# Career Identity and Profiles of Value Beliefs in Four Academic Domains in High School

by

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**Abstract**

This project analyzed five waves of longitudinal survey data from all grades in a high school ($N$ = 2,681), including academic value beliefs in English, math, science, and social studies in addition to career identity commitment and career identity exploration. The first aim of the study was to determine the extent to which students experience declines in academic value beliefs and whether these trends differ based on gender, Racial/Ethnic identification, and parental educational attainment. This aim was addressed using both a variable-centered method (Latent Curve Analysis; LCA) and an exploratory person-centered method (Growth Mixture Modeling; GMM). The second aim was to assess the extent to which students specialize in value for one specific academic domain, and whether greater specialization is positively associated with career identity development. This question was addressed by modeling the development of career identity and exploration with LCA and linking these variables with indicators of academic specialization.

On average across students, value beliefs in math, value beliefs in science, and career commitment decreased during students' time in high school. However, value beliefs in English and social studies increased, and career exploration remained stable. Greater career commitment was associated with higher initial value for science and less decline in math and science value. In demographic group differences, women reported higher initial levels of English value while men expressed higher initial levels of math value. Lower parental educational attainment was associated with lower initial levels of value in math, science, and social studies, greater declines in value beliefs in all subjects, and greater initial career commitment. Students with higher personal educational aspirations showed higher initial levels of value for math and science and experienced less decline in science value. Black/African American students indicated lower initial value beliefs in science and greater initial career commitment than other Racial/Ethnic groups, while Asian/Asian American students expressed the highest initial value for math and science of any group.

The GMM analysis of value beliefs found six classes: a “High stable” class (75%), a “Humanities preference” class (8%), a “STEM preference” class (6%), a “STEM decline” class (4%), an “Increasing” class (4%), and a “Declining” class (3%). Women were overrepresented in the “STEM decline” class and “Humanities preference” class but underrepresented in the “STEM preference” class. Students with the lowest parental educational attainment and Black/African American students were underrepresented in the “High stable” class, while students with highest parental educational attainment and White/Caucasian students were overrepresented in that class. Students in the three classes with more specialized value patterns reported greater initial levels of and less decline in career commitment.

The results of this analysis indicate that high-performing schools wishing to improve equity in subject area value beliefs may consider focusing on students with lower parental educational attainment in relation to all content areas, Black/African American students in science, women in math, and men in English; however, no gender differences were evident in science. To promote career identity commitment, the positive relationships between this variable and value for math, value for science, more specialized value belief profiles, Black/African American identification, and lower parental educational attainment could be further investigated.

## Chapter 1

## Introduction

Career selection, one of the most important developmental tasks of adolescence as described by young people themselves (Nurmi, 1991; Vondracek & Porfeli, 2003), has been linked to interests early in life. As early as third and fourth grade, children state that selecting an adult career involves matching the job to personal interests (Nelson, 1994; Trice, Hughes, Odom, Woods, & McClellan, 1995) and many undergraduate students in science, technology, engineering, and math (STEM) fields report an interest in the material beginning in childhood (Maltese & Tai, 2010; Russell, Hancock, & McCullough, 2007). Based on this line of research, some scholars have concluded that “inculcation of enthusiasm is the key element—and the earlier the better” (Russell et al., 2007, p. 549) in encouraging STEM career choices. However, this interest must be maintained over the course of development in order to exert an influence on choices in adolescence and young adulthood. For example, an interview study found that loss of interest in the topic was the most common reason cited for abandoning a STEM major, more common than perceived lack of knowledge, talent mismatch, or the major being too competitive (Seymour & Hewitt, 1997).

Given the importance of interest in career decision-making, it is concerning that many studies have found declines in student interest as well as a range of other motivational constructs through the grade school years (Wigfield et al., 2015). This often-cited pattern has been replicated in a wide variety of motivational beliefs including value for academic subjects

(Archambault, Eccles, & Vida, 2010; Fredricks & Eccles, 2002; Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002), intrinsic motivation (A. E. Gottfried, Fleming, & Gottfried, 2001), and self-concept of ability (Marsh & Ayotte, 2003), and across numerous cultures including the United States (Fredricks & Eccles, 2002; Jacobs et al., 2002), Australia (Watt, 2004), and Germany (Frenzel, Goetz, Pekrun, & Watt, 2010; Köller, Baumert, & Schnabel, 2001). Authors who have reported these results describe this pattern as "a—sad but true—normative phenomenon" (Frenzel et al., 2010, p. 1069) or a "ubiquitous and alarming" trend (Gottfried, Marcoulides, Gottfried, Oliver, & Guerin, 2007, p. 317).

However, much of the existing research has observed these declines by examining average level of interest across the sample (Archambault et al., 2010; Fredricks & Eccles, 2002; Jacobs et al., 2002; Watt, 2004). This technique may mask important group differences in motivational trajectories. For example, one study (Ratelle, Guay, Larose, & Senécal, 2004) observed that deterioration in motivation from high school to college was only experienced by a small group of students. Similarly, Archambault and colleagues (Archambault, Janosz, Morizot, & Pagani, 2009) determined that a majority of high school students experienced a positive trajectory of school engagement, with a negative trajectory demonstrated in a smaller group. Therefore, a clear consensus has not yet emerged about the proportion of students who experience motivational declines. An additional limitation of many analyses that identify negative trends in motivation is the inclusion of only a single content area. Cases in which motivation stays high or even increases in an alternate academic domain will not be apparent using this approach. Average declines across students in one subject alone may be partially explained by the process of interest specialization; as students focus their time and resources on their most preferred subject, value and competence beliefs in their least preferred subjects may decrease (Marsh et al., 2015). As one scholar of interest argues:

> When at this age the structure of individual interests becomes increasingly focused on certain points, this necessarily leads to a reduction of individual interests in other areas. On the whole, this inevitably leads to a negative trend in the average level of any subject-related interest in the student population. ... The results ... concerning the continual decline of school-oriented interests at secondary level can in part be due to this. (Krapp, 2002, p. 393).

Similarly, vocational theorists (Skorikov & Vondracek, 2011) propose that a process of interest specialization may in fact be desirable in the career decision-making process. Therefore, determining how many students truly display deteriorating motivational beliefs in every school subject and how many maintain high interest in at least one academic subject may be necessary in order to understand potential needs for intervention. Overall, adolescence represents a developmental period in which examining a range of content areas may be critical to a complete understanding of motivational declines.

The present analysis aims to address the above limitations by using a person-centered analytical technique that is able to identify subgroups of individuals with similar patterns of interest across several academic domains simultaneously (Growth Mixture Modeling, “GMM”). Developmental trajectories in the domains of math, English, science, and social studies will then be compared based on student demographic differences and linked with career identity development outcomes.

# Chapter 2

## Literature review

### Expectancy-Value Theory

The modern reconceptualization of Expectancy-Value Theory (EVT; Eccles-Parsons, 1983; Wigfield & Eccles, 2000) often guides the study of declines in subject area academic motivation. In this framework, the decision to engage and persist in an achievement task arises from the combination of one's expectation for success or "expectancy" and one's subjective valuation or "value" for the activity. The expectation of success originates from an individual's "self-concept of ability" (SCA), or evaluation of their level of competence in an area, as well as their self-schemata, goals, and perceptions of task difficulty. An assessment of value develops from an individual's consideration of "utility value," "attainment value," "intrinsic value," and "cost". Utility value represents an activity's pragmatic usefulness, attainment value is the importance of a pursuit to the maintenance of one's identity, and intrinsic value refers to enjoyment or a task's positive emotional appeal. Finally, cost includes any negative consequences associated with engagement in a task, such as the use of time and other resources. A key contribution of this approach is the incorporation of contextual and social factors, including stereotypes, gender roles, family demographics, and the behavior of socializers, that are proposed to affect behavior based on an individual's subjective interpretations and internalization of these influences. In order to apply this model to academic motivation, these constructs are usually assessed in reference to a content area such as "math" or "English" and used to predict outcomes such as school grades in that specific domain. Supporting this theory, expectancy and value beliefs as well as conceptually similar constructs such as self-efficacy and interest have been linked with a range of positive outcomes including engagement, grades, standardized test scores, choices to take school courses, college major selection, career aspirations, and career choices (Wigfield et al., 2015). These relationships have been found in both concurrent and longitudinal analyses.

Several such studies that predicted behavior from expectancy and value beliefs longitudinally have used the Childhood and Beyond dataset (CAB; described further below), which consists of participants in the United States who were surveyed from first grade through young adulthood beginning in 1987. An analysis of this dataset in the literacy domain ($N$ = 606) reported that number of English classes taken by 12th grade were predicted by earlier self-concept of ability, utility value, and intrinsic value in 10th grade (Durik, Vida, & Eccles, 2006). Another outcome, aspirations in 12th grade to careers that require language skills, was predicted by 10th grade self-concept of ability and utility value. In addition, intrinsic value for reading in fourth grade predicted amount of leisure reading in 10th grade, and utility value in 4th grade predicted eighth grade reading achievement.

Another similar analysis of the CAB data ($N$ = 227) was conducted with a focus on science and math (Simpkins, Davis-Kean, & Eccles, 2006). In math, utility/importance value did not predict any later outcomes, but math interest as well as self-concept of ability in 10th grade predicted number of math courses taken by 12th grade. In addition, math interest and self-concept of ability in sixth grade predicted achievement in math class in 10th grade. For science, all EVT subcomponents in 10th grade predicted subsequent number of courses taken, and self-concept of ability in sixth grade predicted achievement in science class in 10th grade. A more recent analysis of the CAB data (*N* = 980) that also concentrated on the math domain included the outcome of career aspirations (Lauermann, Tsai, & Eccles, 2017). These authors found that utility value, interest, and self-concept of ability in ninth grade predicted career aspirations in 12th grade. Additionally, in a novel demonstration of reciprocal effects over time, career aspirations at grade nine also predicted subsequent utility value and self-concept of ability in grade 12.

