week is associated with significantly lower GPAs.

Literature demonstrating predictive validity evidence

There is a substantial amount of large-scale research examining the longitudinal relationship between work experiences in K-12 and later achievement and postsecondary outcomes. Research primarily focuses on student employment status as well as the number of hours students spent working each week.

- Marsh and Kleitman (2005) used the NELS:88 data (n=12,084) to investigate the effects of working during high school on grade 12 and postsecondary outcomes. The authors found, controlling for background variables and previous achievement, that the number of hours worked in grade 8 had a negative relationship with several student outcomes in grade 12, including GPA and occupational aspirations. A similar relationship was found between the number of hours worked in grades 10 and 12 for GPA, attendance, and not participating in delinquent activities. Additionally, working in grade 12 had a negative association with postsecondary outcomes, such as college enrollment, months in college, and educational attainment.
- McNeal (2011) examined NELS:88 data, merged with the Common Core of Data, Census of Finance files, and School District Databook (n=13,902), to examine the relationship between youth employment, labor market area, and dropping out of high school. The study found that intensive work was significantly related to dropping out of high school, and this effect was stronger for students of lower socioeconomic status.
- Hwang and Domina (2017) analyzed data from the Education Longitudinal Study of 2002 (ELS:2002) to investigate the association between paid youth employment and college outcomes and to determine whether the association differed by students' demographic backgrounds. Controlling for gender, previous achievement, family demographic variables, and race/ethnicity, student employment was measured as the number of working hours per week in the 10th and 12th grades. Logistic regression models showed that working fewer than 5 hours per week was positively related to the probability of attending college and obtaining a bachelor's degree.

- However, high-intensity work, defined as more than 20 hours per week, was negatively associated with attending college and receiving a bachelor's degree. Adding interaction terms to the model, they found high-intensity work to be negatively associated with educational attainment for White students but not for Black students and mid-intensity work to be associated with lower odds of receiving a bachelor's degree for Hispanic students but not for White students. However, the negative association did not vary by parental educational level or family income.
- Lee and Orazem (2010) focused on how cumulative time spent working in high school may affect students' performance and their likelihood of dropping out. The authors analyzed nationally representative data from the 1997 National Longitudinal Survey of Youth (NLSY 97) (n=8,984) and concluded that there was a small positive relationship between the number of hours worked and high school completion. However, when students' work hours increased by 10 percent, their probability of going to college decreased.
- In a research synthesis examining why students drop out of high school, Rumberger and Lim (2008) identified 37 studies examining whether high school work experience could predict high school dropout status. They concluded that students who work more than 20 hours per week were more likely to drop out of high school; however, they also found evidence from some studies that students who work a few hours per week are less likely to drop out of high school than those who do not work at all.
- Using data from Monitoring the Future, a longitudinal survey that measured adolescents in the 8th, 10th and 12th grades, Staff et al. (2010) examined the within-individual changes across high school in student employment and academic outcomes (n=3,860). They found that working intensive hours, defined as more than 20 hours per week, was related to lower GPAs, educational expectations, and school activities. In addition, working intensive hours was related to increased academic misbehavior, such as suspensions and truancy.

In summary, a majority of studies demonstrate that high-intensity work, defined generally as working more than 20 hours per week, is negatively related to academic outcomes, such as GPA, high school graduation, and college attendance. However, some studies did show a positive relationship between working a few hours per week (5 or fewer) and high school and postsecondary outcomes.

Analyzing work experience using HSLS:09

HSLS:09 includes numerous student survey items to measure students' work experience in the base year (2009) and the first follow-up of the survey in 2012. As it is less common for students to work as freshmen in high school, the focus of our analysis was on examining data from the job and internship items collected through the first follow-up questionnaires of 2012, administered for the majority of respondents in the spring of their junior year.

We focus on two sets of items (Table 16-a). The first set was administered to students currently in high school or being homeschooled and focuses on working for pay during the high school year. The second set was administered to all participants, including those who had dropped out of high school, and focuses on their involvement in internships, apprenticeships, and other career goal-related jobs. Four of the five items (three in the first set and two in the second set) were closed-response items, asking participants to respond "Yes" or "No". The item asking current students about the number of hours worked was an open-response item, allowing them to specify the number of hours, rounded to the nearest whole number.

Table 16-a. HSLS:09 variables measuring work experience

Work experience items: Administered to students in high school (or being homeschooled) in spring 2012
Teenager ever worked for pay during high school year *Yes* *No*
Teenager was working for pay (excluding work around the house) at the end of the spring term of 2012 *Yes* *No*
Hours per week teenager worked in spring 2012/ most recent school-year job (open response)
Internships, apprenticeships, and career goal-related job items: Administered to all participants in spring 2012
Teenager performed paid/volunteer work in job related to career goals *Yes* *No*
Teenager participated in an internship or apprenticeship related to career goals *Yes* *No*

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), First Follow-up: 2012.

