**Method**

**Sample**

We used data from the Longitudinal Study of American Youth (LSAY) for this study (Miller, 2011). Funded by the National Science Foundation in 1985, the primary purpose of LSAY was to examine student mathematics and science attitudes and achievement in relation to career choices from a nationally representative sample of students (Kimmel, & Miller, 2008). The full database includes longitudinal data from two cohorts: a cohort of students who were tenth grade who were followed for seven years (data collection ending four years after high school) and a cohort of students who were seventh grade who were followed for seven years (data collection ending one year after high school). This particular study only included data from the cohort of seventh grade students because of our interest in better understanding the influence of early attitudes and achievement in mathematics and achievement on long-term occupational outcomes.

The cohort were seventh graders in 1987 who attended public schools in the United States (*N* = 3,116). The sample was selected based on a two-stage stratified probability sampling design. In the first stage, the 12 strata were identified based on four geographic regions (Northeast, North Central, South, West) and three levels of urban development (urban, suburban, rural) in the United States. In the second stage, 60 students from 52 schools within each of those 12 strata were selected (see Miller & Kimmel, 2012 for greater detail). The sample is predominantly White with approximately equal numbers of females (48%) and males (52%). Thirty-one percent of the students in the sample had at least one parent who completed college, while the other 69% did not.

Additional data collection began in 2006 respondents were in their mid-30’s. The purpose of the additional, follow-up data collection effort was to determine educational and occupational outcomes. More than 95% of the original sample was located and 70% of those completed the follow-up survey (Miller & Kimmel, 2012).

**Measures**

This particular study used data from the seventh, tenth and twelfth grade student survey responses and follow-up survey. We included seventh and twelfth grade response because this was the first and last year in which student achievement measures and student attitudinal responses were available. We included the tenth grade student responses based on literature from a small scale study that suggests that student attitudes do not change after tenth grade (Aschbacher, Li, & Roth, 2010). Student responses were used to create attitudinal profiles of student at each grade level which were then linked to gender and ethnicity and the following outcome measures: twelfth grade mathematics and science achievement, interest and support of science issues and STEM career attainment.

The mathematics and science attitudinal items, mathematics and science achievement, interest and support of science issues and STEM career attainment are described below. Gender and ethnicity (based on student self-reports) were dichotomous variables. For gender, a “0” represents male and “1” represents female. For ethnicity, a “0” represents White and Asian (referred to as “not underrepresented”); and a “1” represents African American, Hispanic/Latino, and Native American (referred to as underrepresented). Underrepresented students are less represented in STEM careers (see, for example, Huang, Taddese, & Walter, 2000). For example, according to figures from the National Science Foundation, African American, Hispanic and American Indians make up approximately 26% of the U.S. population between the ages of 20 and 70 but only 10% of the science and engineering workforce (National Science Foundation, 2013). The sample included 23% underrepresented students and 77% are not underrepresented.

**Mathematics and science attitudes**. Drawing on our previous research on mathematics and science attitudes (Ing & Nylund, 2013), ten items were include in the analyses (Table 1). The same ten items with the same possible response option (strongly agree, agree, not sure, disagree, strongly disagree) were included in seventh, tenth and twelfth grade. These response options were coded in a way that higher values represented stronger agreement or more positive attitudes, and lower values represented less agreement or less positive attitudes. Five items relate to mathematics attitudes and an analogous set of five items relate to science attitudes.

The selection of these items reflects a social cognitive career development perspective (Betz & Hackett, 2006; Lent, Brown, & Hackett, 1994, 1996). This perspective highlights the importance and influence of personal beliefs about one’s ability to succeed (self-efficacy), personal beliefs about the outcome of performing particular behaviors (outcome expectations) and personal goals. These social and cognitive factors help individuals regulate their career-oriented behavior by influencing attitudes, interests, choices and attainment (Lent & Brown, 1996, 2006). For example, in terms of STEM career interest and attainment, this theory would suggest that children who have early positive science attitudes and experiences are more likely to perceive that they can succeed in careers that include these particular types of experiences and to engage in behaviors that will prepare them for these types of careers.