Expectancy and value beliefs in math were also used to predict course enrollment and career aspirations in a recent project (Watt et al., 2012) that compared a selection of CAB participants (*N* = 418) with groups from the Study of Transitions and Education Pathways (STEPS) in Australia (*N* = 358) and the Canadian Adolescent Development and Educational Transitions (CADET) project (*N* = 471). Students were either in grade nine or 10 at the first time point, and in grade 11 or 12 at the second time point. In a complex set of results, no EVT subcomponent at the first time point predicted outcomes at the second time point consistently across all samples and for both genders. Predicting math-related career aspirations, significant effects were found for attainment/utility value among women in the Australian and Canadian samples. For math course enrollment, significant effects were observed of intrinsic value for Australian students, of self-concept of ability for Canadian and U.S. students, and attainment/utility value in the Canadian sample for male students but in the U.S. sample for female students. Such cross-cultural research on the topic of EVT beliefs has been recently expanding, and continuing these efforts may help clarify these inconsistent results.

These results are partially inconsistent with an earlier analysis by this same author (Watt, 2006) of the same Australian dataset (*N* = 442). As in the previous study, math course selection in grade 11 was predicted by intrinsic value in ninth grade, but unlike the previous study the effect of self-concept of ability was also significant. Notably, math career aspirations were only predicted by utility value in a quadratic trend that varied between genders. While males and females reported math-related career aspirations at similar rates in the upper third and the lowest third of utility value levels, females in the middle third of the utility value distribution were less likely to indicate math-related career aspirations than men.

Several other longitudinal studies have supported elements of the EVT model in the domain of math. Predicting outcomes in ninth grade from motivational beliefs in seventh grade, an analysis of U.S. participants ($N$ = 250) found that self-concept of ability predicted later achievement while value beliefs predicted course selection (Meece et al., 1990). Such a pattern in which self-concept primarily predicts achievement while values primarily predict choice was partially supported in a large-scale analysis ($N$ = 10,370) of the 2003 Longitudinal Study of Australian Youth (an extension of the Program for International Student Assessment [PISA]; Guo, Parker, Marsh, & Morin, 2015). Among a nationally representative group of students who were assessed annually for 10 years, EVT beliefs assessed at the first time point in 10th grade were used to predict number of math courses taken throughout high school, math achievement in grade 12, and choice of a STEM major two years after finishing high school. Math achievement in 12th grade, as assessed with a combined index of high school grades and standardized tests, was predicted by earlier levels of math interest as well as self-concept. Number of math courses taken by the end of high school was predicted by all three EVT beliefs in grade 10, but choice of STEM major two years after high school was predicted by value beliefs and not self-concept. Similarly, a study in the U.S. ($N$ = 3,116) demonstrated that value beliefs for math in 12th grade, but not self-concept beliefs, predicted STEM employment at ages 33-37 while controlling for achievement (Wang, Degol, & Ye, 2015).

## Expectancy-Value Theory and STEM Participation

Due to the relationships described above between EVT beliefs and career outcomes including course selection, college major selection, occupational aspirations, and actual occupational choice (see Table 2-1 for a summary of reviewed studies), this approach is now often used to examine disparities in STEM career participation among U.S. demographic groups. Promoting equity in participation in these fields would allow many individuals access to well-paying jobs (Dey & Hill, 2007) for which demand is currently high and expected to increase (U.S. Congress Joint Economic Committee, 2012). Further, failure to draw from all segments of the population for skilled workers in these fields represents a missed opportunity to encourage innovation and national economic growth (Olson & Riordan 2012). For example, a recent study found that children's math test scores in third and eighth grade strongly predicted the likelihood of receiving patents in adulthood only for White and Asian American men from high income families (Bell, Chetty, Jaravel, Petkova, & Van Reenen, 2017). This relationship was suppressed among all other demographic groups, such that even individuals with significant early math skills were much less likely to receive patents in adulthood. Therefore, methods of encouraging STEM participation among women, persons of color, and individuals from low-income backgrounds are often viewed as key outcomes of research on adolescent academic motivation.

**Gender.** In the U.S. in 2017, women made up only 15% of those employed in engineering, 26% in computer and math sciences, and 28% in physical sciences. Similarly, among students receiving Bachelor's degrees in the same year and therefore soon to enter the workforce, women made up 20% of degrees in engineering, 18% in computer science, and 19% in the physical sciences (National Science Foundation [NSF], 2019). Women are also more likely to leave college majors in math and science (Ellis, Fosdick, & Rasmussen, 2016).

Critically, as several recent reviews have documented, this disparity is not explained by differences in math ability or achievement (Ceci, Ginther, Kahn, & Williams, 2014; Cheryan, Ziegler, Montoya, & Jiang, 2017; Else-Quest, Hyde, & Linn, 2010; Hyde, 2014; Wang & Degol, 2017). Young women now enroll in advanced math and science courses in high school at comparable rates to men and achieve higher grades in these classes (Voyer & Voyer, 2014). Further, while males are overrepresented in the upper end of performance distributions of a variety of standardized math tests beginning in early adolescence (Wai, Cacchio, Putallaz, & Makel, 2010), overall average scores on such tests are now nearly equivalent (Lindberg, Hyde, Petersen, & Linn, 2010). The magnitude of these achievement differences falls dramatically short of the gender difference in selection of math-intensive college majors and workforce participation (Riegle-Crumb, King, Grodsky, & Muller, 2012).

Several recent analyses have suggested that gender differences in value and self-concept of ability partially account for differences in STEM field participation (Wang, Eccles, & Kenny, 2013; Watt et al., 2012). In accordance with the importance of contextual influences proposed by EVT, women may be expected to express less interest in math due to prevailing stereotypes of this subject as a male domain. For example, young women in national, ethnic, school, and household contexts that communicate greater endorsement of this stereotype and include fewer female role models develop lower interest and confidence in the subject (Wang & Degol, 2013). However, current results on this topic are inconsistent. Some previous research has indeed identified gender differences in adolescence favoring males (Frenzel et al, 2010; Jacobs et al., 2002; Steinmayr & Spinath, 2008). However, other research has observed no differences, or varying results based on value subcomponents. For example, males and females are more likely to differ in intrinsic value or interest (Frenzel, Pekrun, & Goetz, 2007; Gaspard et al., 2017; Lee

& Kim, 2014; Ma & Cartwright, 2003; Spinath, Eckert, & Steinmayr, 2014; Watt, 2004) than in utility value, usefulness, or importance (Gaspard et al., 2017; Ma & Cartwright, 2003; Watt, 2004) expressed for mathematics.

**Socioeconomic status.** An individual's combined economic and social standing in society or socioeconomic status (SES) encompasses factors in addition to income or wealth, as individuals with similar financial resources may differ in the relative prestige of occupations or other aspects of behavior or cultural expression (Baker, 2014). Assessments of SES often include income, educational attainment, occupational prestige, or indices based on combinations of these measures, although such variables as wealth, home ownership, and neighborhood disadvantage are occasionally included. Individuals from lower SES backgrounds are also less likely to enter STEM fields (Graham & Provost, 2012; Wang & Degol, 2013) and have lower educational aspirations (Halle, Kurtz-Costes, & Mahoney, 1997) than do their higher-SES peers. These students face negative stereotypes of their academic competence (Durante, Tablante, & Fiske, 2017; Volpato, Andrighetto, & Baldissari, 2017) and often have less social support and role models for STEM career interest and self-efficacy (Alliman-Brissett & Turner, 2010; Diemer & Ali, 2009). Recent research has considered whether the connection between SES to academic achievement and educational aspirations may be mediated by motivation (Grolnick, Friendly, & Bellas, 2009). SES differences in academic self-concept of ability and self-efficacy are often observed (Ivcevic & Kaufman, 2013; Kudrna, Furnham, & Swami, 2010) and first-generation college students have expressed less adaptive motivational beliefs such as greater fear of failure (Bui, 2002) and performance-avoidance goals (Jury, Smeding, Court, & Darnon, 2015). However, results have varied about differences in domain-specific academic value beliefs. While some studies show lower levels of academic value (Archambault et al., 2010), others have found no difference (Musu-Gillette et al., 2016; Gottfried et al., 2001).

**Racial/Ethnic identification.** In a similar pattern, individuals identifying as Black/African American, Hispanic/Latinx, and Native American represented about 30% of the US population in 2017, but earned only 22% of STEM Bachelors' degrees, 13% of STEM Master's degrees and 9% of STEM doctoral degrees (NSF, 2019). Similarly, about 70% of the STEM workforce was White in 2017 (NSF, 2019). Compared to White and Asian American students, such underrepresented minority (URM) students face academic challenges in STEM career preparation. African American students often have lower achievement in math (McGee & Martin 2011), and White and Asian American students are more likely to go to college than Black/African American and Hispanic/Latinx students (NSF, 2019). In addition, Asian American students take more advanced high school science and math courses than all other groups (NSF, 2019). On the 2005 NAEP math assessment, Asian/Asian American students scored the highest, followed by White/Caucasian, then Black/African American and Hispanic/Latinx students (Grigg, Donahue, & Dion, 2007). This Racial/Ethnic achievement gap may be partially but not fully accounted for by SES (Byrnes, 2003; Stevenson, Chen, & Uttal, 1990).

