High School Longitudinal Study of 2009 (HSLS:09)

Website: http://nces.ed.gov/surveys/hsls09/
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High School Longitudinal Sample Survey:

HSLS:09 collects data from:

- Students
- Parents
- Teachers
- School administrators
- School counselors
- Transcripts

1. OVERVIEW

The High School Longitudinal Study of 2009 (HSLS:09) is the fifth study undertaken by the National Center for Education Statistics (NCES) as part of its Secondary Longitudinal Studies Program. The predecessors of HSLS:09 include three completed studies (the National Longitudinal Study of the High School Class of 1972 [NLS:72]—see the NLS:72 chapter; the High School and Beyond Longitudinal Study [HS&B]—see the HS&B chapter; and the National Education Longitudinal Study of 1988 [NELS:88]—see the NELS:88 chapter) as well as one ongoing study (the Education Longitudinal Study of 2002 [ELS:2002]—see the ELS:2002 chapter).

HSLS:09 is a nationally representative, longitudinal study of more than 21,000 ninth-graders in 944 schools who will be followed through their secondary and postsecondary years. The study focuses on understanding students' plans and trajectories from the beginning of high school into postsecondary education, the workforce, and other early adulthood transitions.

What students decide to pursue when, why, and how are crucial questions for HSLS:09, especially, but not solely, with regard to science, technology, engineering, and math (STEM) courses, majors, and careers. Additionally, this study features a new student assessment in algebraic skills, reasoning, and problem solving while, as in past studies, including surveys of students, their parents, math and science teachers, and school administrators, as well as a new survey of school counselors. The HSLS:09 base-year data collection took place in fall 2009 and generated a set of nationally representative data as well as state-level representative data for 10 states.

The first follow-up took place in the spring of 2012, and further depicts the circumstances and implications for later outcomes of process data on student decision-making. With the advent of first follow-up data, HSLS:09 can now measure mathematics achievement gains in the first 3 years of high school. Generally, across both the base year and first follow-up, the study questions students on when, why, and how they make decisions about high school courses and postsecondary options, including what factors, from parental input to considerations of financial aid for postsecondary education, enter into these decisions. Because the study started with fall ninth-graders, it was able to identify high school dropouts in the first follow-up. The antecedent data from the base year will enable researchers to study the process of school disengagement, and will include relatively "early" dropout, those who left as early as spring of ninth grade.

The 2013 Update and the High School Transcript Collection of HSLS:09 allow researchers to begin analyses of high school outcomes and immediate postsecondary plans and experiences, bolstered by the rich data gathered in prior rounds. The goal of the 2013 update was to efficiently collect information on sample members' status with respect to high school completion, postsecondary applications and enrollment, financial aid applications and offers, and employment.

The second follow-up data collection was conducted from March 2016 through January 2017, approximately 3 years after high school graduation for most of the cohort. The data collected allow researchers to examine an array of young-adulthood outcomes among fall 2009 ninth-graders, including delayed high school completion, postsecondary enrollment, early postsecondary persistence and attainment, labor market experiences, family formation, and family financial support. Analyses of these outcomes can capitalize on the large amounts of data gathered about the students in fall 2009, in 2012 (when most were spring-term 11th-graders), and in summer and fall 2013 (when most had completed high school). Analyses can also be augmented with information collected from parents, teachers, administrators, counselors, and high school transcripts.

Purpose

The core research questions for HSLS:09 explore students' secondary to postsecondary transition plans and the evolution of those plans. Included is consideration of paths into and out of STEM courses and the educational and social experiences that affect these shifts. In this regard, HSLS:09 addresses many of the same educational and occupational issues as its predecessor longitudinal studies; however, HSLS:09 places added emphasis on the paths that lead students to pursue and persist in courses and careers in STEM fields.

Components

The student is the fundamental unit of analysis in HSLS:09. In the base-year survey, data from students' school, classroom, and home environment were collected and attached to the student record to provide information on the contextual factors that might influence their motivation, beliefs, and interests in goal setting and decision-making. Contextual information was provided by several sources, including the school's head administrator, the lead counselor (or staff member most knowledgeable about the entering ninth-grade class), students' mathematics and science teachers, and a parent.

Base-year survey. The base-year survey was conducted in fall 2009, and included the student questionnaire, the student assessment of algebraic reasoning, and the parent, teacher, school administrator, and counselor questionnaires as described below.

First follow-up survey. The first follow-up questionnaires comprised measures repeated from the base year, in order to measure change in a base-year construct (e.g., educational expectations) or outcome measures (e.g., dropping out of high school) that can be related to base-year antecedents, and augmented by further items that are specific to the first follow-up (e.g., transition to high school ceases to be an emphasis in the first follow-up, but transition plans for postsecondary education loom larger). Instruments were developed, and revised, based on results from the base-year and first follow-up field tests, cognitive interviews, and feedback from the Technical Review Panel (TRP) and Office of Management and Budget (OMB). The contents of the four first follow-up questionnaires—student, parent, administrator, and counselor—are described below. Certain items were deemed "critical" (i.e., of special importance to the study), and respondents who skipped such items were prompted, with a message noting the importance of the item and requesting that they provide an answer if at all possible.

2013 Update survey. The 2013 Update survey took place between June and January 2014. The survey, which could be completed by either the sample member or a parent, was designed to gather basic information about the sample member's high school completion status or plans, postsecondary education and work plans, and the college application and financing process. Questions were adapted so that parent respondents were providing information about their child's activities and plans, although some subjective questions (e.g., about the reasons for choosing a college) were also asked and may systematically differ across parents and children. Because the survey was administered over a number of months that preceded and overlapped with the traditional start of college classes in the fall, a number of questions were anchored to November 1, 2013, and designed to elicit the anticipated or realized activities of respondents on that date.

High School Transcript Collection. High school transcripts were collected in the 2013–14 academic year; methodology was tested in the transcript field test (see the appended field test report, appendix A). Records matching (for example, ACT and SAT scores, Free Application for Federal Student Aid [FAFSA] data, General Educational Development [GED] data) also contributed to the dataset.

Between fall 2013 and spring 2014, high school transcripts were gathered from all schools that students had attended—including schools known from prior rounds, schools identified by the student or parent during the 2013 update survey, or schools discovered during the request for transcripts from existing schools. Coursetaking records from transcripts were keyed and coded using the School Courses for the Exchange of Data (SCED), a code frame that classifies courses into standard 12-digit codes reflecting their course content and placement within subjects. HSLS:09's use of SCED marks the first implementation of this code frame on any NCES transcript study. Course credits, course grades, and other measures derived from transcripts were standardized to ensure comparability across schools. In addition, student records were matched to external data sources to obtain data on

SAT and ACT scores, Free Application for Federal Student Aid (FAFSA) data, and GED completion data.

Second follow-up survey. The second follow-up was designed to collect information from the cohort approximately 3 years after the modal high school completion date. The second follow-up survey explored a variety of academic and employment-related topics that include, but are not limited to, high school completion and experiences, college enrollment history and future enrollment plans, and employment and unemployment history. The second follow-up survey collected information on each of these diverse activities while continuing to capture information on students' experiences and the influences and constraints on their decision-making about postsecondary education, fields of study, and occupations. Selected survey items paid particular attention to students' experience with and choices related to STEM fields. Respondents were asked to anchor their responses for a number of questions to the end of February 2016 (the month before data collection began), and many questions asked specifically about the respondent's activities and status in that month.

The second follow-up also covered a range of topics related to family, community, and personal characteristics including marital and parental status, household composition, financial well-being, community engagement (e.g., citizenship, voting registration, volunteering), personal characteristics and values (e.g., disabilities, sexual orientation and gender identity, experiences of discrimination, life values), and significant life events (e.g., job loss, death, serious injury or illness).

Student financial aid and postsecondary transcript collection. In addition to information obtained from sample members who participated in the second follow-up survey, data were obtained in 2017 from postsecondary institutions as part of the student financial aid records and postsecondary transcript collection. Financial aid data records include data collected from the institutions that sample members attended, and federal student loan records from the Department of Education's Office of Federal Student Aid. Records collected from the institutions attended by HSLS:09 sample members provide detailed information about students' enrollment patterns, degree programs or other programs of study, progress toward degree, and costs of attendance. The postsecondary transcript data cover postsecondary coursetaking through 2016 and provide detailed information on students' academic experience, including academic performance, credit accumulation, enrollment periods, and transfer between institutions.