**Mathematics and science achievement.** Student mathematics achievement (*M* = 68.74, *SD* = 15.00) and science achievement (*M* = 65.54, *SD* = 12.59) was measured in the fall of twelfth grade. The mathematics achievement measure included content such as basic mathematics skills and quantitative literacy from the National Assessment of Education Progress (NAEP) assessment. The science achievement measure also included items from NAEP with content such as biology and environmental science. Scores on both achievement measures were calculated using Item Response Theory (Lord, 1980) and then scaled to range from 0 to 100. The seventh grade scores were scaled to a mean of 50 and standard deviation of 10) and the subsequent years (including the twelfth grade scores included in this study) were calibrated accordingly (see Miller, 2011 for details). We used scores that included imputed values for missing data. Scores were not imputed when students dropped out of school or did not include more than four achievement scores. For example, if the student did not have mathematics achievement scores in seventh, eighth, ninth, and tenth grade, their twelfth grade scores were not imputed. Students who were missing more than four achievement scores and did not have twelfth grade scores were dropped from the analyses that linked student attitudes to mathematics achievement (34%) or science achievement (34%). To impute values for the twelfth grade achievement scores, twelfth grade scores were regressed on tenth and eleventh grade scores or ninth and tenth grade sores. The calculation of imputed values for mathematics was further conditioned on the student enrolling in trigonometry or calculus in twelfth grade. Approximately 25% of the mathematics twelfth grade achievement scores and 25% of the science twelfth grade achievement scores were imputed.

**Interest in science.** LSAY surveyed students about their interest in science issues in twelfth grade (Table 1). Students were asked whether they were “not at all interested,” “moderately interested” or “very interested” in space exploration, agricultural and farming issues, issue about new scientific discoveries, issues about the use of new inventions and technologies issues about energy policy, and issues about environmental quality. We created dichotomous variables that indicated whether students were “1” very interested (which included “very interested”) or “0” not very interested (which included “not at all interested” and “moderately interested”). We then averaged the dichotomous responses to a single composite to create a variable that ranged from 0 to 1 that indicated interest in science issues in twelfth grade (α = .71). A higher value on this composite variable represents the student being more interested in science issues compared to lower values.

**STEM career attainment.** When respondents were in their mid-30’s they were surveyed about their current occupation. Occupations were coded using the 3-digit classification system created by the U.S. Bureau of the Census in 1970. The database contains a dichotomous variable that indicates whether or not the respondent was employed in a science, technology, engineering, mathematics or medical profession. A 1 indicated that the respondent was in a STEM career (8%) and a 0 indicated that the respondent was not in a STEM career (92%). There is a wide range of careers included as STEM. These careers vary in terms of the required level of education but all require technical knowledge and skill (Cover, Jones, & Watson, 2011). An example of a STEM career that does not require a college degree but does require technical knowledge and skill is manufacturing and repairing technologically advanced equipment, such as semiconductor processors. This occupation requires overseeing the manufacturing process of semiconductors and troubleshooting production problems to ensure that the equipment is functioning properly. The educational requirements for this occupation are at least an associate degree or one-year certificate program in semiconductor technology or high-technology manufacturing. An example of a STEM career that requires additional education is materials science engineering where new nanoscale materials are synthesized to address challenges in the area of solar power generation.

**Analysis**

We used latent transition analysis (LTA) to study the change in student math and science attitudes from 7th to 10th grade and 10th to 12th grade. LTA is a longitudinal model that describes stage sequential change process (Collins, 2006; Collins & Lanza, 2011; Collins & Sayer, 2001). LTA models are a longitudinal extension of the latent class model (LCA; Nylund, 2007), where LCA is used at each time point to create groups of students, called latent classes, who have similar math and science attitudes and the LTA model then is used to model the change in these latent classes over time. The LTA model used in this model is specified using the recommended building process that helps to ensure correct model specification (Nylund, Muthén, Nishina, Bellmore, Graham, 2008). This process starts by fitting LCA models at each time point (e.g., 7th, 10th, and 12th grade) independently and deciding on the number of latent classes. After deciding on the number of classes at each time point, the LTA model was specified using the class specification from the independent LCAs. No covariates are included in these modeling steps.