Similar to the work on socioeconomic status, it has been hypothesized that these differences in outcomes for URM students may be partially mediated by differences in motivation and a psychologically protective process of devaluing of and disidentification with academics. Compared to White/Caucasian and Asian/Asian American students, URM students face negative stereotypes about STEM talent (Sinclair, Hardin, & Lowery, 2006; Wenner, 2003), as well as intelligence and general academic ability (Graham & Hudley. 2005; Steele, 1997). The majority of children in the U.S. are likely aware of such stereotypes by 10 years of age

(McKown & Weinstein, 2003; Rowley, Kurtz-Costes, Mistry, & Feagans, 2007). According to research on "stereotype threat," salience of a negative stereotype about one's own social group can harm task performance through increased physiological stress and error monitoring, ultimately harming working memory capacity and self-regulation (Inzlicht & Kang, 2010; Schmader, 2010). Some researchers propose that if consistently faced with this barrier, individuals' self-efficacy will be harmed, eventually causing disengagement from the academic domain in question (Steele, Spencer, & Aronson, 2002). Indeed, endorsement of negative race stereotypes about academics is associated with lower academic self-concept among African American students (Evans, Copping, Rowley, & Kurtz-Costes, 2011; Okeke, Howard, Kurtz-Costes, & Rowley, 2009), and stereotype threat is associated with leaving STEM majors for URM students (Beasley & Fischer, 2012).

However, counter to these results, multiple researchers have not found higher levels of disidentification among African American youth (Wigfield, Eccles, Schiefele, Roeser, & Davis-Kean, 2006) or differences in self-concept of ability in academic domains (Graham, 1994). In a pattern that has been called "the race paradox," Black/African American individuals report more positive mental health outcomes including self-esteem than do White/Caucasian individuals, despite comparatively increased exposure to a range of stressors and poorer average academic performance (Mouzon, 2013). For example, a recent large-scale study of 10th graders in the 2002 Education Longitudinal Study ($N$ = 15,240), Black/African American students expressed more positive self-concept of ability in math than White/Caucasian students (Seo, Shen, & Alfaro, 2018). Anticipation of bias in society buffers the impact of perceived discrimination on self-esteem for African American youth (Harris-Britt, Valrie, Kurtz-Costes, Rowley, 2007), and in the academic domain Black/African American students are more likely to discount negative feedback (Schmader, Major, & Gramzow, 2001). In addition, Black/African American students are able to draw on unique cultural and community resources such as spirituality, extended family relationships, ethnic pride (Evans et al., 2012), and positive Racial/Ethnic identity (Rowley, Sellers, Chavous, & Smith, 1998). Overall, the proposal that Black/African American students place less value on academics is often not supported. While some have observed that African American students report lower value for school than White/Caucasian students, (Osborne, 1997; Murdock, 2009), others find that Black/African American parents value education highly as a route to social mobility (Eccles, Wong, & Peck, 2006, Mickelson, 1990, Wentzel, 1998).

Results have also been mixed regarding Racial/Ethnic differences in value and interest for specific academic domains. Certain results indicate that White/Caucasian students have more positive opinions about science than do Black/African American students (Slate & Jones, 1998) and that URM students are more likely to decline in science identity in college (Robinson, Perez, Nuttall, Roseth, & Linnenbrink-Garcia, 2018). However, others have found no Racial/Ethnic differences in science task value for science in middle school (Britner & Pajares, 2001), or science attainment value in high school (DeBacker & Nelson, 2000). Indeed, although completion rates for STEM majors after 5 years were 38% for White/Caucasian and Asian/Asian American students, 22% for Black/African American students, 18% for Latinx/Hispanic students, and 19% for Native American students (Hurtado et al., 2010), URM and majority students initially aspired to STEM majors at the same rate (Crisp, Nora, & Taggart, 2009; Koenig, 2009). Some research has also found more positive academic value beliefs for URM compared to majority students, such as value for reading in fifth and sixth grade (Baker & Wigfield, 1999, Guthrie, Wigfield, & You, 2012), while other studies identified no difference

(Guthrie, Coddington, et al., 2009). In another study demonstrating more positive attitudes for URM students, Black/African American and Latinx/Hispanic students reported higher interest and perceptions of usefulness for math in eighth grade in the 1988 National Education Longitudinal Study of over 5,000 students (Muller, Stage, & Kinzie, 2001). Relating to differences among majority groups in STEM, Asian/Asian American students expressed higher value for math than White/Caucasian students in eighth grade in this same study, although no differences were apparent for any Racial/Ethnic group in science (Muller, Stage, & Kinzie, 2001). Asian/Asian American students have also displayed greater levels of interest in math than White/Caucasian students in high school (Chen & Stevenson, 1995).

**Gender and race interactions.** The present study will also assess possible gender and race interactions in academic value beliefs. While it has previously been proposed that URM women would hold especially negative self-views in STEM fields due to the “double jeopardy” (Beal, 1970) effect of representing two negatively stereotyped group identities, recent research has not supported this conclusion. Instead, some studies have found that gender differences in math and science attitudes and achievement are smaller among Black/African American (but not Latinx/Hispanic) students than White/Caucasian students (Catsambis, 1994; Coley, 2001; McGraw, Lubienski, & Strutchens, 2006). Similarly, in the 2002 Education Longitudinal Study analysis mentioned above, women reported lower self-concept of ability in math than did men among White/Caucasian and Latinx/Hispanic adolescents only, with no significant gender differences among Black/African American and Asian/Asian American adolescents (Seo, Shen, & Alfaro, 2018). In addition, one study demonstrated that Black/African American women have more positive attitudes towards science than White/Caucasian women (Hanson, 2006).

A recent study of 10th grade students in a northeastern city examined gender by race interactions in attitudes towards and achievement in math and science (Else-Quest, Mineo, & Higgins, 2013), including White/Caucasian ($N$ = 102), Black/African American ($N$ = 96), Latinx/Hispanic ($N$ = 84), and Asian/Asian American ($N$ = 85) participants. Unlike previous research, the authors did not find race by gender interactions in any variable. Asian/Asian American students outperformed all other groups in both math and science achievement, while Black/African American students expressed higher math value than White/Caucasian students. Men reported higher math self-concept of ability levels than women on average, yet in science, women indicated greater value than men. All other group differences were not significant. These results therefore do not support the view that negative stereotypes about STEM ability exert a negative influence on value for women or URM individuals, and also do not replicate race by gender interactions.

Therefore, based on the trends in this research, it is hypothesized in the present study that URM students may either place lower value on STEM domains than majority students or display no difference, and that gender differences in STEM attitudes will be smaller among African American and Asian American students than White or Latinx students.

**Proposed Causes of Declining Value**

Due to the research that has linked EV beliefs with key career outcomes as well as engagement and achievement during school, many scholars have expressed concern about the apparent pattern found in this area of research of declines in motivational beliefs from first through 12th grade (Archambault et al., 2010; Fredricks & Eccles, 2002; Jacobs et al., 2002). However, although studies have independently examined a range of academic domains, it is less common for a single study to consider more than one domain simultaneously. Therefore, research showing motivational declines in multiple subjects individually may collectively give the impression that students becomes less motivated over time across all school subjects. Indeed, several of the hypotheses about the causes of motivational declines focus on factors related to school in general or least academics in general.

One hypothesis proposes that older students, having more developed cognitive abilities, make greater use of performance feedback and social comparison than do younger students and therefore arrive at a less optimistic assessment of their abilities (Wigfield et al., 2015). This change in competence beliefs could then lead to the observed decline in value beliefs as individuals place lower value on areas in which they feel less successful to protect self-esteem. Self-concept of ability in a domain is in fact a strong predictor of later value for the same domain, a relationship that grows stronger with age (Denissen, Zarrett, & Eccles, 2007). In addition, during adolescence students may experience developmental shifts in the ways they assess competence and value. For example, some evidence suggests that younger children view effort as the primary cause of performance while older students have a more differentiated concept of ability and effort (Wigfield et al., 2006). Similarly, factor analysis of the task value subcomponents demonstrates that children do not differentiate between utility and attainment value before grade five (Wigfield & Eccles, 1992). Interviews with fifth and ninth grade students also showed that older children view the idea of interest with a greater focus on cognitive factors while the younger students focus more on affective factors (Frenzel, Pekrun, Dicke, & Goetz, 2012; Linnenbrink-Garcia, et al., 2010).

Another common proposal is that students become less interested in school and academics in general over time, instead becoming more interested in social or extracurricular activities (Wigfield et al., 2006). While academic classes in school include more social interaction for younger students, academics and social activities become increasingly mutually exclusive in older grades (Shernoff et al.,1999; Urdan & Maehr, 1995; Hidi, 2000). For example, Anderman & Maehr (1994) in their review concluded that starting in middle school, interest declines for academic subjects but increases for nonacademic subjects. Many other studies have also observed increasing interest in sports (Follings-Albers & Hartinger, 1998), music, and art (Ainley et al., 1999; Wigfield & Eccles, 1992) throughout adolescence.

However, research investigating rank-order hierarchies do not identify steady shifts favoring non-academic domains in older students. For example, two studies that examined rank orders for ability beliefs in sixth and seventh grade found that the ordering changed at every measurement, although English was consistently ranked as the lowest in one study (Eccles et al., 1989; Wigfield, Eccles, Iver, Reuman, & Midgley, 1991). Other research considering rank order preferences in value showed greater levels of stability. Sixth and seventh graders consistently ranked social as their most preferred domain, followed by math, English, and then sports in one transition study (Eccles et al., 1989). In a similar transition study, students in the same grades also selected social as the most highly valued domain, followed by sports, math, and English (Wigfield et al., 1991). A third study that included first through sixth grade demonstrated that students rate reading and math as most useful and important followed by sports and music, but liked sports the most at each measurement (Wigfield et al., 1997). Therefore, although students may value non-academic domains more highly than academic domains, the current research does not show a change over time in these hierarchies that aligns with motivational declines.