Student questionnaire. The student questionnaire was typically self-administered using a computer during in-school interview sessions. If a student was unable to participate in school, a telephone interview was conducted using the same survey instrument with the addition of interviewer instructions.

Background information was collected from the ninth-graders, including demographic information (such as sex, race/ethnicity, birth date, and native language) and the names, addresses, and phone numbers of people who would know how to locate them for future rounds of the study. Information was also gathered on students' recent school experiences, including the school they attended in the previous school year (2008–09) and their grade level at the time; their involvement with various math and science activities since the beginning of the previous school year; and the math and science courses they took in the eighth grade, along with the final grade earned in each.

Questions were also asked about students' self-efficacy in math and science and self-identification as a math and science person. Additionally, data were collected on the math and science courses they were taking in the fall of 2009, and students were asked to identify the teachers of these courses. Questions were asked about students' attitudes toward school, math, and science, as well as about whom students spoke with regarding their future education, career plans, and personal problems. Moreover, data were collected on friends' attitudes about school and related behaviors, as well as on programs in which the student had participated, such as Upward Bound or MESA (Mathematics, Engineering, Science Achievement). Students were also asked about their perceptions of males' and females' abilities in math, science, and English and language arts. Finally, information was collected on their high school, career, and college plans. Specifically, students were asked about their plans to take additional math and science courses in high school, career or college plans, plans to take standardized college placement exams, and general plans for the year after high school. Data were also collected on students' educational expectations, such as how confident they were of graduating from high school, as well as their estimates of the cost of college and their expected occupation at age 30.

The first follow-up Student Questionnaire targeted the fall 2009 ninth-grade cohort members in the spring term of the 2011–12 school year, regardless of their school enrollment status (i.e., whether they are students, dropouts, or early graduates). The questionnaire was designed with content appropriate for dropouts and early graduates, as well as students still enrolled in the base-year school, those who have left the base-year school for homeschooling, or those who have transferred to a new school. The first follow-up student questionnaire was a web survey.

Some first follow-up participants were nonrespondents in the base year. Therefore, a number of questions were asked only of sample members for whom the information was missing in the base year. These items pertain to critical classification variables such as language use, and parental education and occupation.

The goal for developing the content of the second follow-up instrument was to design a web survey that, in conjunction with data collected in previous rounds of the study, could provide information on sample member's choices related to secondary education completion, postsecondary education, entry into the workforce, and family formation. The second follow-up survey not only collected new information about sample members' activities, but also updated information obtained in previous data collections and gathered information that was missing in prior rounds of the study (either from item- or unit-level nonresponse).

The second follow-up survey was designed for self-administration on the Web as well as interviewer administration via telephone or in-person interviews. The web instrument could be completed on a desktop or laptop computer or a mobile device such as a tablet or smartphone. The survey did not have to be completed in a single session or in a single mode. Respondents could begin the survey, log out, and resume where they left off at a later time. Moreover, respondents could switch modes across survey sessions. For example, they could begin the survey on their own and later complete the survey with an interviewer. For sample members who decided to complete the survey over the phone or in-person, trained interviewers administered the survey, following instructions on each screen that indicated how each question was to be administered (e.g., whether the response options were to be read aloud, and when to probe for more information).

In developing the second follow-up survey instrument, a primary challenge was to minimize respondent burden while collecting as much information as possible. One way to do this was by routing the survey around questions when the answer could be logically inferred from the answer provided to an earlier question. Additionally, the full-length survey instrument was used from the beginning of data collection through December 11, 2016, at which time it was replaced by an abbreviated instrument to encourage the remaining nonrespondents to participate. Survey respondents who partially completed the full-length instrument before that date and resumed after that date were automatically switched from the full-length to the abbreviated survey.

Student assessment of algebraic reasoning. The HSLS:09 assessment battery was designed to allow for comparison of students' algebraic reasoning skills across years. Algebraic reasoning skills were first assessed in the fall of 2009, when students were in the 9th grade, and were assessed again in the spring of 2012, when most students were in the 11th grade.

The assessment was designed to measure students' understanding, and growth in understanding, of key algebraic knowledge and skills useful in the preparation for the study of science, further study within the mathematical sciences and statistics, and the requisite skills expected in the workplace. Accordingly, the framework was designed to assess a cross-section of topics representative of six major content domains of algebra (the language of algebra; proportional relationships and change; linear equations, inequalities, and functions; nonlinear equations, inequalities, and functions; systems of equations; and sequences and recursive relationships) and four key processes of algebra (demonstrating algebraic skills; using representations of algebraic ideas; performing algebraic reasoning; and solving algebraic problems).

As with the base year, the HSLS:09 first follow-up mathematics assessment was administered by computer, using a two-stage design wherein each student completed a Stage 1 "router test" and then a Stage 2 test designated as "low," "moderate," or "high" difficulty that was assigned on the basis of Stage 1 performance. The first follow-up assessment consisted of 73 unique items, with 23 serving as linking items to the base-year assessment, with any given student receiving 40 items. The computer-delivered design included an online scientific calculator and allowed students to skip and return to items within each stage and to identify items for review within each stage before submitting their answers as finished.

Parent questionnaire. The parent questionnaire was completed by the parent or guardian most familiar with the ninth-grader's school situation and experience. Most often this was the student's mother or father (although, in rare instances, a guardian such as a grandparent responded). The questionnaire collected information on the presence of parents or guardians in the household, their relationship to the ninth-grader, and their marital status; the parents' race and ethnicity, immigration status, language use, and socioeconomic status; the student's place of birth, immigration to the United States and grade placement upon arrival (if born abroad), and whether the student had ever been or was currently enrolled in a program for English language learners; the student's educational history (e.g., skipping or repeating grades, changing schools, dropout episodes, suspensions and expulsions, special education services, enrollment in honors courses); the parents' involvement in the ninth-grader's education and learning; the parents' plans and preparations for their child's postsecondary education; and contact information

for parents, relatives, and friends who could locate the ninth-grader in subsequent rounds of the study.

In the first follow-up, a random subsample of students' parents were administered the parent questionnaire. Data collection staff asked that the parent or guardian most familiar with the school situation and experience of the student sample member complete the parent questionnaire. As with the student questionnaire, there are questions that have been adapted to the situation of parents of dropouts as well as to parents of school attendees. The first follow-up parent questionnaire was fielded as both a web survey and a computer-assisted telephone or in-person survey. In the beginning of data collection, the survey was fielded with the web option. As the period of data collection elapsed, parents were also given computer-assisted options, with an interviewer over the telephone and at the end of the field period an in-person interviewer.

Parents were asked about their relationship to their child, how much of the time the cohort member lives with the parent respondent, if other parents reside in the household, parent respondent's current marital status, counts of household members by age, school enrollment status of the student sample member, negative life events, prior educational experience including grades their child repeated, school suspensions, dropout episodes, number of times parent contacted the school, family activities, parent-child activities to prepare for the postsecondary transition, parent aspirations and expectations, ability to complete a bachelor's degree, ranking of importance of various college features, degree of parent and student input for postsecondary decision-making, affordability of college, means of getting financial aid information, expectations for qualification for financial aid, obstacles to applying for financial aid, savings for education, willingness to borrow, family educational and occupational background, employment status, income, demographic background, and languages spoken in the home. Some questions (e.g., national origin) that were asked in the base year are only repeated in the first follow-up if base-year data are missing due to unit or item nonresponse.

Teacher questionnaire. All teachers who had an HSLS:09 student in their math or science course were eligible for the teacher questionnaire. Teachers were asked to answer questions regarding their own demographic characteristics, educational history, certification, and teaching history. Additionally, they were asked to evaluate their departments, departmental colleagues, principal and faculty.

As well, the teacher questionnaire included questions about students in general (i.e., they were not asked questions about any particular students). For instance, teachers were asked to report on their beliefs about the influence of a student's home environment on their ability to be effective teachers; how male and female math and science abilities compared; and how they assessed the achievement levels and preparedness of students in their class. As well, teachers provided information on the use of small groups in class and their emphasis on various course objectives.