Once the unconditional LTA model was specified, auxiliary information in the form of covariates (i.e., gender and ethnicity) and distal outcomes (i.e., mathematics and science achievement, STEM career attainment and interest and support of science) were included in the model. Recent methodological work suggests using a three-step method for including distal outcomes in mixture models (Asparouhov & Muthén, 2013; Vermunt, 2010), which ensures that both the measurement parameters in LCA and structural parameters in LTA are not unintentionally biased by the auxiliary variables. In a three-step LTA, there are several modeling steps involved that involve specifying each LCA model, fixing values in the LTA model and then including the auxiliary variables. For more information on specifying a three-step LTA model see Nylund-Gibson, Grimm, Quirk, & Furlong (in press).

All modes were estimated in the statistical software package Mplus 7.1 (Muthén & Muthén, 1998-2013) using full information maximum likelihood estimation. This approach allows for item-level missing data under the missing at random (MAR, see Little and Rubin, 1990; Rubin, 1987) assumption. Students who have data on at least one outcome variable at one time point are included in the analysis and only excluded if they were missing on covariates. The LTA model is considered a longitudinal mixture model, and as with all mixture models have well document problems with converging on local, versus global, likelihood solutions. As result, random start values that are generated in Mplus are used to ensure that the results are global ones.

Multiple indicators of model fit were used since, to date, there is no single statistical indicator that is a perfect indicator of which model fits best (Nylund, Asparouhov, & Muthén, 2007). The Bayesian Information Criterion (BIC; Schwartz, 1978), the most commonly used and trusted fit index for model comparison, where lower values of the BIC indicates better fit. In addition, we compared models that differed in the number of classes using the Lo-Mendell-Rubin (LMR) test and the bootstrap likelihood ratio test (BLRT) to evaluate if adding an additional class significantly improved model fit (for more on these fit indices, see Nylund et al., 2007). The entropy of the final model selected is reported in the text but not used for model fit since it is a measure that describes the overall classification of students into the latent classes assuming the model is correct and not intended for model selection.

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Table 1

*Descriptive Statistics for LSAY Survey Items*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Description* | *Grade* | *N* | *M* | *SD* |
| I enjoy math | 7 | 3060 | 0.69 | 0.46 |
| 10 | 2259 | 0.63 | 0.48 |
| 12 | 1560 | 0.55 | 0.50 |
| Math is useful in everyday problems | 7 | 3001 | 0.70 | 0.46 |
| 10 | 2238 | 0.63 | 0.48 |
| 12 | 1547 | 0.64 | 0.48 |
| Math helps a person think logically | 7 | 2998 | 0.64 | 0.48 |
| 10 | 2232 | 0.66 | 0.47 |
| 12 | 1544 | 0.68 | 0.47 |
| It is important to know math to get a good job | 7 | 3008 | 0.76 | 0.43 |
| 10 | 2239 | 0.67 | 0.47 |
| 12 | 1538 | 0.59 | 0.49 |
| I will use math in many ways as an adult | 7 | 3010 | 0.74 | 0.44 |
| 10 | 2248 | 0.65 | 0.48 |
| 12 | 1540 | 0.64 | 0.48 |
| I enjoy science | 7 | 3042 | 0.61 | 0.49 |
| 10 | 2250 | 0.58 | 0.49 |
| 12 | 1540 | 0.53 | 0.50 |
| Science is useful in everyday problems | 7 | 2988 | 0.40 | 0.49 |
| 10 | 2235 | 0.43 | 0.50 |
| 12 | 1530 | 0.46 | 0.50 |
| Science helps a person think logically | 7 | 2992 | 0.49 | 0.50 |
| 10 | 2234 | 0.51 | 0.50 |
| 12 | 1531 | 0.54 | 0.50 |
| It is important to know science to get a good job | 7 | 3012 | 0.40 | 0.49 |
| 10 | 2238 | 0.42 | 0.49 |
| 12 | 1532 | 0.37 | 0.48 |
| I will use science in many ways as an adult | 7 | 3043 | 0.46 | 0.50 |
| 10 | 2250 | 0.42 | 0.49 |
| 12 | 1539 | 0.42 | 0.49 |