Overall, if such changes in whole-school context are a major cause of decreases in motivation, one would expect to see that declines in motivation would occur broadly across subject areas. However, a large portion of the existing findings on motivational declines includes only a single academic domain.

## Longitudinal Studies including a Single Domain

### Longitudinal Studies Based on Expectancy-Value Theory

A substantial number of existing longitudinal studies based on the EVT approach have shown such declines in motivation for a single academic subject. The first set of studies described below are projects that use assessments of motivational beliefs that are based on Expectancy-Value Theory in particular. Several of these studies have used the influential Childhood and Beyond (CAB) dataset, which consists of about 1,000 students from the midwestern U.S. who were assessed in nine waves between 1987 and 1999. With three cohorts of participants, all grades from first through 12th are represented by between about 900 and about 300 participants. The items on these surveys for intrinsic value consisted of "In general, I find working on assignments in [subject]... Very interesting (1) to Very boring (7)" and "How much do you like [subject]? Not at all (1) to Very much (7)". For attainment value, the item consisted of "For me, being good at [subject] is... Not at all important (1) to Very important (7)," and the utility value item consisted of "In general, how useful is what you learn in [subject]"? Therefore, the overall value scale usually used for this dataset represents of four items. However, some analyses of this dataset also incorporate an additional item in each subscale, "Compared to most of your other activities, how useful/important is what you learn in math" and "how much do you like math"?

First, a study of motivation trajectories using this dataset (Fredricks & Eccles, 2002) focused on 514 participants (the sample size was limited due to the inclusion of parent survey variables in parts of the analysis), using five waves of data representing third through 12th grade.

Growth curves were applied separately to six different variables, consisting of math competence, math interest, math importance, sports competence, sports interest, and sports importance. Importantly, in this analysis intrinsic value (the “interesting” and “like very much” survey items) is analyzed separately from importance (the “useful” and “important” survey items). Math competence, interest, and importance all showed significant negative trends. However, math importance beliefs leveled off in eighth and ninth grade with a rebound over the high school years. Genders differed in competence beliefs, but not in value.

Another analysis of the CAB data that reached different conclusions included 761 participants, using all six waves of data collection with each grade one through 12 represented by between 233 and 528 participants (Jacobs, Lanza, Osgood, & Eccles, 2002). Self-concept beliefs and value beliefs were examined in the domains of math, language arts, and sports. Unlike the previous study, value beliefs were analyzed as a single construct combining intrinsic value and importance. While the previous study found a rebound in intrinsic value in math during high school, when using both variables combined this analysis identified a consistent decline. Again, no gender differences were present in math value. In language arts (the items referred to “reading” in younger grades and “English” in later grades), value beliefs displayed a negative trend until ninth grade, but then remained largely stable for boys and rebounded for girls during the high school years. Language arts competence beliefs followed the same trend, declining only until the beginning of high school. However, competence beliefs in math demonstrated a more consistent decrease, with a gender difference favoring boys that became smaller and disappeared by the end of high school.

Research conducted in Australia on competence and value beliefs in math and English replicated declining value beliefs in middle school that stabilize in high school for several variables. Participants (*N* = 1,323) in three cohorts were followed across four time points (1995, 1996, 1997, and 1998), with grades seven through 11 represented by between 459 and 1,323 students. Using an expanded assessment of expectancy and value beliefs, surveys included utility value, intrinsic value, self-perceived talent, success expectancies, difficulty, and effort required, with the trajectories of each variable analyzed separately. Math intrinsic value, English intrinsic value, and English utility value all declined until ninth grade before largely stabilizing. Conversely, math utility value followed an accelerating negative trajectory. While math intrinsic value, English intrinsic value, and English utility value exhibited gender differences in stereotype-consistent directions, no such gender differences were present for math utility value. Math talent, English talent, and English success expectancies declined more consistently, while math success expectancies were also stable. Differences favoring men were present in math competence beliefs, but not for English.

Again, declining math utility value was seen in a Canadian study of 1,130 participants from 18 secondary schools (Chouinard & Roy, 2008). This project included two cohorts beginning in grades seven (*n* = 704) and nine (*n* = 625) and followed for three years, in total representing grades seven through eleven with both cohorts assessed in grade nine. Math utility value declined steadily, with a nonsignificant gender difference favoring girls and the negative trend steeper for boys. However, in a result different from each of the previous studies, math competence beliefs did not decline for girls. A significant trend was found only for boys, who began seventh grade with higher competence beliefs then girls but converged in eleventh grade.

Further supporting the pattern of declining math utility value was an analysis of 288 young adolescents in the Wisconsin Study of Families and Work (Petersen & Hyde, 2017), although this study did not include high school. Math ability beliefs, utility value, and interest were assessed longitudinally for all participants in fifth, seventh, and ninth grades. All three variables followed a significant negative trend, with a gender difference found only in initial levels of ability beliefs. Notably, this study reported that the slope parameters of all three analyses had significant variance, demonstrating that not all participants followed similar trajectories. Another result showing that developmental trends differ substantially between individuals was the finding that higher initial levels in both self-concept beliefs and interest were related to steeper declines. This study went on to predict math achievement scores from these developmental trajectories, indicating that self-concept beliefs predicted achievement even after controlling for earlier test scores, while utility and interest did not.

A further demonstration of different developmental trends between value subcomponents can be seen in a German cross-sectional study of 830 students from grades five to 12 ($n = 77$ to 117 per grade; Gaspard, Hafner, Parrisius, Trautwein, & Nagengast, 2018). As part of a project to create an expanded assessment of expectancy and value beliefs, participants completed this novel measure in relation to the academic subjects of German, English, math, biology, and physics. This measure, consisting of 37 items per subject, divides each value subcomponent into several facets. Intrinsic value was expanded to “intrinsic value” assessed with four items (e.g. “[subject] is fun to me”), “importance of achievement” with four items (e.g. “It is important to me to be good at [subject]”), and “personal importance” with four items (e.g. “I care a lot about remembering the things we learn in [subject]”). Utility value is expanded to “utility for daily life” assessed with three items (e.g. “What we learn in [subject] is directly applicable to everyday life”), “utility for job” with four items (e.g. “A good knowledge of [subject] will help me in my future job”), “utility for school” with four items (e.g. “Being good at [subject] pays off because it is simply needed at school”), and “social utility” with two items (e.g. “If I know a lot in [subject], I will leave a good impression on my classmate”). Finally, “effort and emotional cost” is measured with eight items (e.g. “Learning [subject] exhausts me”) and “opportunity cost” with three items (e.g. “I have to give up a lot to do well in [subject]”). Developmental trends were estimated from the cross-sectional data separately for each facet in each subject.

In apparent trends across facets, value expressed for each subject declined before the high school years but then stabilized in several subjects. Biology and English did not display substantial declines after ninth grade, German value declined during high school only for men, and math and physics value declined during high school only for women. However, facets often followed different trajectories. For example, intrinsic value facets often declined more than utility for job, utility for school, and social utility. Further, in the case of math, utility for daily life declined steeply while utility for school remained stable. Gender differences were evident in all subjects during the high school grades, favoring women in English, and German, and men in math. Importantly, in a replication of much previous research (Miller, Blessing, & Schwartz, 2006), gender differences in value beliefs favored men in physics yet favored women in biology. Finally, this research also reported the ordering of subject preferences for each value facet. Often, English was the favorite subject, followed by math, then German, then biology, then physics as the least favorite. However, intrinsic value levels were high for biology, placing it as the second favorite for that facet.

**Other Longitudinal Studies of Academic Value Belief in a Single Domain**

The next group of studies also examined longitudinal trajectories of academic value beliefs or interest, but did not use measures based on Expectancy-Value Theory.

In a large-scale study (Ma & Cartwright, 2003), data from the Longitudinal Study of American Youth (LSAY) was used to analyze math “utility” (four items; e.g. “I will use math in many ways as an adult”), math “anxiety” (two items; e.g. “Doing math often makes me nervous or upset”), and math “attitudes” (four items; e.g. “I am good at math,” “I like math,” and “I enjoy my math class”). Note that this “attitudes” measure combines items similar to both self-concept of ability and intrinsic value in Expectancy-Value Theory, due to the fact that they factored together in this analysis. The LSAY project began data collection in 1987 from a nationwide probability sample of public middle and high schools, with the younger cohort consisting of 60 seventh graders randomly selected from the each of 52 chosen middle schools. These seventh-grade students were assessed annually for six years, and therefore each grade seven through 12 is represented in this data by between 3,117 (seventh grade) and 2,215 (twelfth grade) students in the same cohort. For all students, attitudes towards and utility of mathematics declined significantly over time, while anxiety increased significantly. Gender differences were present for math attitude in initial levels but not rate of decline, genders were initially similar in anxiety with women increasing faster, and no gender differences were found for utility. The variance of all latent slopes was nonsignificant, indicating that these trajectories were fairly uniform across participants in the study. However, initial levels and slopes were significantly correlated for all variables, showing that students lower in initial anxiety increased faster, and that students with higher initial utility beliefs and attitudes decreased less.

This study also examined these variables by Racial/Ethnic groups (Black/African American, Asian/Asian American, Hispanic/Latinx, Native, and White/Caucasian) and school-level socioeconomic status. Black/African American students declined in math attitude significantly less than did White/Caucasian students, an effect that was stronger among males than females. Similarly, Black/African American students declined less than White/Caucasian students in attitudes. In addition, Asian/Asian American males declined in these beliefs less than

White/Caucasian males. Socioeconomic status was aggregated at the school level, and operationalized as a composite of parent-reported educational attainment and student-reported household possessions. SES was related to attitudes for men but not women, with men at low-SES schools declining significantly more than at high-SES schools. For anxiety, all students at low-SES schools increased more than students at high-SES schools.