Importantly, the teacher data are meant only to supply contextual information for students' classrooms, while the student remains the unit of analysis. The teacher sample is not representative of teachers in the school. The design of this component does not provide data for a standalone analysis sample of teachers, but instead permits specific teacher characteristics and practices to be related directly to the learning context and educational outcomes of sampled students.

School administrator questionnaire. Most of the school administrator questionnaire could be completed by the principal or another knowledgeable staff member at the school. Respondents were asked factual questions about the school's characteristics, including grade span, control (public or private), type (e.g., charter, magnet, single sex, religious), academic calendar, and course scheduling. Questions were also asked about the student body, school faculty, and math and science curriculum. The final section, which could only be answered by the school administrator, included questions about the administrator's background and an evaluation of the school's problems and challenges.

In the first follow-up, the school administrator questionnaire targeted the base-year schools, 2.5 years later. In addition, an abbreviated version of the administrator survey was fielded to collect information from schools to which students in the study transferred. The school administrator questionnaire was fielded as a web survey.

The full administrator survey consisted of four sections: (1) school characteristics; (2) programs, policies, and statistics of the school; (3) school staffing; and (4) opinions and background of the school principal. The school characteristics section contains questions about the school type (e.g., regular, charter, alternative); magnet and school choice programs; academic calendar; course scheduling; hours of instruction; and percentage of students who attend area or regional career and technical schools. The second section includes questions about enrollment; proportion of students who receive free or reduced-price lunch, who are English language learners, and who receive special education services; enrollment and assignment policies; average daily attendance; absenteeism policies; programs to help students who are struggling academically; credit recovery programs; alternative and

dropout prevention programs; activities to increase student interest and achievement in math and science; and years of coursework required for graduation. The third section asks questions about teachers within the school. Topics include numbers of teachers by full- and part-time status and by subject matter; teacher recruitment and retention; teacher absenteeism rates; and support for new math and science teachers. The fourth and final section includes questions on counseling goals and emphases; difficulty and methods of filling teaching vacancies for science and math; principal's perception of school problems; principal demographic characteristics; and principal's educational background and experience.

Because the first three sections contained factual questions about the school, these questions could be completed by the principal or another knowledgeable individual designated by the principal. However, the final section contains background and subjective questions, and the only appropriate respondent is the principal. Therefore, different login credentials were issued to school administrators and their designees such that school administrators were able to access the entire questionnaire, while designees were able to access only the first three parts. In an effort to reduce the burden of reporting detailed statistics, respondents were instructed that informed estimates were acceptable.

In addition to the full school administrator questionnaire, an abbreviated version was sent to schools to which students had transferred. The abbreviated version could be completed by a knowledgeable person in the school administrator's office by web, computer-assisted telephone interview (CATI), or paper-and-pencil interview (PAPI) instruments. The abbreviated version included a subset of questions. These include questions about the school type (e.g., regular, charter, alternative); hours of instruction; course scheduling; enrollment; proportion of students who receive free or reduced-price lunch, who are English language learners, and who receive special education services; postsecondary destinations of seniors; numbers of full- and part-time teachers, and math and science teachers; and years of service of the principal.

Counselor questionnaire. The counselor questionnaire was filled out by the lead counselor (or staff member most knowledgeable about the entering ninth-grade class) at each school, and gathered information on the total number of full- and part-time counselors at the school, the number certified as high school counselors, and the average caseload per counselor. Information was also collected on the school's counseling program and tasks performed by the counselor. The questionnaire also focused on how counselors and the school as a whole assisted eighth-grade students' transition into ninth grade and the school's use of career and education plans. Counselors were asked to remark on programs and services offered to students, such as enrichment courses, assistance for struggling students, dropout prevention programs, encouragement of the pursuit of math and science education and employment, and assistance with the transition from high school to college or the workforce. Counselors also reported on the criteria used to place ninth-graders and upperclassmen in math and science courses. In addition, background information on the school counselor, including how he or she entered the profession, how many years served as a counselor, and educational history, were collected. Since the head counselor at each school was asked to complete the questionnaire, the respondents do not constitute a standalone nationally representative sample of high school counselors (or 9th-grade counselors).

As in the base year, in the first follow-up the head or senior-most counselor at each base-year school was asked to complete the survey. The resulting counselor data are purely contextual, linked to the basic unit of analysis, the student sample member. The student, in turn, will have no first follow-up counselor data if she or he transferred to a new school, went into homeschooling, or attended a base-year school in which the counselor did not participate in 2012. The school counselor questionnaire was fielded as a web survey.

The counselor survey contained four sections: (1) counselor staffing and practices, (2) programs and support for students, (3) math and science placement, and (4) school reporting and statistics on students. The first section includes questions on number of full- and part-time counselors, average caseload, method of assignment to students, breakdowns of percentage of time spent between delivering various services to students, and counselor duties and functions.

The second section contains questions such as programs and supports offered by the school, dual or concurrent enrollment offerings, summer enrichment, sources of credits beyond those offered directly by the school, attention given students in need of extra assistance, dropout prevention programs and services it offers, General Educational Development preparation, assistance with college entrance exams, assistance identifying and applying to colleges and universities, modes of assistance with college or university applications or financial aid and Free Application for Federal Student Aid preparation, programs and initiatives to ease the transition from high school to work, percentage of juniors and seniors taking advantage of various work preparation services, and school linkages with local employers.

The third section includes questions such as factors associated with mathematics and science course placement and sequencing, importance of various factors for

advanced science and math placement, onsite and offsite calculus and physics, student participation and success in Advanced Placement and International Baccalaureate courses and exams, and average SAT and ACT scores of the school. The last section contains questions about the types of transition and outcomes data collected and analyzed by the school.

Periodicity
The base-year data collection of HSLS:09 took place in the fall of the 2009–10 school year. The first follow-up took place in the spring of 2012, when most sample members were in the 11th grade. A postsecondary update took place in the summer/fall of 2013, and high school transcripts were collected in the 2013–14 school year (i.e. fall of 2013 and spring of 2014). The second follow-up took place March 2016 through January 2017, approximately 3 years after high school graduation for most of the cohort. The number and timing of future follow-ups is yet to be determined, although the expectation is that the cohort will be followed at least to age 30, with a questionnaire administration and a postsecondary education transcript collection in 2025–26.

Data Availability
Public-use data for HSLS through the second follow-up data collection can be obtained at https://nces.ed.gov/onlinecodebook. Information on restricted-use data is available at https://nces.ed.gov/pubsearch/getpubcats.asp?sid=111. Additional data on HSLS is projected to be available in Summer 2019.

2. USES OF DATA

Adolescence is a time of psychological and physical changes. Attitudes, aspirations, and expectations are sensitive to the stimuli that adolescents experience, and environments influence the process of choosing among opportunities available to individuals. Parents, educators, and policymakers all have a shared interest in better understanding how guidance from school and home can be consequential for the educational, occupational, and social success of youth. HSLS:09 examines both the individual and contextual characteristics important to the transitions associated with these successes during later adolescence and early adulthood.

Major areas that HSLS:09 attempts to cover include the following:

- academic, social, and interpersonal growth;
- transitions from high school to postsecondary education, and from school to work;
- students' choices about, access to, and persistence in math and science courses, majors, and careers;
- the characteristics of high schools and postsecondary institutions and their impact on student outcomes;
- baccalaureate and subbaccalaureate attainment;
- family formation, including marriage and family development, and how prior experiences inside and outside of the school setting relate to decisions about family formation, and how marital and parental status affect educational choice, persistence, and attainment; and
- the contexts of education, including how historically disadvantaged racial/ethnic group membership and at-risk status are associated with education and labor market outcomes.

3. KEY CONCEPTS

Assessment of algebraic reasoning. Several different types of scores are used in HSLS:09 to describe students' algebraic reasoning skills: theta, estimated number right, standardized T-scores, quintile, and proficiency probability scores. Each score is derived from Item Response Theory (IRT) models. The theta (ability) estimate provides a summary measure of achievement useful for correlational analysis with status variables, such as demographic characteristics, school type, or behavioral measures, and may be used in multivariate models as well. IRT scores from HSLS:09 first follow-up can be equated to the scale of HSLS:09 base year so that scores may be compared longitudinally. The common items between the HSLS:09 base year and first follow-up allowed for this. The tests were equated using the Stocking and Lord procedure. The procedure allowed the base-year thetas to remain unchanged while the first follow-up thetas were equated to the existing base-year scale.