Table 2

*Descriptive Statistics for Distal Outcomes*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Description* | *Grade* | *N* | *M* | *SD* |
| Mathematics achievement | 12 | 1168 | 68.74 | 15.00 |
| Science achievement | 12 | 1854 | 65.54 | 12.59 |
| Interest in science issuesa | 12 | 1588 | 0.19 | 0.25 |
| Interest in space exploration | 12 | 1625 | 0.16 |  |
| Interest in agricultural issues | 12 | 1619 | 0.09 |  |
| Interest in science issues | 12 | 1619 | 0.22 |  |
| Interest in new technologies | 12 | 1625 | 0.24 |  |
| Interest in energy policy issues | 12 | 1618 | 0.13 |  |
| Interest in environmental quality | 12 | 1615 | 0.32 |  |
| STEM career attainment | --- | 1912 | 0.08c |  |

aTo create this variable, we averaged student responses to the 10 items listed below related to interest and support for science.

bProportion of students who expressed moderately or very interested

cProportion of students who attained STEM career.

Table 2

*Latent Class Analysis Fit Statistics for Grades 7, 10, and 12*

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *Grade* | *Classes* | *Log Likelihood* | *# of Parameters* | *BIC* | *ABIC* | *VLMR p-value* | *BLRT p-value* | *Entropy* |
| 7 | 1 | -19319.60 | 10 | 38719.49 | 38687.72 | --- | --- | --- |
| 2 | -17198.43 | 21 | 34565.46 | 34498.74 | 0.00 | 0.00 | 0.80 |
| 3 | -16782.26 | 32 | 33821.44 | 33719.76 | 0.00 | 0.00 | 0.75 |
| 4 | -16587.89 | 43 | 33521.03 | 33384.40 | 0.00 | 0.00 | 0.69 |
| 5 | -16479.34 | 54 | 33392.24 | 33220.66 | 0.00 | 0.00 | 0.73 |
| 10 | 1 | -14929.94 | 10 | 29937.12 | 29905.35 | --- | --- | --- |
| 2 | -12538.67 | 21 | 25239.55 | 25172.83 | 0.00 | 0.00 | 0.86 |
| 3 | -12014.10 | 32 | 24275.37 | 24173.71 | 0.00 | 0.00 | 0.83 |
| 4 | -11775.68 | 43 | 23883.50 | 23746.88 | 0.00 | 0.00 | 0.78 |
| 5 | -11694.37 | 54 | 23805.84 | 23634.28 | 0.00 | 0.00 | 0.79 |
| 12 | 1 | -10339.03 | 10 | 20751.59 | 20719.83 | --- | --- | --- |
| 2 | -8392.68 | 21 | 16939.79 | 16873.08 | 0.00 | 0.00 | 0.86 |
| 3 | -7928.52 | 32 | 16092.39 | 15990.73 | 0.00 | 0.00 | 0.86 |
| 4 | -7742.22 | 43 | 15800.68 | 15664.08 | 0.00 | 0.00 | 0.81 |
| 5 | -7661.56 | 54 | 15720.25 | 15548.70 | 0.00 | 0.00 | 0.84 |