A longitudinal study (*N* = 402) in the northeastern U.S. analyzed general academic interest (e.g. “How interested are you in [subject]?”), after concluding that the individual subjects of reading, writing, language arts, math, and science formed a single factor (Dotterer, McHale, & Crouter, 2009). This study included nine time points with several cohorts, such that ages seven through 18 were represented in the data. A significant decline was evident in general academic interest over time, as well as a significant quadratic component representing a flattening of this decline around 14 and rebounding at ages 16 through 18. Intercept values did not vary significantly between participants, but significant variance was found between participants in trends over time. Boys and girls reported similar initial levels of academic interest, but boys showed a more rapid decline than girls and maintained lower levels of interest than girls throughout high school. Socioeconomic status was also included as measured by parental educational attainment, with higher fathers’ education associated with less steep declines.

The Fullerton Longitudinal Study in California (Gottfried, Fleming, & Gottfried, 2001) has led to several longitudinal analyses of academic value beliefs. This project began in 1979 with 130 one-year-old children, who were then assessed every six months before school age, every year while in grade school, and with several follow-up surveys administered in adulthood. At ages nine, 10, 13, 16, and 17, students (*N* = 114) completed the “Children's Academic Intrinsic Motivation Inventory” which incorporates enjoyment of learning, curiosity, persistence, and desire for mastery. This questionnaire includes the subjects of math, science, social studies (“history” in high school), reading (“English” in high school), as well as “school in general,” with 26 items for each subject. In an analysis of this data relating to all five domains, intrinsic motivation in social studies/history remained stable, while all other subscales declined from ages nine to 16 then remaining stable at age 17 (Gottfried, Fleming, & Gottfried, 2001). No differences by gender or socioeconomic status were evident. Two other analyses of this dataset go on to link these trajectories with predictors and outcomes, demonstrating that positive parent behaviors can buffer declines in math and science (Gottfried, Marcoulides, Gottfried, & Oliver, 2009) and that greater declines in math intrinsic motivation predict taking fewer courses in high school as well as fewer years of educational attainment at age 29 (Gottfried, Marcoulides, Gottfried, & Oliver, 2013). Another analysis of this dataset, discussed below, reported that math, reading, and science all displayed significant variance in rate of change, again showing that not all individual participants are well characterized by the overall trend (Marcoulides, Gottfried, Gottfried, & Oliver, 2008).

The Project for the Analysis of Learning and Achievement in Mathematics (PALMA) in Germany represents a large longitudinal dataset ($N$ = 3,193), with five annual waves of data collection between grades five and nine including schools in all three tracks (vocational, college preparatory, and intermediate) of the German school system (Frenzel, Goetz, Pekrun, & Watt, 2010). The motivation assessment was the “Questionnaire for Study Interest,” with six items related to being “interested” in, “curious” and “exited” about, and “liking” working on math. Significant decline was found in math interest that leveled out towards ninth grade, with significant variance in intercept but not slope. Boys had higher intercept but no difference in slope. The vocational school track, which is related to lower parent socioeconomic status, showed less of a decline than the other tracks. However, this study did not include high school ages.

In Korea, the Korea Education Longitudinal Study (KELS) includes five waves of data from the same nationally representative cohort of students ($N$ = 5,545) between seventh and 11th grade (Lee & Kim, 2014). Intrinsic motivation was assessed in English and math, using a three item scale relating to amount of engagement with, importance placed on, and interest in the subject. While intrinsic motivation in English declined only in middle school and then rebounded in high school, intrinsic motivation in math followed a continuous negative trend. Girls expressed a higher level of intrinsic motivation English than did boys in ninth grade, and these value beliefs declined more slowly and rebounded faster than did boys'. In math, boys showed higher intrinsic motivation in ninth grade, with faster declines in middle school than girls and no differences in rate of change during high school. Attending an elite school generally related to higher intrinsic motivation in both subjects, while attending a vocational school generally related to lower intrinsic motivation in both subjects.

Finally, a recent meta-analysis was conducted for the variables of self-esteem, self-efficacy, mastery goals, performance-avoidance goals, performance-approach goals, self-concept, and intrinsic motivation between first and twelfth grade, including 107 separate studies (Scherrer & Preckel, 2019). Most of these studies included only two time points in order to conduct cross-lagged analyses. Results showed that self-esteem, general academic self-concept, self-efficacy, and performance avoidance goals did not change over time. However, all other variables followed a significant negative trend, including math self-concept (22 studies), language self-concept (12 studies), general academic intrinsic motivation (19 studies), math intrinsic motivation (16 studies), and language intrinsic motivation (12 studies). Unlike several studies mentioned above, this analysis did not find evidence that these trends leveled off or rebounded at later ages. Follow-up analyses indicated that results were not related to year of publication, and that no publication bias was evident.

**Summary**

In the research reviewed above, patterns of declining value differ substantially based on subject, gender, achievement, and value subcomponent or facet. Several analyses in fact demonstrated that value decreased during the middle school years yet remained stable or even improved during high school. Although declines were apparent more frequently during the high school years in math (Lee & Kim, 2014; Ma & Cartwright, 2003; Scherrer & Preckel, 2019), this result was less common in relation to language arts (Archambault et al., 2010; Gaspard et al., 2017; Lee & Kim, 2014; Watt, 2004). For science, declines were evident in one study for the subject generally (Gottfried et al., 2001), and by another study for physics but not biology (Gaspard, et al., 2017). One analysis included social studies, in which a decline was not apparent (Gottfried et al., 2001). In relation to gender comparisons, differences favoring women were usually identified in language (Jacobs et al., 2002; Lee & Kim, 2014; Watt, 2004), but no differences were present in about half of these analyses for at least one value subcomponent in math (Fredricks & Eccles, 2002; Gottfried et al., 2001; Ma & Cartwright, 2003; Watt, 2004). For science, one study found a difference favoring women in biology yet favoring men in physics (Gaspard et al., 2017), and the analysis of social studies value observed no difference (Gottfried et al., 2001). Finally, several of the above analyses reported that significant levels of variance were present in trajectory parameters (Dotterer, McHale, & Crouter, 2009; Petersen & Hyde, 2017; Marcoulides, Gottfried, Gottfried, & Oliver, 2008) demonstrating that students differ considerably in patterns of motivational beliefs over time. Due to these considerations, the use of exploratory analyses that divide participants into subgroups based on shared patterns has been recently expanding and will be described in further detail below.

## Longitudinal Analyses of Subgroups in a Single Domain

The studies described next are examples of analyses that use the Growth Mixture Modeling (GMM) technique, as the present study does, to identify common patterns of value belief trajectories while focusing on a single academic domain.

One study using the CAB data focused on literacy and included both self-concept of ability and value, using 655 total participants (Cohort 1, $n = 215$; Cohort 2, $n = 232$; Cohort 3, $n = 208$) from five waves of the study such that each grade one through 10 as well as grade 12 was represented by between 208 and 440 participants (Archambault, Eccles, & Vida, 2010). In the survey assessment, the items referred to "reading" in earlier grades and "English" in older grades and all value items were combined into a single construct. The mixture modeling analysis, which included both self-concept of ability and value simultaneously, resulted in seven subgroups. In order of size, these groups consisted of "Constant decline" (28%), "Moderate" (20%), "Late decline" (13%), "Transitory decline" (18%), "High" (10%), "Early decline" (8%), and "Low," (2%). All groups except "Moderate," in which self-concept was stable yet value declined, showed trajectories of self-concept of ability and value that were quite similar to each other. Overall, all groups exhibited declining value beliefs from elementary through middle school. However, when focusing on high school ages only, only 42% of students belonged to a group with substantial declines, while 20% belonged to a group with stable value beliefs and 28% belonged to a group that demonstrated improvement. These results are consistent with the previously discussed variable-centered analysis of literacy motivation using this data, which found a stable trajectory for males and a rebound for females (Jacobs et al., 2002). In the GMM study, women were significantly overrepresented in the “High” and “Constant decline” groups and underrepresented in the “Transitory decline,” “Early decline,” “Late decline,” and “Low” groups. In addition, children from lower-income families were more likely to belong to groups with greater motivational declines.

Another application of growth mixture modeling to the CAB dataset analyzed math self-concept of ability, intrinsic value, and importance (Musu-Gillette, Wigfield, Harring, & Eccles, 2015). One out of the three cohorts was included ($N$ = 421), in order to make use of an additional survey wave that a subset of this cohort completed in their second year of college ($N$ = 129). Therefore, math self-concept and value beliefs were available from grades four, five, six, 10, 11, and 12, as well as college. Unlike the previous analysis, this study did not include more than one variable in the models simultaneously. Instead, a separate GMM model was used for each variable individually.

For self-concept of ability, three groups were identified consisting of “High” trajectory (39%), “Slow decline” (39%), and “Fast decline (22%). Participants belonging to the high trajectory were more likely to report having a math-intensive major on the college survey. For intrinsic value, three equivalent groups were evident: “High” (40%), “Fast decline” (38%), and “Slow decline” (22%). Again, participants in the “High” group of participants were more likely to have a math intensive major. Three groups were found again for importance/utility value: “Slow decline” (49%), “Low stable” (39%), and “Fast decline” (13%). Individuals in the “Slow decline” group were most likely to have a STEM major. When focusing on the high school years only, this analysis does not support a pattern of decline for interest. On this measure, 22% of participants belonged to a group with largely stable value beliefs, 38% belonged to a group showing a decline, and 40% belonged to a group that improved during high school. However, a majority of students belonged to a group with a negative trajectory for importance (52%) while the rest of the participants remained stable (48%). Surprisingly, these results are the reverse of the pattern found in the variable-centered analysis of the same data mentioned above (Fredricks & Eccles, 2002), in which an improvement was seen in math importance during high school and a decline in intrinsic value. In another outcome that contradicts this previous study, no differences in math value were apparent based on gender. These inconsistencies may be due to the fact that the two analyses used different subsets of participants. In further unexpected results, group membership was not predicted by either parent income or elementary school math achievement.