The estimated number-right score represents the number of items that students would have answered correctly had they answered all 72 items in the item pool. Similar to the theta scores above, the estimated number-right score provides a measure of achievement useful for correlational analysis with status variables and may be used in multivariate models.

Standardized T-scores provide norm-referenced measurements of achievement relative to the HSLS:09 student population (i.e., fall 2009 grade 9 students). A change in mean T-scores over time reflects a change in the individual's or group's relative status in the distribution of achievement scores. (Note that these scores do not indicate whether students have mastered a particular algebraic skill or concept, but represent students' standing in relation to others.) For the first follow-up, the standardized scores

provide a norm-referenced measurement of achievement, that is, an estimate of achievement relative to the HSLS:09 first follow-up student population. They provide overall measures of status at a point in time compared with those of peers, as distinguished from the criterion-referenced scores, which represent status with respect to achievement on a particular criterion set of test items. The norm-referenced standardized scores do not answer the question "What skills do students have?" but rather, "How do they compare with their peers?" Because the scores are standardized within assessment, the base-year standardized T-score is not comparable to the first follow-up standardized T-score.

The mathematics quintile score is a norm-referenced measure of achievement. The quintile score divides the weighted (population estimate) achievement distributions into five equal groups based on the standardized T-scores. Quintile 1 corresponds to the lowest achieving one-fifth of the population and quintile 5 to the highest achieving one-fifth of the population. Quintile scores are convenient for analysts interested in examining associations between variables for students at different achievement levels.

Proficiency probability scores provide a continuous measure of students' mastery of the five levels of algebraic reasoning (i.e., algebraic expressions, multiplicative and proportional thinking, algebraic equivalents, systems of equations, and linear functions). The probability of proficiency for a given student at a given level is calculated as the probability of getting correct at least three of the four items in a given cluster marking a proficiency level. Proficiency at a higher level is indicative of proficiency at a lower level, and these scores are also useful as longitudinal measures of change because they show the extent of gains, as well as the skill sets in which gains are taking place.

In the base-year assessment, five mastery or proficiency levels were identified. With the addition of more difficult items in the first follow-up assessment, two additional levels were identified. Thus five levels are calculated for the baseline and seven proficiency levels are calculated for its longitudinal follow-up.

Plans, transitions, and evolutions. Core research questions for HSLS:09 explore students' secondary to postsecondary plans and transitions, and how they evolve over time. Additionally, HSLS:09 brings a new and special emphasis to the study of youth transitions by exploring the path that leads students to pursue and persist in courses and careers in STEM fields. Specifically, HSLS:09 collects data on when, why, and how students make decisions about high school courses and postsecondary options, including what factors, from parental input to considerations of financial aid for postsecondary education, enter into them. In later waves, questions will be asked regarding students' follow-through on their plans as well as the academic and social factors that contribute to their completion or evolution.

Contextual influences. The HSLS:09 design acknowledges the importance of social context—families, teachers, peers, and the wider community—to students' experiences. As such, information was collected from parents, teachers (math and science), school principals, and school counselors to provide contextual information that can be attached to students' records for analysis.

Dropping out of school. Due to the grade level of students during the first data collection period (fall semester, ninth grade), HSLS:09, similar to NELS:88, will be able to identify and study "early" and "late" dropouts. Early dropouts are defined as individuals who leave school without graduating or receiving an alternative credential by the spring of 10th grade. Overall, the dropout data from HSLS:09 will be comparable with dropout data from the four previous education longitudinal studies, but the distinction between early and late dropouts is shared by only HSLS:09 and NELS:88.

4. SURVEY DESIGN

Target Population

The target population at the school level was defined as regular public schools, including public charter schools, and private schools, in the 50 states and the District of Columbia, providing instruction in both 9th and 11th grade. The target population of students was defined to include all ninth-grade students who attended the study-eligible schools in the fall 2009 term. Public schools, including public charter schools, and private schools in the 50 states and the District of Columbia providing instruction to both 9th-grade and 11th-grade students, were sampled in the base year of HSLS:09.

Sample Design

In the fall of 2009, ninth-graders were sampled within selected schools. All ninth-grade students in the sampled schools were classified as eligible for the study, including students with disabilities and English language learners who may not have been capable of completing the survey instruments. Moreover, the base-year dataset is not only nationally representative of ninth-graders in schools with both 9th and 11th grades, but also includes 10 individual state-level representative samples of students and schools. The first follow-up sample consisted of those students selected for the base year in 2009–10 that are still eligible for HSLS:09.

Base-year survey. In the base-year of HSLS:09, students were sampled through a two-stage process. First, stratified

random sampling and school recruitment resulted in the identification and contacting of 1,889 eligible schools. The primary sample of regular public and public charter schools was selected from the 2005–06 Common Core of Data (CCD). Private schools were sampled from the 2005–06 Private School Universe Survey (PSS).

The following is a complete list of criteria used to exclude schools from the sampling frame: Bureau of Indian Education (BIE), special education, career technical education, Department of Defense schools located outside the United States, and ungraded schools, as well as schools not in operation during the fall of 2009, schools without both 9th and 11th grades, juvenile correction facilities, schools that only offer testing services for home-schooled students, and schools that do not require students to attend daily classes at their facility.

The national design called for the selection of a sufficient sample to yield 800 eligible, participating schools—600 public schools and 200 private schools—which represented a similar proportion of each school control type in the population. However, the design also called for the oversampling of Catholic schools relative to other types of private schools; thus, 100 Catholic schools were chosen (or 8 percent of all eligible Catholic schools), and 100 other private schools were chosen (2 percent of eligible other private schools). The overall school sample size was allocated to the sampling strata in proportion to the relative number of ninth-grade students within the strata. A total of 48 mutually exclusive first-stage sampling strata were created by cross-classification of three variables: school type or sector (public, private-Catholic, private-other); region of the United States (Northeast, Midwest, South, West); and locale (city, suburban, town, rural). A sample of 1,889 eligible schools were selected, and about 940 schools eventually participated in the first wave of HSLS:09.

In the second stage of sampling, students were randomly sampled from school ninth-grade enrollment rosters, with 25,206 eligible selections (or about 28 students per school). A stratified systematic sample was drawn from the enrollment lists where the strata were equivalent to four categories of race/ethnicity—Hispanic, Asian, Black, and Other with inflated overall sampling rates for Asian students to ensure sufficient size for analysis. All students who met the target population definition were deemed eligible for the study. However, not all students were capable of completing a questionnaire or assessment. Students who, due to language barriers or severe disabilities, were unable to directly participate in the study were retained in the sample, and contextual data were sought for them. (Their ability to complete the study instruments was reassessed in the first follow-up in 2012.) Of the 25,210 eligible students, 550 were classified as questionnaire-incapable due to physical limitations, cognitive disabilities, or limited English proficiency, and an additional 3,210 were nonrespondents.

First follow-up survey. The first follow-up target populations are the same as defined for the base year. Consequently, the student target population contains all 9th-grade students as of fall 2009 who attended either regular public or private schools, in the 50 United States and the District of Columbia, that provide instruction in both 9th and 11th grade. This population is referred to as the ninth-grade cohort.

All of the 944 base-year participating schools were eligible for the HSLS:09 first follow-up. No new sample of schools was selected for this round. Therefore, the base-year school sample in the first follow-up is not representative of high schools with 9th and 11th grades in the 2011–12 school year, but rather is intended as an extension of the base-year student record, to be used to analyze school-level effects on longitudinal student outcomes.

All 25,206 base-year study-eligible students, regardless of their response status, were included in the first follow-up sample. Unlike prior NCES studies, the HSLS:09 student sample was not freshened to include a representative later-grade cohort (such as 11th-graders in HSLS:09) as was done with 12th-graders in the Education Longitudinal Study of 2002, for example. Therefore, first follow-up estimates from the sample are associated only with the 9th-grade cohort 2.5 years later, and not the universe of students attending the 11th grade in the spring of 2012.