Table 3

*Item Probability Profiles by Grade Level and Latent Class Attitudinal Profile*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | *Positive* | *Qualified Positive* | *Indifferent* | *Dim* |
| **Grade 7** | **26%** | **27%** | **29%** | **18%** |
| I enjoy math | 0.85 | 0.73 | 0.66 | 0.44 |
| Math is useful in everyday problems | 0.96 | 0.88 | 0.62 | 0.20 |
| Math helps a person think logically | 0.97 | 0.71 | 0.58 | 0.17 |
| It is important to know math to get a good job | 0.98 | 0.91 | 0.70 | 0.32 |
| I will use math in many ways as an adult | 0.99 | 0.88 | 0.71 | 0.20 |
| I enjoy science | 0.87 | 0.42 | 0.73 | 0.35 |
| Science is useful in everyday problems | 0.90 | 0.10 | 0.46 | 0.07 |
| Science helps a person think logically | 0.94 | 0.25 | 0.56 | 0.11 |
| It is important to know science to get a good job | 0.87 | 0.08 | 0.50 | 0.07 |
| I will use science in many ways as an adult | 0.92 | 0.11 | 0.63 | 0.08 |
| **Grade 10** | **32%** | **23%** | **24%** | **21%** |
| I enjoy math | 0.82 | 0.75 | 0.52 | 0.32 |
| Math is useful in everyday problems | 0.94 | 0.86 | 0.45 | 0.14 |
| Math helps a person think logically | 0.95 | 0.81 | 0.57 | 0.16 |
| It is important to know math to get a good job | 0.96 | 0.87 | 0.54 | 0.16 |
| I will use math in many ways as an adult | 0.96 | 0.92 | 0.43 | 0.10 |
| I enjoy science | 0.89 | 0.37 | 0.67 | 0.20 |
| Science is useful in everyday problems | 0.90 | 0.11 | 0.44 | 0.03 |
| Science helps a person think logically | 0.93 | 0.28 | 0.58 | 0.04 |
| It is important to know science to get a good job | 0.91 | 0.09 | 0.42 | 0.02 |
| I will use science in many ways as an adult | 0.92 | 0.06 | 0.42 | 0.02 |
| **Grade 12** | **35%** | **21%** | **24%** | **20%** |
| I enjoy math | 0.80 | 0.64 | 0.40 | 0.19 |
| Math is useful in everyday problems | 0.96 | 0.88 | 0.46 | 0.04 |
| Math helps a person think logically | 0.98 | 0.79 | 0.61 | 0.11 |
| It is important to know math to get a good job | 0.89 | 0.81 | 0.38 | 0.06 |
| I will use math in many ways as an adult | 0.96 | 0.93 | 0.39 | 0.05 |
| I enjoy science | 0.89 | 0.28 | 0.60 | 0.10 |
| Science is useful in everyday problems | 0.93 | 0.14 | 0.45 | 0.00 |
| Science helps a person think logically | 0.97 | 0.29 | 0.58 | 0.04 |
| It is important to know science to get a good job | 0.81 | 0.06 | 0.32 | 0.00 |
| I will use science in many ways as an adult | 0.89 | 0.05 | 0.43 | 0.00 |

*Note*. Bolded value at the top of each section break represents the class size at each grade.

Table 4

*Unconditional Latent Transition Probabilities*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Conditional on Grade 7* | Transitioning to Grade 10 | | | |
|  | Positive | Qualified Positive | Indifferent | Dim |
| Positive | 0.52 | 0.18 | 0.20 | 0.10 |
| Qualified Positive | 0.24 | 0.39 | 0.16 | 0.22 |
| Indifferent | 0.26 | 0.14 | 0.37 | 0.23 |
| Dim | 0.13 | 0.17 | 0.21 | 0.50 |
| *Conditional on Grade 10* | Transitioning to Grade 12 | | | |
| Positive | 0.64 | 0.08 | 0.17 | 0.12 |
| Qualified Positive | 0.21 | 0.54 | 0.08 | 0.18 |
| Indifferent | 0.20 | 0.09 | 0.49 | 0.22 |
| Dim | 0.07 | 0.16 | 0.20 | 0.58 |

Table 5

*LTA Trajectories Based on Grades 7, 10 and 12 Latent Class Attitudinal Profiles*