The third study using the GMM approach to examine a single academic domain concentrated on science (Wang, Chow, Degol, & Eccles, 2017), using several waves of the CAB dataset that included value items referring to “physics and chemistry” together. This analysis included three waves of data collection, such that grades seven through 12 were each represented by between 197 and 502 participants (total $N$ = 699). In results similar to the literacy study described previously (Archambault, Eccles, & Vida, 2010), value and self-concept of ability were both incorporated simultaneously in the GMM model, seven groups were identified, and the trajectories of value and self-concept closely resembled each other in all groups. In order of size, the groups consisted of “Stable moderate” (36%), “Stable high” (27%), “Steady decreasing” (16%), “Transitory decreasing” (7%), “Sharp decreasing” (5%), “Transitory increasing” (5%), and “Increasing” (4%). With respect to the high school grades only, 10% of participants belonged to a group with declining value during this period, 11% belonged to a group with increasing value, and 78% exhibited largely stable trends.

While neither the effects of gender nor SES were tested in the model, when reported as correlations males expressed significantly higher value beliefs than females in ninth through 12th grade but not earlier. Family income was positively correlated with value beliefs in 11th and 12th grades only. Further, this study found that after controlling for gender, parent income, and elementary school science grades, group membership predicted several outcomes. Average course grades in 10th, 11th, and 12th grades, number of AP physics and chemistry courses taken in high school, and STEM career aspirations differed significantly between groups, with “Stable high” being highest on all the outcomes.

## Person-Centered Research and Domain Comparisons

Although the studies described above have focused on only one academic domain, many scholars of motivation and interest agree that within-person hierarchies, rankings, or comparisons of available options are critical to decision-making (Krapp, 2007; Marsh et al., 2005; Wigfield & Eccles, 1992). Researchers have therefore called for additional analyses of the role of domain comparisons within individuals (Eccles, 1994) and the multidimensional nature of motivation (Archambault et al., 2010). The value of these person-centered techniques is demonstrated by analyses that offer contrasting implications to the results of variable-centered approaches. For example, Eccles and colleagues found that women's aspirations toward science careers were strongly predicted by the absence of a competing interest, the desire to go into human service careers (Jozefowicz et al., 1993). Therefore, simply knowing the value that a person places on one option is “necessary, but not sufficient” to predict choice (Eccles, 1994, p. 599).

Several studies of gender differences in motivational beliefs have also observed that examining patterns of beliefs across multiple domains can result in different implications than focusing on one domain at a time. For example, in a cluster analysis of a 10th grade sample of American students, boys were more likely to belong to subgroups that valued math and science more highly than English, although no overall correlation between gender and math value was present in the data (Chow & Eccles, 2012). Similarly, an analysis of PISA data across 29 countries demonstrated that although males and females across countries generally performed similarly on the science test and reported placing equal importance on doing well in STEM domains, girls placed higher importance on literacy than STEM while boys placed more equal value on both domains (Jerrim, 2005). A corresponding pattern was found in self-concept for math, with gender differences not apparent in math self-concept but girls displaying higher self-concept in reading (Eccles & Harold, 1992). In fact, after one cluster analysis of achievement goals revealed subgroups that had not been identified using variable-centered methods, Meece and Holt (1993) argued that "results based on linear methods of analysis may be incomplete and possibly misleading" (p. 589).

**Domain Comparisons at One Time Point**

The studies described next used person-centered analyses to identify patterns of value beliefs across several academic domains simultaneously, while considering a single time point.

A Finnish sample of 9th grade students in the Kuopio School Transition study ($N$ = 614) was included in a latent class analysis based on value for Finnish language, social sciences, "practical and art subjects" (e.g. music and physical education), math, science, and foreign languages (Viljaranta, Nurmi, Aunola, & Salmela-Aro, 2009). The authors found that students fell into six clusters, consisting of groups with high value for all topics (38%), low value in all topics (6%), high value on practical subjects and art as well as foreign language (18%), high value on math and science only (15%), high value on social sciences and Finnish language only

(14%), and high value on art and practical subjects only (10%). Girls were overrepresented in the high motivation group as well as the practical subjects and language group, while boys were overrepresented in the low motivation group, the practical skills group, and the math and science group. The authors then linked group membership with prestige level of career aspirations, determining that the groups with low value across subjects and with value only for practical skills and art aspired to careers with lower prestige than the other three groups.

Another study observing that the largest subgroup of students reported high value in all academic domains (Chow & Salmela-Aro, 2011) included Finnish ninth grade students (*N* = 638). This analysis assessed task value for languages, math and science combined, social sciences (including history and social studies), and practical subjects (such as music and physical education). The "all subjects" group (55%) had high value in every subject, especially in language, the "practical subjects" group (6%) favored practical subjects only, the "high math and science" (20%) group had moderate value in all domains with a small but significant preference for math and science, and the "low math and science" (19%) group preferred language and practical subjects, followed by social sciences with math/science as the least favorite. Boys were overrepresented in the "high math and science" group and "practical subjects" group, girls were overrepresented in the "low math and science" group, and finally the "all subjects" group had an even gender distribution. The "high math and science" group reported the highest educational aspirations.

A sample of 10th grade participants from the CAB dataset (*N* = 249) was compared with 11th grade students (*N* = 351) from the Finnish Educational Transition (FinEdu) study in an analysis that examined value beliefs in STEM and non-STEM domains (Chow, Eccles, & Salmela-Aro, 2012). "High math and science" groups were identified in both populations (U.S. =

42%, Finland = 20%), as well as “low math and science” groups (U.S. = 15%, Finland = 26%). A third cluster in the U.S. sample was labeled “moderately low math and science” (44%), and a third “no preference” cluster was found in the Finnish sample (54%). As noted above, although gender and math value were not significantly correlated overall, boys were more likely to belong to subgroups that valued math and science more than English. Cluster membership predicted aspirations towards careers in physical science or Information Technology one to two years later, partially mediating the relationship between these aspirations and gender.

**Domain Comparisons Over Time**

Although these analyses have made significant progress toward the understanding of within-person profiles of value beliefs at single time points, researchers have also called for the investigation of these within person patterns as they develop over time (Archambault et al 2010; Schurtz, Pfost, Nagengast, & Artelt, 2014). Several existing studies in fact demonstrate that apparent patterns of falling motivation can conceal sustained or increased motivation that is only discovered by examining a broader range of content. For example, one study suggested that while interest in biology declines overall among high school girls, this drop is driven by decreasing interest in zoology and botany while interest in human biology and ecology instead increases (Todt, Arbinger, Seitz, & Wildgrube, 1974). In another set of studies focusing on girls' interest in science, interest in the overarching subject of physics declined from fifth to 10th grade but interest in applications of physics to human biology, medicine, and the environment was stable or increased (Hoffmann, Lehrke, & Todt, 1985; Haußler, 1987; Lie & Bryhni, 1983; Todt & Händel, 1988; Whyte, 1986). A qualitative investigation into trajectories of interest development in a vocational training program similarly found that declining interest in the program as a whole belied the fact that participants developed stronger interests over time in specific aspects of the material (Krapp & Lewalter, 2001). The studies described below include examples of research that addresses these concerns by examining multiple academic domains as well as multiple time points.

A U.S. study that considered within-person patterns of subject area value longitudinally made use of the Fullerton Longitudinal Survey, which has been mentioned above (Marcoulides, Gottfried, Gottfried, & Oliver, 2008). Intrinsic motivation for the domains of reading, math, science, and school in general were used to create latent classes across the five longitudinal time points (ages nine, 10, 13, 16, and 17). Three classes were apparent without apparent differentiation in value between subjects, consisting of the “Gifted,” “Intermediate,” and “At-risk” groups. Membership in the “Gifted” class decreased dramatically between ages nine (57%) and 17 (19%), while membership in the “Intermediate” class increased considerably (7% to 59%) and membership in the “At-risk” decreased slightly (36% to 22%). The decline in proportion of students with high levels of motivation is consistent with the variable-centered analyses of this dataset mentioned above. However, this analysis technique identified a substantial group of “At-risk” students in younger ages, when average levels of value beliefs were high. The authors went on to assess movement between these different classes over time in a latent transition analysis (LTA), finding that movement between groups was much more common at earlier ages but stabilized after age 13.

Using two time points, a Finnish study of 231 seventh graders and 237 ninth graders (Lazarides, Viljaranta, Aunola, Pesu, & Nurmi, 2016) included both task values and self-concept across mathematics, Finnish language, and art. The “high motivation” cluster consisted of 30% of participants in grade seven and 25% in grade nine, with consistently high scores in task value and self-concept in all three domains. The “math motivated” group represented 38% of participants in grade seven and 39% in grade nine, while the “low motivation” group represented 9% of participants in grade seven and 6% in grade nine. Finally, the “practical” group reported value and self-concept above the mean in art only, representing 26% of participants in both grades. Boys were overrepresented in the math-motivated group and underrepresented in the high motivation group, with inverse results for girls. Cluster membership was linked with educational aspirations, such that students in the “high motivation” and “math motivation” groups displayed higher aspirations.