Explaining changes in estimates from the base year to the first follow-up is of prime importance to researchers interested in HSLS:09. To ensure sufficient resources to maximize response from the sampled students, a decision was made to select a random subsample of parents in the first follow-up, with the goal of achieving 7,500 or more parent interviews.

The subsample of parents was randomly selected from within categories defined by the combination of the base year first- and second-stage sampling strata. The parent subsample was selected using a PPS minimal replacement methodology and the student base weight as the measure of size. Use of the base weight from the base year minimized the variation in the first follow-up student home-life contextual base weights. This sampling approach has been used in other NCES surveys such as the National Education Longitudinal Study of 1988 fourth follow-up to subsample prior-wave nonrespondents.

2013 Update and High School Transcript Collection. Of the 25,206 students eligible for the base year, 25,168 were eligible for the 2013 Update and the High School Transcript Study (a total of 38 were deceased). Not all

cases were fielded: sample members were excluded from fielding when neither base-year nor first follow-up data were collected for them, or were out of scope for a given round in accordance with one of four out of scope categories: incapable of meaningful participation, inaccessible, deceased, or study withdrawal. These unfielded cases are classified as nonrespondents and appear in the sample denominator for calculation of response rates.

Second follow-up survey. The second follow-up fielded sample included 23,316 of the 23,401 sample members fielded and found eligible for the 2013 Update. The 85 sample members not fielded withdrew from the study between the end of the 2013 Update collection and the beginning of the second follow-up data collection or were found to be deceased.

Data Collection and Processing

Reference dates. In the base-year survey, recruitment of school districts and schools began a year before data collection activities commenced. In-school data collection (from September 2009 through February 2010) comprised a student questionnaire and an assessment of algebraic reasoning. Students who did not participate in the initial in-school session were contacted to complete the questionnaire outside of school. Out-of-school data collection (from September 2009 through May 2010) comprised parent and school staff (school administrator, teacher, and school counselor) questionnaires.

The first follow-up of HSLS:09 took place in 2012 when most of the cohort were in the second semester of their 11th-grade school year. The first follow-up assessment was administered in two settings: in-school (as in the base year) and out-of-school in a self-administered web-based environment. The 2013 Update occurred in summer and fall 2013, when most members had already graduated from high school. The second follow-up was conducted from March 2016 through January 2017, approximately 3 years after high school graduation for most of the cohort.

Data collection. Prerecruitment activities for school districts and schools began with the solicitation of study endorsements (HSLS:09 was endorsed by 30 organizations) and a courtesy notification to the states. Obtaining cooperation from school districts, dioceses, and schools followed. Once schools agreed to participate, the recruitment team worked with them to set up study logistics for the student sessions and to facilitate list collection.

School recruitment. Before school recruitment began, the Chief State School Officer (CSSO) from each state was notified that HSLS:09 would be conducted in districts and schools in his or her state. No follow-up was performed at the state level. Recruitment commenced with public school districts, and information packages were sent to the superintendent of each district and diocese containing sampled schools. For public and Catholic schools, school-level contact commenced upon receipt of district or diocesan approval. The sampled non-Catholic private schools were contacted directly because it was not necessary to wait for higher approval. For these schools, the principal received an informational package and later was contacted by the recruiting team to answer any questions about the study and to provide an overview of the various data collection activities.

An exception to this recruitment procedure occurred for sampled school districts and public schools in 10 states that were identified for an augmentation (supported by the National Science Foundation) to allow for the collection of data that would be representative at the state level. (Information on the 10 states selected is documented in materials available for restricted-use data license holders.) If any of the 10 states had not already sampled enough public schools to generate representative state-level data with a reasonable level of precision (ideally, 40 or more participating schools), additional schools were contacted in order to achieve the desired yield.

For each school selected to participate in HSLS:09, upon gaining access, recruiters identified a school coordinator to serve as a point of contact and to provide logistical information. The school coordinator was responsible for scheduling the in-school sessions for data collection and identifying the appropriate staff members to complete the school administrator questionnaire and school counselor questionnaire. The school coordinator was also responsible for working with school personnel to specify the type of parental permission required for the in-school student sessions and to grant permission to use Sojourn (Linux operating system) on the school's computers.

For the first follow-up, 5 of the 944 schools were found to be closed or had no eligible sampled students still enrolled in the base-year school. Of the eligible 939 schools, 904 base-year schools (96 percent) agreed to continue participation in the HSLS:09 first follow-up.

Student data collection. Student data collection was conducted in 944 high schools by trained session administrators. Student sessions were composed of a computerized questionnaire and an assessment of algebraic reasoning. The session administrator and school coordinator distributed the permission forms and tracked their return, confirmed the eligibility and capability of sampled students, and determined whether any sampled students needed special accommodations to participate in the study. Students were deemed incapable of participating if they had a physical or cognitive disability or a language

barrier that precluded them from participating in the base-year data collection.

HSLS:09 first follow-up student questionnaires were completed in one of four data collection modes: in-school, web, CATI, and CAPI. The student questionnaire was completed by 82 percent of eligible sampled students in the first follow-up. Sixty-one percent of students completed the questionnaire in school, while 20 percent completed the questionnaire outside of school, which comprised students who were no longer enrolled in the base-year school and those who missed the in-school session. During out-of-school data collection, 9 percent of student respondents completed the questionnaire via the web, 6 percent completed the questionnaire with a field interviewer, and 5 percent completed the questionnaire by phone.

The second follow-up data collection ended with a 68 percent weighted response rate.

Parent data collection. One parent of each sampled student was asked to complete a 30-minute questionnaire. The parent questionnaire could be self-administered on the web or completed with a professional interviewer via computer-assisted telephone interviewing (CATI). Additionally, to reduce nonresponse, a brief paper-and-pencil questionnaire containing critical items was sent to nonresponding parents near the end of data collection.

In response to a lower-than-desired response rate to the parent questionnaire, an incentive experiment was implemented about 3 weeks prior to the end of data collection. Parents were included in the experiment if one of three criteria was true: (1) the sample member refused to participate but was not coded a final refusal; (2) 15 or more calls had been placed to the sample member, or (3) the sample member had an address but no phone number was found after all intensive tracing processes had been exhausted. At 47 percent, the highest percentage of completed interviews was achieved by parents who were offered $20 (as opposed to $10 or $0) and who had been included in the experiment because they have received more than 15 CATI calls.

Among the subsample of parents contacted to participate in the HSLS:09 first follow-up, about 72 percent completed a questionnaire. The average time to complete a parent questionnaire across all data collection modes was 37 minutes. Time to complete the parent questionnaire varied by mode with web respondents averaging 34 minutes, CAPI respondents averaging 37 minutes, and CATI respondents averaging 40 minutes.

School staff data collection. In addition to the student and parent questionnaires, the school administrator, a school counselor, and the math and science teachers of each sampled student were asked to complete a 30-minute questionnaire. Each staff questionnaire was available on the web or via CATI.

Like the base-year data collection, contacting of school districts and schools for first follow-up began a year before data collection commenced. In-school data collection comprised a student questionnaire and mathematics assessment. Students who did not participate in the in-school session, including those who were no longer enrolled at the base-year school, were contacted to complete the questionnaire and mathematics assessment outside of school. First follow-up data collection also included surveys of school administrators, counselors, and a subsample of parents. There was no teacher data collection in the first follow-up.

Data processing. All questionnaire data were stored in an SQL server database. CATI applications were used to obtain participation where web interviews could not be obtained; however, the data were stored in the same SQL server database. SQL data were exported nightly into SAS datasets. Cleaning programs were designed to partition the data into questionnaire datasets and methodological datasets and to attach variable names and labels.

All respondent records in the final dataset were verified with the case management/control system to identify inconsistencies. For example, it was possible that data were collected from a sample member who later was set to nonrespondent status. It would not be appropriate to retain these data, and the case management/control system served as a safeguard to ensure they were removed.

Documentation procedures were developed to capture variable and value labels for each item. Item wording for each question was also provided as part of the documentation. This information was loaded into a documentation database that could export final data file layouts and format statements used to produce formatted frequencies for review. The documentation database also had tools to produce final electronic codebook input files.