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | *Grade 7* | | | | *Grade 10* | | | | *Grade 12* | | | |
| *LTA Trajectory* | *P* | *QP* | *I* | *D* | *P* | *QP* | *I* | *D* | *P* | *QP* | *I* | *D* |
| Stay High (19%) |  |  |  |  |  |  |  |  |  |  |  |  |
|  | X |  |  |  | X |  |  |  | X |  |  |  |
|  | X |  |  |  |  | X |  |  | X |  |  |  |
|  | X |  |  |  |  |  | X |  | X |  |  |  |
|  | X |  |  |  |  |  |  | X | X |  |  |  |
| Stay Medium (16%) |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | X |  |  |  | X |  |  |  | X |  |  |
|  |  | X |  |  |  |  | X |  |  | X |  |  |
|  |  | X |  |  |  |  |  | X |  | X |  |  |
|  |  | X |  |  | X |  |  |  |  | X |  |  |
| Stay Low (25%) |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  | X |  | X |  |  |  |  |  | X |  |
|  |  |  | X |  |  | X |  |  |  |  | X |  |
|  |  |  | X |  |  |  | X |  |  |  | X |  |
|  |  |  | X |  |  |  |  | X |  |  | X |  |
|  |  |  | X |  | X |  |  |  |  |  |  | X |
|  |  |  | X |  |  | X |  |  |  |  |  | X |
|  |  |  | X |  |  |  | X |  |  |  |  | X |
|  |  |  | X |  |  |  |  | X |  |  |  | X |
|  |  |  |  | X | X |  |  |  |  |  | X |  |
|  |  |  |  | X |  | X |  |  |  |  | X |  |
|  |  |  |  | X |  |  | X |  |  |  | X |  |
|  |  |  |  | X |  |  |  | X |  |  | X |  |
|  |  |  |  | X | X |  |  |  |  |  |  | X |
|  |  |  |  | X |  | X |  |  |  |  |  | X |
|  |  |  |  | X |  |  | X |  |  |  |  | X |
|  |  |  |  | X |  |  |  | X |  |  |  | X |
| Start High and End Low (8%) | X |  |  |  | X |  |  |  |  |  | X |  |
|  | X |  |  |  |  | X |  |  |  |  | X |  |
|  | X |  |  |  |  |  | X |  |  |  | X |  |
|  | X |  |  |  |  |  |  | X |  |  | X |  |
|  | X |  |  |  | X |  |  |  |  |  |  | X |
|  | X |  |  |  |  | X |  |  |  |  |  | X |
|  | X |  |  |  |  |  | X |  |  |  |  | X |
|  | X |  |  |  |  |  |  | X |  |  |  | X |
| Start High and End Medium (4%) | X |  |  |  | X |  |  |  |  | X |  |  |
|  | X |  |  |  |  | X |  |  |  | X |  |  |
|  | X |  |  |  |  |  | X |  |  | X |  |  |
|  | X |  |  |  |  |  |  | X |  | X |  |  |
| Start Low and End High (6%) |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  | X |  | X |  |  |  | X |  |  |  |
|  |  |  | X |  |  | X |  |  | X |  |  |  |
|  |  |  | X |  |  |  | X |  | X |  |  |  |
|  |  |  | X |  |  |  |  | X | X |  |  |  |
|  |  |  |  | X | X |  |  |  | X |  |  |  |
|  |  |  |  | X |  | X |  |  | X |  |  |  |
|  |  |  |  | X |  |  | X |  | X |  |  |  |
|  |  |  |  | X |  |  |  | X | X |  |  |  |
| Start Low and End Medium (4%) |  |  | X |  | X |  |  |  |  | X |  |  |
|  |  |  | X |  |  | X |  |  |  | X |  |  |
|  |  |  | X |  |  |  | X |  |  | X |  |  |
|  |  |  | X |  |  |  |  | X |  | X |  |  |
| Start Medium and End High (7%) |  | X |  |  | X |  |  |  | X |  |  |  |
|  |  | X |  |  |  | X |  |  | X |  |  |  |
|  |  | X |  |  |  |  | X |  | X |  |  |  |
|  |  | X |  |  |  |  |  | X | X |  |  |  |
| Start Medium and End Low (11%) |  | X |  |  | X |  |  |  |  |  | X |  |
|  |  | X |  |  |  | X |  |  |  |  | X |  |
|  |  | X |  |  |  |  | X |  |  |  | X |  |
|  |  | X |  |  |  |  |  | X |  |  | X |  |
|  |  | X |  |  | X |  |  |  |  |  |  | X |
|  |  | X |  |  |  | X |  |  |  |  |  | X |
|  |  | X |  |  |  |  | X |  |  |  |  | X |
|  |  | X |  |  |  |  |  | X |  |  |  | X |

*Note*. P = Positive; QP = Qualified Positive; I = Indifferent; D = Dim

Table 6

*Percent of Students Classified in LTA Trajectory by Covariates*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | *Gender* | | *Ethnicity* | |
| *LTA Trajectory* | Female | Male | Underrepresented Minority | Not Underrepresented Minority |
| Stay High | 15 | 22 | 22 | 18 |
| Stay Medium | 20 | 13 | 18 | 15 |
| Stay Low | 23 | 26 | 25 | 24 |
| Start High and End Low | 7 | 9 | 7 | 9 |
| Start High and End Medium | 4 | 4 | 4 | 4 |
| Start Low and End High | 6 | 6 | 6 | 6 |
| Start Low and End Medium | 5 | 3 | 5 | 3 |
| Start Medium and End High | 8 | 6 | 5 | 8 |
| Start Medium and End Low | 12 | 10 | 8 | 13 |