The distribution of responses to the closed-response items can be found in Table 16-b. As shown in the table, 47 percent of high school students reported ever working for pay during the high school year and 31 percent had a job in the spring 2012 term. Among all participants, 16 percent had participated in an apprenticeship and 34 percent had performed paid or volunteer work in a job related to their career goals.

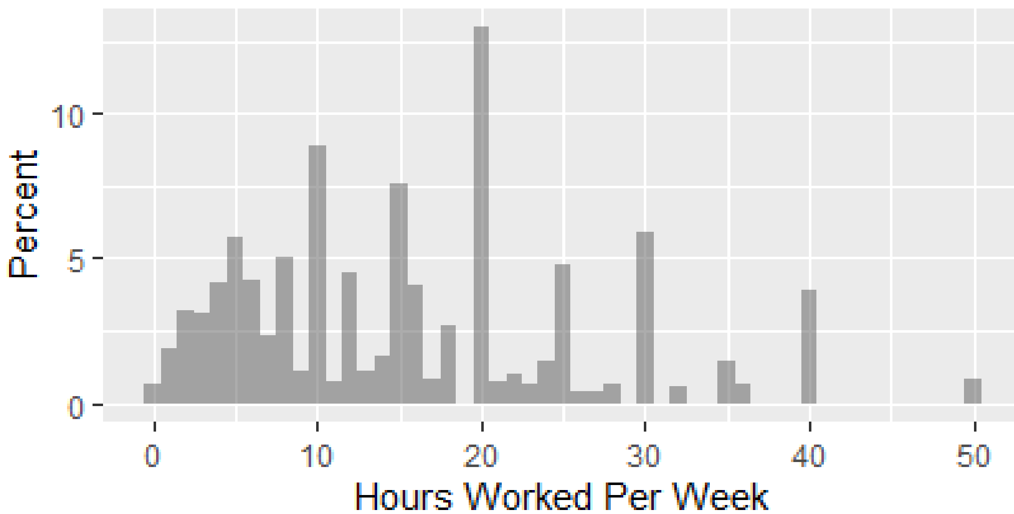
Table 16-b. HSLS:09 variables measuring work experience

Work experience items administered to students in high school (or being homeschooled) in spring 2012	Yes	No
Teenager ever worked for pay during high school year	47%	53%
Teenager was working for pay (excluding work around the house) at the end of the spring term of 2012	31%	69%
Internships, apprenticeships, and career goal-related job items: Administered to all participants in spring 2012		
Teenager performed paid/volunteer work in job related to career goals	34%	66%
Teenager participated in an internship or apprenticeship related to career goals	16%	84%

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), First Follow-up: 2012.

Figure 16-a shows the distribution of responses to the number of hours worked by high school students with jobs in spring 2012. As the figure shows, there was great variance in the number of hours worked, with a mode of 20 hours and a mean of 16 hours.

Figure 16-a. Distribution of hours worked per week among high school students with jobs



SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), First Follow-up: 2012.

Results

Initial regression analyses examined the relationship between each high school work experience variable and enrollment in a 4-year college before controlling for the grade 11 algebra score. The results can be found in Table 16-c. Among high school students, both having a job in the spring of their junior year or ever having a job in high school fell below our practical significance threshold of 0.1. A null relationship was also found for working in a job related to career goals and 4-year college enrollment. However, among high school students ever having a job, we found a negative relationship between the number of hours worked and enrollment. Having participated in an internship was also negatively related to 4-year college enrollment.

Since none of the zero-order relationships was positive and above our practical significance level of 0.1, we did not do follow-up with analyses including algebra achievement in the model, as we did in most other chapters.

Table 16-c. Bivariate regression analysis examining work experience predicting 4-year college enrollment

Item	Standardized Coefficient	SE
Teenager worked in spring 2012	-0.06	0.043
Teenager ever worked during school year	-0.06	0.046
Time teenager spent working (continuous)	-0.27	0.027
Teenager worked in job related to career goals	0.07	0.043
Teenager participated in an internship	-0.16	0.064

NOTE: Weight W4W1W2W3 was applied to the analysis. There were 0 degrees of freedom so fit statistics are not reported.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09), First Follow-up to Second Follow-up: 2012-2016.

Conclusion

In conclusion, the results failed to show a positive relationship between working and later enrollment in a 4-year college, 3 years after expected high school graduation. However, we did observe that there was a significant negative relationship between the number of hours that a teenager spent working and college attendance, as there was for participating in an internship as a teenager. The results largely align with those found in the literature review. Although there were a few papers in our review where, under certain circumstances, positive relationships were identified between working in high school and educational outcomes (Lee & Orazem, 2010; Rumberger & Lim, 2008), most cases pointed to a null or negative relationship (e.g., Buscha et al., 2012; Keister & Hall, 2010; Marsh & Kleitman, 2005), with higher intensity work in particular having a negative relationship with academic outcomes (Staff et al., 2010; Rumberger & Lim, 2008; Hwang & Domina, 2017).

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