For each type of questionnaire (e.g., student, parent, and school administrator), the survey instrument was the same regardless of data collection mode (web survey and CATI). Responses for each type of questionnaire were thus able to be stored in a SQL server database regardless of the collection mode used. This helped ensure that skip patterns were consistent across collections. An exception to this standard was for parent data, since an abbreviated paper-and-pencil instrument was administered for nonresponse conversion. The abbreviated parent questionnaire was designed to include key questions from the instrument that could be entered into the parent questionnaire database.

Data editing. Editing programs were developed to identify and output inconsistent items across logical patterns within questionnaires. These items were reviewed, and rules were written to correct previously answered (or unanswered) questions to stay consistent with previously answered items.

Programs were also developed to review for consistencies across multiple sources of data and identify discrepancies that required further review and resolution. For example, the student's sex was obtained from the school and stored in his or her roster data; in addition, the student's sex was collected in the student interview and the parent interview. If there was a discrepancy across sources, the student's first name was reviewed to determine and store the correct value.

For first year follow-up, consistency checks were included for unlikely patterns across rounds (i.e., between base year and first follow-up) as well as across sources within a given round (e.g., between parent and student reports). Additionally, the HSLS:09 first follow-up parent instrument included tools that allowed online coding of literal responses of occupation job title and duties to the 2000 Standard Occupational Classification (SOC) taxonomy. The HSLS:09 first follow-up student instrument also asked respondents to indicate what occupation they thought they would have when they were age 30. Students entered a job title, but were not asked to enter job duties. Respondents also had the option of checking a box to indicate that they did not know. Students were not asked to code their expected occupations so all job titles needed to be coded after data collection using the O*NET taxonomy. The text strings were first matched against coded strings from the base year. When text strings matched between base year and first follow-up, the base-year code was applied to the first follow-up text string.

The following editing steps were implemented:

- rule-based edits (i.e., changes that were made based on patterns in the data);
- hard-coded edits based on changes recommended by a reviewer if respondents misunderstood the questionnaire (e.g., respondent was instructed to enter a percentage; however, there was strong evidence that the respondent entered a count rather than the percentage); and
- edits based on logical patterns in the questionnaire (e.g., skip pattern relationships between gate and dependent questions).

Estimation Methods

Weighting. Analytic weights are used in combination with software to account for the complex survey design of HSLS:09 and produce estimates that are nationally representative, with appropriate standard errors. The HSLS:09 base-year contains five sets of analytic weights: a school-level weight; a student-level weight; and three special student-level weights: two linked with contextual data from science and mathematics courses and one linked with parent-reported family and home contextual data.

The school-level weight can be used for school-level analyses involving the school administrator and counselor questionnaires. The student-level weight is for student-level analyses using student response data. In contrast, because of the low unit response rates for parents and teachers, the three special student-level weights are used for analyses at the student level that rely on a combination of student, parent, and teacher response data. Importantly for such analyses, the student still serves as the unit of analysis, and the parent and teacher data are used to provide contextual information. Corresponding balanced repeated replication (BRR) weights were constructed in a similar fashion as the analytic weights and should be used to achieve proper variance estimates.

The first follow-up data file contains a total of nine analytic weights: five weights for analysis of the base-year data and four weights to be used in conjunction with the first follow-up data (two weights for analysis of first follow-up responses, and two weights for analysis of population change from base year to first follow-up). In summary, researchers analyzing *any* data from the first follow-up (alone or in conjunction with base-year data) should use one of the four first follow-up weights. Analyses involving *only* the base-year data, with no first follow-up data, should include one of the five weights for analysis of base-year data. Three sets of weights were created on the cumulative analytic first follow-up file: a set of base-year student BRR weights; a set of first follow-up student BRR weights, and a set of base-year to first-follow-up longitudinal weights.

Two sources of contextual information for analysis of the student data were obtained in the HSLS:09 base year but not in the first follow-up. They include interviews with the science teacher and mathematics teacher for students taking the associated course in the ninth grade. Researchers may choose to condition the analyses of first follow-up student data on teacher responses obtained in the base year. Unlike the base-year data file, the HSLS:09 first follow-up data file does not contain contextual analytic weights to account for nonresponse among students with base-year teacher information. Instead, either student or parent weights should be used depending on the inclusion of parent responses. Note that estimates generated with student data and either the student or parent weight, in conjunction with the base-year teacher responses, are no longer associated with the HSLS:09 target population of ninth-grade students and should be used with caution.

School level. The elements combined to form the school analytic weight are a base weight, two nonresponse adjustments, and a final calibration adjustment.

An initial base weight (sometimes referred to as a design or sampling weight) was constructed as the inverse of the probability of selection. Then, the base weight was adjusted for (1) school administrators who declined to participate in HSLS:09, but provided information as part of the nonresponding-school questionnaire; and (2) school administrators who declined to participate in HSLS:09 and did not provide information for the nonresponding-school questionnaire. Both adjustment factors were constrained to minimize excess variation in the resulting weight. A final adjustment was applied to school weights to calibrate the sum of the analytic weights to target population counts tabulated from the 2007–08 CCD and the 2007–08 PSS. The calibration adjustments are also known to reduce coverage bias and variation in the resulting analytic weights, improving precision in the survey estimates.

Student level. The components of the student analytic weights are a base weight, two nonresponse adjustments, and a final calibration adjustment.

HSLS:09 ninth-grade students were randomly selected from four race/ethnicity sampling strata (Hispanic, Asian, Black, and other). The conditional base weight for students in each of the race/ethnicity strata was constructed as the inverse of the probability of selection within the school sampled in the first stage of the design. Though the weighted response rate was above the 85 percent threshold, a nonresponse adjustment weight was developed to address two sources of bias: parent refusal to give permission to participate in the study and student refusal to participate.

There were 24,660 questionnaire-capable students in the sample. Approximately 9 percent (n = 2,380) did not participate because of a parent refusal. To minimize bias associated with this type of student nonresponse, a nonresponse adjustment was applied to the weights of the 22,280 questionnaire-capable students without a parent refusal. Note that the decision of the student to participate in the study was determined prior to data collection. Thus, all nonresponding students were classified as questionnaire capable, and the questionnaire-incapable students were excluded from the weight adjustment.

The sum of the nonresponse-adjusted weights was compared against totals tabulated from the 2007–08 NCES sampling frame files of eligible schools. The weighted sums were less than the sampling frame counts; therefore, a calibration adjustment was applied so that the weighted sums matched the estimates from the sampling frame.

Student linked with science and mathematics course weights. Teacher background and limited classroom information was collected from the science and mathematics teachers of sampled students during the fall of 2009. Weighted response rates for science and mathematics teachers were 70 and 72 percent, respectively. Nonresponding teachers were linked with 32 percent of the science enrollees and 25 percent of the mathematics enrollees. To account for the loss of student records resulting from nonresponding teachers, two subject-specific enrollee weights were created for student-level analyses that used classroom context information. The two weights were independently created by adjusting the main student analytic weight.

Typically, variables used for a nonresponse weight adjustment are only effective if they are related to the response patterns exhibited in the data. However, since teachers in HSLS:09 were not sampled directly, information was not available on nonresponding teachers. Consequently, a weight adjustment could not be calculated to adjust for patterns of HSLS:09 teacher nonresponse. Instead, students linked to a responding teacher were combined with students not enrolled in the course and then the weights were calibrated to the sum of the final student analytic weight for the full set of course enrollees.

Student linked with parent-reported family and home life weights. Information on factors affecting family life and background, as well as parent/guardian opinions on education and school involvement, were collected through the parent questionnaire. The weighted parent/guardian response rate was 68 percent. As with the adjustments for the weights used in analyses involving data from science and mathematics teachers, information on nonresponding parents was not available; therefore, adjustments to weights for parental nonresponse relied on using student data to calibrate the final student analytic weight.

5. DATA QUALITY AND COMPARABILITY

Sampling Error

Analyses with HSLS:09 data should use statistical software that can calculate (a) BRR variance estimations using replicate weights and an associated analytic weight; or (b) linearization variance estimations through a Taylor series approximation using only the analytic weight. BRR weights are constructed to capture the variance associated with the sampling information and, along with appropriate software, provide an alternative to the linearization method. Linearization variance estimation requires software that constructs a first-order Taylor series approximation of the statistic being analyzed (e.g., the mean) and data sources containing the analytic stratum and primary sampling unit (PSU) identifiers as well as a single analytic weight (see, e.g., Binder 1983; Woodruff 1971). In contrast, BRR variance estimation does not require

knowledge of the analytic strata and PSUs and instead only requires a large set of replicate weights and the main analytic weight.