A Finnish study that included three time points over the span of one year (Aunola, Selänne, Selänne, & Ryba, 2018) assessed intrinsic value, utility value, and attainment value for school and sports among 15 to 16 year-old student athletes ($N = 391$). All six variables were included in the cluster analysis, finding three groups. The “dual motivated” group with high value for both was 62% of participants at the first time point, decreasing to 47% of participants at the final time point. The “low academically motivated group” was 25% of participants at the first time point, increasing to 30% at the last time point. Finally, the “relatively low sport motivated” indicated value below the mean on all measures but particularly in sports, representing 13% of participants at the first time point and 23% at the last time point. Boys were over-represented and girls under-represented in the “low academically motivated” group. Cluster membership was largely stable over the three time points, and was linked with future aspirations such that the “low academically motivated group” reported lower educational aspirations and the “relatively low sport motivated” group was less likely to aspire to a sports career.

An analysis that observed similar profiles among participants in several countries included adolescents in Finland ($N$ = 699, grades 9-11, three time points), Australia ($N$ = 457, grades 9–11, three time points), Germany ($N$ = 424, grades 11-13, three time points), and the

United States (*N* = 432, grades 10-12, two time points; Viljaranta et al., 2018). Measures for interest, attainment and utility values in mathematics and language were all included in a latent class analysis for each sample. Common patterns across all time points were identified using the I-States as Objects (ISOA) approach, in which the latent class analysis is applied to data from all time points simultaneously. Across all four populations, the analysis found that three profiles consistently emerged: students reported either higher values for math than language arts, higher values for language arts than math, or similar value for both subjects. The undifferentiated class represented low values on all variables in Australia and Finland, and high values on all variables in Germany and the United States. Specifically, in the Australian sample, 29% of participants fell into a cluster with low value on all variables, 45% fell into a math preference cluster, and 26% into an English preference cluster. In the Finnish sample, a group with uniformly low value represented 30% of participants, the math preference group represented 25% of the participants, and the Finnish preference group represented 45% of the participants. For the German sample, the undifferentiated high group consisted of 38% of participants, the math preference group 23% of participants, and the English preference group 39% of participants. Finally, in the United States sample, 26% of participants were classified in the group with undifferentiated high value, 30% in the math preference class, and 44% in the English preference class.

When class membership was analyzed by gender, in a finding similar to previous research, men tended to be overrepresented in the math-specific value clusters and women overrepresented in the language-specific value cluster. In addition, more women were present in the clusters with uniformly high value and more men present in the uniformly low value clusters. Finally, the longitudinal analysis of the data determined that cluster membership remained extremely stable over time, with no statistically significant patterns of group transitions observed between any time point.

**Growth Mixture Modeling Studies**

Finally, two studies have recently been completed that are quite close to the present analysis in using GMM to compare EVT value beliefs across academic domains and over time.

The first of these studies used a Finnish sample (*N* = 849) from the Finnish Educational Transition Studies (FinEdu) with three longitudinal waves from the same cohort, at grades nine, 10, and 11 (Guo, Wang, Ketonen, Eccles, & Salmela-Aro, 2018). A three-item value measure based on the original EVT scale included questions about how interesting, important, and useful subject areas were in reference to Finnish, math/science combined, and social studies (called “social subjects” by the authors, including history and civics). In a method unique corresponding to the present analysis, the authors compared a variable-centered approach and a person-centered approach by first completing a latent curve analysis and then using the GMM method. In the latent curve analysis, results indicated that value beliefs in math and science decreased significantly while Finnish and social studies remained stable. The intercepts of all subjects were positively correlated, reflecting the pattern that students usually report similar levels of value and follow similar trajectories across all subjects. However, the participants differed from each other in these trajectories, as demonstrated by the fact that variance in the intercept and slope parameters for all subjects were significant. The order of preference (intercepts) was Finnish, then math/science, then social subjects.

In the next stage of the analysis, the GMM model resulted in three classes. The “High but decreasing all subjects” was the largest with 48% of participants, with small but significant negative slopes in all subjects. The “Low but increasing math and science” group consisted of

33% of participants, with only a significant positive slope in math/science. The “High but increasing Finnish” was 19% of participants, with a positive Finnish slope, negative math/science slope, and stable social studies slope. In this group, Finnish was preferred to all other subjects. In total, 67% of participants belonged to a group with a negative trend in math/science, 48% belonged to a group with a negative trend in Finnish, and 48% belonged to a group with a negative trend in social studies. These proportions replicate the conclusion of the growth curve model that value beliefs declined significantly only in math/science.

A third stage of the analysis made use of two additional waves of data were collected four years after high school ($n$ = 577) and six years after high school ($n$ = 535) to assess STEM participation outcomes. Four years after high school, 21% of participants were working, and the survey included the question “What is your field of desired occupation?” At six years after high school, when 41% of participants were working, the survey question was “What is your professional field at the moment?” and if not working “What is your field of study at the moment ?” Aspirations and occupations were coded as either STEM or non-STEM. The authors then predicted each of these variables from GMM class membership. The results demonstrated that after including gender, standardized achievement test scores in Finnish and math from the end of high school, as well as SES as controls, class membership accounted for significant additional variance in both aspirations and participation. In addition, class membership partially mediated the effect of gender on these outcomes when added to the model. Further, class membership maintained a significant relationship with STEM outcomes even after controlling for initial task value in all three subjects. Therefore, this analysis is unique in demonstrating that within-person patterns of subject value predict behaviors above and beyond average levels of value beliefs.

Regarding gender differences, in the latent curve model women had a significantly higher intercept than men in Finnish and social subjects, a significantly lower intercept in math/science, and a significantly more negative slope than men in math/science. In the growth mixture model, men were overrepresented in the increasing math/science group, women were overrepresented in the increasing Finnish group, and genders were equally represented in the slightly declining group. Socioeconomic status, represented by a four-category measure of parent occupation at grade nine (unsalaried position, blue collar, lower white collar, and upper white collar), was included as a control variable. In correlations, SES was positively related to STEM aspirations and participation, but this relationship was no longer present in a regression that also included gender and test scores in math and language. While SES effects on group membership were not reported, in the latent curve model SES was not related to intercepts for any subject but showed a significant positive relationship with Finnish slope.

The second example of a GMM analysis that compared academic subjects used the CAB dataset ($N$ = 1,069) and included both self-concept and intrinsic value in math and reading/English from first through 12th grade (Gaspard, Lauermann, Wigfield, & Eccles, 2018). One GMM model was used for self-concept, and another for intrinsic value. Two groups were identified for self-concept, “Moderate math decline and high stable language arts” (72%) and “Moderate math decline and strong language arts decline” (28%). The intrinsic value analysis found three groups, “Strong math decline and language arts decline leveling off” (33%), “Moderate math decline and strong language arts decline” (36%), and “Stable math and language arts” (31%). Focusing on the high school years of these trajectories only, the total percentage of participants belonging to a class that declined in math intrinsic value was 69%, while 36% belonged to a class that declined in English value. When compared to the other GMM analysis mentioned above of reading/English value in the same dataset (Archamabault, Eccles, & Vida, 2010), these analyses identified similar proportions of students who declined in English value during high school (42% and 36%), remained stable (30% and 31%), and improved (33% and 28%).

The authors then examined demographic differences in group membership and used group membership to predict number of math courses taken in high school, STEM career aspirations in grade 12, and human service career aspirations in grade 12. For self-concept, women were overrepresented in the high language arts group, and members of this group had greater parental educational attainment, income, cognitive ability, and teacher-rated reading aptitude but not teacher-rated math aptitude. In outcomes, members of the language arts decline group took more math classes in high school, were more likely to aspire to a STEM job in 12th grade, and were less likely to aspire to a human service job in 12th grade. For intrinsic value, no differences were found based on parental educational attainment, family income, cognitive ability, or teacher-rated reading aptitude. However, the strong language arts decline group had greater teacher-rated math aptitude as well as a greater proportion of women. Women were overrepresented in the strong math decline group, and members of this group were less likely to take math courses or report a STEM career aspiration.

**Summary**

Across all studies described here that compare profiles of value or interest across academic domains (see Table 2-4 for a summary), such analyses commonly identify clusters with high STEM value, low STEM value (Chow et al., 2012, Nurmi and Aunola, 2005), high value for non-academic subjects (Chow and Salmela-Aro, 2011, Viljaranta et al., 2009), and high value for all subjects (Chow and Salmela-Aro, 2011, Nurmi and Aunola, 2005). Further, women are often overrepresented in clusters with lower STEM value relative to other domains (Chow et al., 2012, Nurmi and Aunola, 2005). In addition, this set of studies provides further support for stability in value during high school for social studies and language (Guo et al., 2017), as well as mixed support for declining value in science (Guo et al., 2017; Wang, Chow, et al., 2017).

## Specialization of Interests

Examining trajectories in motivational beliefs across multiple domains simultaneously allows the identification of students who may be specializing in interests, or declining in value for some domains while retaining a high level of value for a preferred domain. The application of person-centered techniques allows the investigation of this specialization of interests over the course of development. While specialization has been studied extensively in the fields of vocational interest (Hirschi, 2011) and self-concept beliefs (Marsh et al., 2014), the extent to which interests or other value constructs specialize has received less attention. Many motivation theorists agree that specialization of interests occurs, but do not agree on the potential outcomes. Focusing interest in only one domain could cause maladaptive reactions to failure and dramatic self-esteem fluctuations, but interest in an excessive number of pursuits could also prove harmful if motivation is too unfocused to promote goal pursuit in any area (Osborne & Jones, 2011). A few studies of the domain specificity have indirectly confirmed that such specialization occurs in finding that relationships between motivational belief in different domains begin to diverge with age. This trend has been demonstrated in expectancy and value beliefs (Denissen et al., 2007), interest, (Koller et al., 1998) and emotions towards academic domains (Goetz et al., 2007). In a study comparing the domain specificity of five different motivational constructs, high school students showed more domain specificity in their beliefs than middle school students for every construct (Bong, 2001).