Table 7

*Log Odds Coefficients and Odds Ratios for LTA Trajectory with Covariates*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | *Logit* | *SE* | *est/SE* | *Odds Ratio* |
| Stay Medium |  |  |  |  |
| Female | 0.76\*\*\* | 0.12 | 6.12 | 2.13 |
| Underrepresented Minority | -0.12 | 0.14 | 0.16 | 1.17 |
| Stay Low |  |  |  |  |
| Female | 0.25\* | 0.11 | 2.20 | 1.28 |
| Underrepresented Minority | -0.20 | 0.13 | -1.50 | 1.06 |
| Start High and End Low |  |  |  |  |
| Female | 0.12 | 0.15 | 0.81 | 1.13 |
| Underrepresented Minority | -0.50\*\* | 0.19 | -2.64 | 0.88 |
| Start High and End Medium |  |  |  |  |
| Female | 0.34 | 0.20 | 1.71 | 1.40 |
| Underrepresented Minority | -0.13 | 0.23 | -0.58 | 1.38 |
| Start Low and End High |  |  |  |  |
| Female | 0.24 | 0.17 | 1.38 | 1.27 |
| Underrepresented Minority | -0.22 | 0.20 | -1.08 | 1.19 |
| Start Low and End Medium |  |  |  |  |
| Female | 1.00\*\*\* | 0.21 | 4.75 | 2.73 |
| Underrepresented Minority | 0.24 | 0.22 | 1.07 | 1.97 |
| Start Medium and End High |  |  |  |  |
| Female | 0.71\*\*\* | 0.16 | 4.41 | 2.20 |
| Underrepresented Minority | -0.65\* | 0.21 | -3.06 | 0.79 |
| Start Medium and End Low |  |  |  |  |
| Female | 0.51\*\*\* | 0.14 | 3.76 | 1.67 |
| Underrepresented Minority | -0.66\*\*\* | 0.18 | -3.78 | 0.73 |

Note: Comparison group is “Stay High.”

\**p* < .05. \*\**p* < .01. \*\*\**p* < .001.

Table 8

*Descriptives for LTA Trajectory by Distal Outcome*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *LTA Trajectory* | *Mathematics Achievement* | *Science Achievement* | *Interest in Science Issues* | *STEM Career Attainmenta* |
| Stay High | 74.80  (14.53) | 70.89  (12.78) | 0.32  (0.29) | 16 |
| Stay Medium | 69.13  (11.58) | 64.80  (10.15) | 0.14  (0.21) | 6 |
| Stay Low | 61.85  (15.75) | 61.60  (12.91) | 0.14  (0.20) | 2 |
| Start High and End Low | 69.21  (14.77) | 65.67  (12.76) | 0.19  (0.25) | 6 |
| Start High and End Medium | 68.76  (13.79) | 62.70  (12.63) | 0.16  (0.24) | 7 |
| Start Low and End High | 69.80  (14.06) | 68.46  (12.44) | 0.26  (0.26) | 17 |
| Start Low and End Medium | 63.29  (12.37) | 61.19  (11.51) | 0.14  (0.20) | 3 |
| Start Medium and End High | 76.06  (12.90) | 69.15  (12.39) | 0.21  (0.24) | 14 |
| Start Medium and End Low | 64.83  (15.33) | 63.62  (11.27) | 0.15  (0.22) | 3 |

*a*Percent of students who attained STEM career.

*Note*. Standard deviation in parentheses.