Design effects. A total of 89 estimates from HSLS:09 were used in the design effects analysis: 22 school-level variables from the administrator and counselor questionnaires; 37 items from the student questionnaire plus one mathematics achievement score (theta); and 29 parent questionnaire items. The items were chosen using six criteria: (1) representation from the school-level instruments (administrator and counselor) and the student-level instruments (student and parent); (2) HSLS:09 variables common to the ELS:2002 base-year design effects analysis; (3) variables identified for the First Look report; (4) substantively important variables to NCES; (5) variables included in several other NCES studies, such as ELS:2002, NELS:88, and the National Postsecondary Student Aid Study (NPSAS); and (6) randomly selected items to ensure coverage of all sections of the instruments.

Nonsampling Error

Nonresponse error. Both unit nonresponse (nonparticipation in the survey by a sample member) and item nonresponse (missing values for a given questionnaire/test item) have been evaluated in the base-year survey of HSLS:09.

Base year unit nonresponse. HSLS:09 schools were classified as respondents if the school administrator permitted student data collection. The overall weighted school response rate for HSLS:09 was 56 percent. For sampled students, the weighted response rate exceeded the 85 percent threshold (86 percent); nevertheless, certain domains (e.g., school type, region, student sex, student race/ethnicity) were flagged for bias analysis.

Base year school-level nonresponse bias analysis. The purpose of this analysis was to determine the extent to which sampled units differed from nonsampled ones. Information was obtained from 66 percent of nonparticipating schools using an abbreviated questionnaire during an interview with the school administrator or contact at the district/diocese level. The abbreviated questionnaire, in combination with the NCES sampling frame items, netted a total of 15 variables for the school nonresponse bias analysis, including school type, region of the country, metropolitan designation, size of the school, ninth- grade enrollment count, and number of full-time teachers. Prior to adjusting the weights for nonresponse bias, 46 percent of the tests showed significant levels of bias, with a median absolute relative bias of 12 percent. Following adjustment of the weights for nonresponse, only 20 percent of the tests showed significant levels of bias, and the median absolute relative bias was reduced to 6 percent.

Base year student-level nonresponse bias analysis. The overall weighted response rate exceeded 85 percent for the HSLS:09 student sample (86 percent); however, the weighted response rates for certain domains fell below the threshold level; thus a nonresponse bias analysis was required. For the analysis, some information for nonresponding students, such as race/ethnicity and sex, was available from the school enrollment lists. School characteristics were also used in the analysis. In total, 17 variables were used. Approximately 18 percent of the 60 statistical tests identified significant bias, with the median absolute relative bias equal to 1 percent before adjustments were made. Following adjustments for nonresponse, no tests showed significant bias and the median absolute relative bias was reduced to zero.

Base year student-level contextual nonresponse bias analysis. The weighted response rates for the providers of student contextual information (science teacher, math teacher, and parent) all fell below 85 percent. Science and math teachers had response rates of 70 and 72 percent, respectively, while parents had a 76 percent response rate. Nevertheless, information on nonresponding teachers and parents was not available for either weight adjustment or for the nonresponse bias analysis. Student and school characteristics were thus used in the student-level nonresponse bias analysis for the contextual analyses. In total, 17 variables were used in the student nonresponse bias analysis. Bias was detected in 33 percent of the 60 tests implemented with the weight linking the student and science teacher and in 23 percent of the 60 tests implemented with the weights linking the student with the mathematics teacher or parent, respectively. Adjusting the weights for nonresponse reduced the observed bias, although some bias was still observed for all three contextual weights.

First follow-up nonresponse bias of student data. In keeping with the NCES statistical standards, nonresponse bias analyses were performed for first follow-up student responses at the student level, because the overall weighted response rate was 82.0 percent. Students who completed a substantial portion of the questionnaire were classified as a respondent, regardless of their level of participation in the mathematics assessment. In total, 17 variables were used for the student nonresponse bias analysis. Approximately 31.8 percent of the 66 statistical tests identified bias significantly greater than zero at the 0.05 significance level prior to adjusting the weights for nonresponse. After adjustment, no levels of bias were detectable at the 0.05 level of significance and the median absolute relative bias was reduced by 72.3 percent. Nonresponse bias was also evaluated in student items available for a longitudinal analysis. The overall weighted response rate for students with responses in the first follow-up and the base year was 74.3 percent. A total of 17 variables were used for the

student longitudinal nonresponse bias analysis. These 17 variables resulted in 66 comparisons (tests). Bias was detected for 33.3 percent of the 66 tests implemented with the student longitudinal weight. After applying the nonresponse adjustments, no bias was statistically significant in any of the 66 tests. A 79.0 percentage point reduction was also seen in the median absolute relative bias.

First follow-up nonresponse bias of parent data. The overall parental weighted response rate for the students randomly selected for the first follow-up parent subsample was 72.5 percent. Information on the nonresponding parents, however, was not available for either weight adjustment or for the nonresponse bias analysis. Consequently, student and school characteristics used in the student-level nonresponse bias analysis were used for the student home-life contextual analyses. In total, 17 variables were used for the student-level contextual nonresponse bias analysis, including characteristics known for the base-year schools where the students were first selected for the study. Bias was initially detected for 25.8 percent of the 66 tests implemented with the first follow-up student home-life contextual weight.

After adjusting the weights, no tests were found to identify significant levels of bias. Also, the median relative bias was reduced by 89.7 percentage points. The weighted response rate for the student first follow-up home-life contextual subsample was 72.5 percent. Accounting for students *and* parents in the subsample who responded to the base year *and* first follow-up, the weighted response rate was reduced by 8.3 percentage points or 64.2 percent. The student home-life contextual nonresponse bias analysis initially identified 37.9 percent of the 66 tests as having significant levels of bias at the 0.05 level using the contextual longitudinal weight. After adjusting the weights, only 3 percent of the statistical tests produced significant results. Additionally, the median relative bias was reduced by 90.4 percentage points. A responsive design was implemented in the HSLS:09 first follow-up as one additional method for reducing nonresponse bias in the contextual information for students in the parent subsample. Through the use of propensity models, the parent cases with low likelihood of response (i.e., low propensity) were identified and targeted for additional recruitment efforts. Overall, approximately 42.4 percent of the categories initially showed an estimated bias that was statistically significant. Consequently, after the inclusion of low-propensity cases, 25.8 percent of the categories show estimated bias to be statistically significant.

2013 update and high school transcript nonresponse. In calculating response rates for the 2013 Update, there were two types to consider. The unconditional response rate is the response rate calculated with no exceptions for the temporarily out of scope, unfielded cases; only the deceased are removed from the study denominator. The unconditional response rate supports statistical description and estimation. The conditional response rate removes all four categories of temporary out of scope students from the denominator. The conditional response rate is a measure of the methodological success of the study, of what its data collection effort was able to accomplish. The 2013 Update data collection ended with a 73.1 percent weighted response rate. For transcripts, an 87.7 percent weighted response rate was achieved.

Second follow-up survey nonresponse. The weighted response rate for the second follow-up fell below 85 percent. Therefore, in accordance with NCES statistical standards, the data were subjected to bias analysis. Unit nonresponse bias analyses were conducted for each set of respondents that corresponded to one of the seven analytic weights: the five second follow-up weights and the two supplemental teacher weights for the 2013 Update. The following 15 categorical variables were used to assess unit nonresponse bias: school type, charter school status, ninth-grade enrollment by race, total school enrollment, ninth-grade enrollment, number of full-time teachers, student-to-teacher ratio, census region, school urbanicity, school grade range, religious affiliation of school, secondary status of school, state of school, sex, and race. (Note that several of the 15 variables are derived from sampling frame data and are therefore not available in either restricted-use or public-use files.) These 15 variables in total comprise 67 categories. For each category, estimates of bias were calculated and statistical significance tests conducted. Further information on the results of this nonresponse bias analysis can be found in the publication *HSLS:09 Base-Year to Second Follow-Up Data File Documentation*.

Item nonresponse. Item response rates measure the proportion of responses obtained for a particular question from respondents who were supposed to answer the question. Item response rates differ from a unit response rate, which measures the proportion of eligible sample members among those selected for the study who actually participate. As with unit nonresponse bias, item nonresponse bias occurs when items that should have a valid response are left blank, which affects the results produced from the data. A weighted item response rate among study participants less than 85 percent, calculated with the final analytic weight as in the HSLS:09 base year, was used to identify first follow-up variables for the item nonresponse bias analysis.

Item nonresponse bias analysis. Item nonresponse bias was evaluated for the questions having low levels of item response (less than 85 percent). The proportion of items requiring a nonresponse bias analysis varied across survey

components. In the school questionnaire, 16 percent of items had response rates below 85 percent (79 out of 481 items). In the student questionnaire, 3 percent of items required nonresponse bias analyses (10 out of 376 items), as did 9 percent (16 out of 178 items) in the science teacher questionnaire; 14 percent (21 out of 152 items) in the math teacher questionnaire; and 26 percent (70 out of 266 items) in the parent questionnaire. The higher proportion of items requiring a nonresponse bias analysis in the parent questionnaire is partially accounted for by the abbreviated questionnaire used during nonresponse conversion. All study items with a weighted response rate less than 85 percent among the study participants were classified as having high item-nonresponse and were included in the item nonresponse bias analyses for first follow-up. Almost 78 percent of the item-nonresponse bias analysis variables (28 of 36 items) had a weighted item response rate of at least 80 percent, and over 54 percent of the item-nonresponse bias analysis variables (18 of 33 items) had a weighted item response rate of at least 60 percent.

Item imputation. In the base-year survey, HSLS:09 variables in general did not suffer from high levels of item nonresponse. Nevertheless, key analytic variables were identified for item imputation to facilitate complete-case analysis on data obtained from the participating ninth-grade students. Single-value imputation was used to replace missing responses for 18 key analytic variables from the student and parent questionnaires. These variables included important demographic variables (e.g., student's race/ethnicity); student and parent educational expectations; parent's relationship to the ninth-grader, highest level of education, employment status, and recent occupation; and family income. Additional variables were considered for this list, but excluded because of a high item response rate.

Missing values for the variables measuring student ability in mathematics (theta), the associated standard error of theta (sem), and socioeconomic status (SES) were dealt with using multiple imputations to produce five estimated values for each variable. For all variables with imputed values, indicator variables (flags) were created to allow users to easily identify which cases had been imputed.

To alleviate the problem of missing data from a respondent record for first follow-up, statistical imputation methods were employed similar to those used for the HSLS:09 base year. More specifically, a weighted sequential hot-deck imputation procedure using the final student analysis weight was applied to the missing values. Four key analysis variables were identified for single-value imputation from the edited HSLS:09 first follow-up data. Additional variables were considered for this list but were excluded because of either high item response rate or they were deemed to be of little analytic importance.

To alleviate the problem of missing data from a respondent record for the second follow-up, statistical imputation methods were employed for the second follow-up that were similar to those used for the HSLS:09 base year, first follow-up, and 2013 Update. Ten key analysis variables were identified for single-value imputation from the second follow-up data. Stochastic methods were used to impute the missing values. Specifically, a weighted sequential hot-deck (WSHD; statistical) imputation procedure using the final second follow-up student analysis weight (W4STUDENT) was applied to the missing values for the ten variables. The WSHD procedure replaces missing data with valid data from a donor record (i.e., item respondent) within an imputation class. In general, variables with lower item nonresponse rates were imputed earlier in the process. Regardless of the method, indicator variables (flags) were created to allow users to easily identify the imputed values.

Future Plans

The number and timing of future follow-ups beyond 2016 is yet to be determined, although the expectation is that the cohort will be followed at least to age 30, with a questionnaire administration and a postsecondary education transcript collection in 2025–26.

Data Comparability

Comparability with questionnaire data in other NCES secondary longitudinal studies. The HSLS:09 data do not directly support certain cross-cohort comparisons that were possible in earlier NCES secondary longitudinal studies. In earlier secondary longitudinal studies, comparisons were possible because each cohort was similarly defined and because, by design, a core set of questions had been repeated across studies. However, students in HSLS:09 were fall-term 9th-graders in the base year, and in the first follow-up were spring-term 11th-graders, which does not correspond to the prior studies' cohorts (spring-term 8th-, 10th-, or 12th-graders). Therefore, HSLS:09 does not allow for an intercohort time-lag study.

Nonetheless, comparisons can be made in a couple of ways: (1) coursetaking can be compared between HSLS:09 and ELS:2002, NELS:88, and HS&B, based on the continuous data for grades 9 through 12 that are supplied by high school transcripts; and (2) because HSLS:09 models the same transition—from adolescence in the high school years to young adulthood, as marked by educational attainment, work and career, and family formation—the design answers the same basic questions as the predecessor studies. Moreover, all of the studies have essentially the same sampling designs, provide nationally representative data across public and private schools, and define

race/ethnicity domains similarly across cohorts. Thus, while each longitudinal study may have slight differences in emphasis, all draw content from the same or similar theoretical constructs (e.g., achievement growth, school effectiveness, social capital, social attainment, human capital).

Table HSLS-1. Selected HSLS:09 base year, first follow-up, 2013 update, high school transcript, and second follow-up response rates: 2009, 2012, 2013, and 2016

	Base year		First follow-up		2013 update		High school transcript		Second follow-up	
Instrument	Eligible	Weighted percent	Eligible	Weighted percent	Eligible	Weighted percent	Eligible	Weighted percent	Eligible	Weighted percent
Student questionnaire	25,206	85.7	25,184	82.0	25,168	73.1	—	—	25,123	67.9
Student assessment	25,206	83.0	25,184	73.0	—	—	—	—	—	—
Parent questionnaire[1]	21,444	76.1	11,952	72.5	—	—	—	—	—	—
Teacher questionnaires										
Math teacher	23,621	65.1	—	—	—	—	—	—	—	—
Science teacher	22,597	63.6	—	—	—	—	—	—	—	—
High school transcript	—	—	—	—	—	—	25,167	87.7	—	—

— Not available.
[1]A subsample of 11,952 eligible parents were asked to participate in the HSLS:09 first follow-up data collection.
NOTE: All weighted percentages are based on the number of sample members in the row under consideration and are calculated with the student base weight.
SOURCE: HSLS:09 methodology reports; available at https://nces.ed.gov/pubsearch/getpubcats.asp?sid=111.

Comparability with student assessment data in other NCES studies. Differences in the content and scaling of the HSLS:09 academic assessment (i.e., algebraic reasoning) and tests administered in prior NCES secondary longitudinal studies severely limit the possibility of comparisons. Moreover, apart from a handful of National Assessment of Educational Progress (NAEP) items, there are no common items that link the HSLS:09 test to earlier mathematics assessments, and due to the testing points—fall of 9th grade and spring of 11th grade—the assessment results are not comparable to prior studies, such as the Program for International Student Assessment (PISA) or NAEP. Therefore, even a weak linkage, such as a concordance, would seem inadvisable to implement.

New features of HSLS:09. Some of the new, distinctive, and innovative features of HSLS:09, compared to the previous NCES secondary longitudinal studies, include the the following:

- use of a computer-administered assessment and student questionnaire in a school setting;
- an assessment that focuses on algebraic reasoning;
- use of computerized (web/CATI) parent, teacher, administrator, and counselor questionnaires;
- inclusion of a school counselor survey;
- starting point in the fall of ninth grade;
- emphasis on the dynamics of educational and occupational decision-making; and
- enhanced emphasis on STEM trajectories;
- in first follow-up, questionnaire and assessment also computer-administered for out-of-school and transfer students.

Although the first follow-up data in particular are designed to facilitate the analysis of change, including gain in mathematical proficiency, and its correlates, the data cannot be used cross-sectionally; unlike the base year, the first follow-up data cannot be used cross-sectionally because freshening for an 11th-grade cohort was not

conducted. Given a 2009 ninth-grade cohort 2.5 years later, first follow-up data can only be used longitudinally.

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7. METHODOLOGY AND EVALUATION REPORTS

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