Table 9

*Log Odds Coefficients and Odds Ratios for LTA Trajectory with Distal Outcomes*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | *Logit* | *SE* | *est/SE* | *Odds Ratio* |
| Stay Medium |  |  |  |  |
| Mathematics Achievement | -0.03\*\*\* | 0.01 | -3.83 | 0.99 |
| Science Achievement | -0.05\*\*\* | 0.01 | -5.95 | 0.96 |
| Interest in Science Issues | -2.91\*\*\* | 0.42 | -6.87 | 0.05 |
| STEM Career Attainment | -1.14\*\*\* | 0.29 | -3.94 | 0.32 |
| Stay Low |  |  |  |  |
| Mathematics Achievement | -0.06\*\*\* | 0.01 | -8.60 | 0.95 |
| Science Achievement | -0.07\*\*\* | 0.01 | -9.32 | 0.94 |
| Interest in Science Issues | -2.90\*\*\* | 0.36 | -7.98 | 0.05 |
| STEM Career Attainment | -2.05\*\*\* | 0.35 | -5.82 | 0.13 |
| Start High and End Low |  |  |  |  |
| Mathematics Achievement | -0.03\*\*\* | 0.01 | -3.66 | 0.99 |
| Science Achievement | -0.04\*\*\* | 0.01 | -4.93 | 0.96 |
| Interest in Science Issues | -1.75\*\*\* | 0.38 | -4.69 | 0.17 |
| STEM Career Attainment | -1.14\*\* | 0.36 | -3.19 | 0.32 |
| Start High and End Medium |  |  |  |  |
| Mathematics Achievement | -0.03\*\* | 0.01 | -3.07 | 0.99 |
| Science Achievement | -0.06 | 0.01 | -5.94 | 0.94 |
| Interest in Science Issues | -2.26\*\*\* | 0.59 | -4.05 | 0.10 |
| STEM Career Attainment | -0.91\* | 0.45 | -2.02 | 0.40 |
| Start Low and End High |  |  |  |  |
| Mathematics Achievement | -0.03\*\* | 0.01 | -3.03 | 0.99 |
| Science Achievement | -0.02\* | 0.01 | -2.17 | 0.98 |
| Interest in Science Issues | -0.79\* | 0.39 | -2.04 | 0.45 |
| STEM Career Attainment | 0.08 | 0.27 | 0.28 | 1.08 |
| Start Low and End Medium |  |  |  |  |
| Mathematics Achievement | -0.06\*\*\* | 0.01 | -5.37 | 0.96 |
| Science Achievement | -0.07\*\*\* | 0.01 | -6.64 | 0.93 |
| Interest in Science Issues | -2.80\*\*\* | 0.61 | -4.61 | 0.06 |
| STEM Career Attainment | -1.91\*\* | 0.73 | -2.61 | 0.15 |
| Start Medium and End High |  |  |  |  |
| Mathematics Achievement | 0.01 | 0.01 | 0.84 | 1.03 |
| Science Achievement | -0.01 | 0.01 | -1.66 | 0.99 |
| Interest in Science Issues | -1.52\*\*\* | 0.40 | -3.82 | 0.22 |
| STEM Career Attainment | -0.18 | 0.28 | -0.65 | 0.84 |
| Start Medium and End Low |  |  |  |  |
| Mathematics Achievement | -0.05\*\*\* | 0.01 | -6.53 | 0.97 |
| Science Achievement | -0.05\*\*\* | 0.01 | -7.11 | 0.95 |
| Interest in Science Issues | -2.62\*\*\* | 0.38 | -6.91 | 0.07 |
| STEM Career Attainment | -1.94\*\*\* | 0.44 | -4.43 | 0.14 |

\**p* < .05. \*\**p* < .01. \*\*\**p* < .001.

*Note*. Comparison group is “Stay High.”

|  |  |
| --- | --- |
| Positive in Grade 7 | Qualified Positive in Grade 7 |
| Indifferent in Grade 7 | Dim in Grade 7 |

*Figure 1*. Student trajectories. Numbers in circles refer to percent of students in each attitudinal profile. Numbers above arrows indicate the percentage of students who transition from one attitudinal profile to another. The numbers for the Grade 10 to Grade 12 trajectory indicate the most common transition.

|  |  |
| --- | --- |
| Positive in Grade 7 | Qualified Positive in Grade 7 |
| Indifferent in Grade 7 | Dim in Grade 7 |

*Figure 2*. Minority student trajectories. Numbers in circles refer to percent of students in each attitudinal profile. Numbers above arrows indicate the percentage of students who transition from one attitudinal profile to another. The numbers for the Grade 10 to Grade 12 trajectory indicate the most common transition.

|  |  |
| --- | --- |
| Positive in Grade 7 | Qualified Positive in Grade 7 |
| Indifferent in Grade 7 | Dim in Grade 7 |

*Figure 3*. Underrepresented minority student trajectories. Numbers in circles refer to percent of students in each attitudinal profile. Numbers above arrows indicate the percentage of students who transition from one attitudinal profile to another. The numbers for the Grade 10 to Grade 12 trajectory indicate the most common transition.