**Specialization in Self-Concept Research**

The relationship between motivational beliefs in different academic domains has been extensively studied in the area of self-concept. In a manner similar to the theories about interest and value, children are hypothesized to start with high self-concept in all domains, leading to differentiation as they realize their actual strengths and weaknesses (Marsh & Craven, 1997; Marsh Ayotte 2003). Individuals also use intra-individual comparisons to focus more on areas they perceive as particular strengths. Marsh and his colleagues have proposed "Dimensional Comparison Theory," which proposes that individuals adjust their self-concept beliefs in a target domain after considering their own performance in other similar and dissimilar domains. Therefore, areas of self-concept viewed as unrelated will diverge while areas of self-concept perceived as related will converge (Marsh & Ayotte, 2003; Niepel Brunner Precker 2014). For example, "people think of themselves as either 'math' persons or 'verbal' persons—but not both" (Marsh & Hau, 2004, p. 57).

A series of large-scale studies have confirmed that the competence beliefs about the domains of math and reading become less correlated with age, while competence beliefs in related domains such as primary language and foreign language become more correlated with age. This effect has been replicated between second grade to sixth grade (Marsh & Ayotte, 2003), between second to fifth grade (Marsh et al, 1984), and more recently between seventh and 10th grade as well as eighth and ninth grade (Marsh et al 2015). Longitudinal studies have also supported this model (Möller et al., 2011). While self-concept theories have long proposed that beliefs will tend to specialize as self-concept drops in some domains due to social comparison and failure experiences, this is the first theory to propose that increasing specialization in self-concept over the course of development is a normative process. This contention is supported by a diary study finding that individuals regularly compare their performance in different domains, for example to improve their mood following failure (Möller & Husemann, 2006).

Given the fact that changes in value are hypothesized by many researchers to follow from changes in self-concept, the processes of self-concept development described by Dimensional Comparison Theory could also drive specialization in value beliefs or interests across academic domains (Schiefele, 2009; Wigfield & Cambria, 2010). Theories of self-esteem propose that areas in which individuals do not feel successful are subsequently devalued (Covington, 1992, 1998; Eccles et al., 1998; Harter, 1982). Similarly, Expectancy-Value Theory suggests that high attainment value will likely be placed in domains with high self-concept to promote self-worth, and that success and failure experiences will influence intrinsic value (Eccles and Wigfield 1995). Social Cognitive Career Theory also proposes that career interests develop as a consequence of career self-efficacy (Lent et al., 1994; Lent, Brown, & Hackett, 1996). These hypotheses have been confirmed by correlational as well as cross-lagged analyses showing that self-concept or efficacy beliefs influence subsequent interest or value both in motivational research (Denissen, Zarrett, & Eccles 2007; Archamabault et al 2010) and in vocational research (Lent et al., 1994; Tracey, 2002; Hartung, Porfeli, & Vondracek, 2005).

Investigations into the cross-domain influences in value beliefs are less common, leading several researchers to call for additional study on this topic (Fredricks & Eccles 2002; Wigfield, Tonks, & Klauda, 2009). Marsh and colleagues have recently incorporated interest into their model, suggesting that dimensional comparisons of achievement would drive a similar process of specialization of interests (Daniels, 2008; Schurtz, Pfost, Nagengast, & Artelt, 2014). Confirming their model, they have found evidence that grades in one domain relate negatively to intrinsic value in unrelated domains (E. M. Skaalvik & Rankin, 1995; S. Skaalvik & Skaalvik, 2005; Gniewosz, Eccles, Noack, 2014). Additional research on the topic of cross-domain effects on value beliefs is currently expanding. For example, a recent German study of self-concept of ability, utility value, intrinsic value, and career aspirations in math and language arts among ninth and 10th graders indicated moderate support for dimensional comparisons (Lazarides & Rubach, 2018). In this study, utility value in language arts negatively predicted career aspirations in math, and likewise career aspirations in language arts negatively predicted intrinsic value in math. However, another German study of younger students in grades two through four did not observe significant cross-domain effects between math and language in self-concept or achievement (Weidinger, Steinmayr, & Spinath, 2018). Researchers have called for further study of task values, as well as additional longitudinal studies to complement the many cross-sectional studies that have been done in this area (Niepel, Brunner, & Precker, 2014).

**Specialization in Vocational Research**

The influence of interest specialization has also received extensive attention in the field of vocational interests. Holland's theory of vocational interests (1985), the most widely studied vocational theory in recent decades and the most widely used in current career counseling, includes specific hypotheses about specialization (Nauta, 2010). This approach proposes a taxonomy of six work “interests” that describe an individual's preferred type of work tasks. For example, a “Realistic” interest reflects a preference for the manipulation of physical objects, an “Investigative” interest a preference for manipulating data or ideas, an “Enterprising” interest an aspiration for leadership positions, an “Artistic” interest a desire for creative pursuits, a “Social” interest a desire for direct interpersonal interaction, and a “Conventional” interest an affinity for organizing and maintaining orderly routines (Holland, 1985; 1997). Based on the names of the interests, this theory is also referred to as the “RIASEC” model. Holland proposed that “differentiation,” or the degree of difference between the most preferred and least preferred interest, could be used as a “secondary construct” indicating the level of career identity “crystallization” (Holland, 1985; 1997). Holland and a range of other career development researchers agreed that career interests should become more differentiated or specialized as adolescents matured psychologically (Tracey, 2002). Indeed, RIASEC interests are uniformly high until middle school, after which some of the six interests begin to decline (Tracey, 2002). “Differentiation” as specified in Holland's theory increases from elementary school to adulthood (Hirschi, 2009; Hartung, Porfeli, & Vondracek, 2005).

Some vocational theorists considered greater differentiation of interests to be adaptive, reflecting greater confidence in one's preferences and promoting “directional choice with minimal conflict or vacillation” (Holland, 1959, p. 39) as well as career stability (Hirschi 2011; Osipow, 1999). However, a more recent theoretical viewpoint argues that low differentiation can instead represent an adaptive sign of “multipotentiality” (Hirschi, 2009, p. 385) rather than confusion and indecision. In this view, major occupational and educational choices that are made without adequate prior exploration create the risk that these choices will no longer match an individual's preferences after they have considered them more fully (Balistreri, Busch-Rossnagel, & Geisinger, 1995; Chen, Sousa, & West, 2005; Marcia, 1980, 1993). Therefore, this approach argues the view that “being interested in many different fields makes identity commitment more difficult but might also prevent premature foreclosure” (Hirschi, 2011, p. 402).

Both perspectives have received varying support. High differentiation of RIASEC interests is associated with a range of outcomes that promote job satisfaction (Hirschi & Lage, 2007), including sense of work meaning and purposefulness (Ibarra & Barbulescu, 2010), work engagement (Luyckx, Duriez, Klimstra, & De Witte, 2010), and career-choice readiness (Hirschi

& Läge, 2007), leading some to conclude that "early differentiation of vocational preferences appears to be a long-term predictor of successful vocational development" (Vondracek & Skorikov, 1997, p. 337). However, other research in the field has failed to support Holland's hypothesis. Some studies have found no relationship between differentiation and positive outcomes such as psychological adjustment (Buboltz & Woller, 1998), career maturity (Miner, Osborne, & Jaeger, 1997), career indecision (Lowe, 1981), job stability, and supervisor's evaluation (Meir, Esformes, & Friedland, 1994). Overall, Holland's hypothesis about differentiation is regarded as having mixed support (Carson & Mowsesian, 1993).

Key to interpreting these conflicting results may be the interaction between differentiation and "elevation," another "secondary construct" of Holland's theory that consists of the average of all six interest scores. For example, individuals with undifferentiated and low interest had lower GPA as well as career choice readiness than individuals with undifferentiated but high levels of interest (Swanson & Hansen, 1986; Hirschi & Läge, 2007). Similarly, elevation moderated the relationship between interest-major congruence and GPA and persistence (Tracey & Robbins, 2006; Tracey 2012). Therefore, it has been proposed that while low and undifferentiated interest may be harmful, individuals with and high undifferentiated interest may be likely to thrive in greater variety of career settings than individuals with more specialized career preferences (Tracey & Robbins, 2006; Tracey 2012).

In summary, multiple perspectives in vocational theory agree that vocational interests specialize over time, and that degree of specialization may have an important role in the career decision-making process. However, despite the fact that academic domains are a primary organizing framework of beliefs in adolescence (Gottfried, 1985, 1990), specialization has been largely in this field studied in relation to RIASEC interests rather than interest in academic domains. Career aspirations begin to form in late childhood, and the influence of school experiences on these aspirations has been extensively demonstrated in motivational research (Eccles, Vida, & Barber, 2004; Wang, 2012) as well as vocational research (Skorikov & Vondracek, 2011). Therefore, the present study of specialization of interest in academic content areas could form a valuable link between motivational and vocational research.

## Career Identity

In order to assess adaptive career decision-making outcomes of academic interests and/or specialization, the present study includes measures of career commitment and exploration drawn from a modern framework of vocational identity status theory. Career decision-making has been studied using a wide variety of constructs, and identity status theory is a prominent contemporary approach. This conceptualization originated with Erik Erikson, who as part of his stage model of life span development stated that forming a sense of global identity was a critical developmental task of adolescence. As part of this stage, he referred to the importance of careers specifically, stating that "in general it is primarily the inability to settle on an occupational identity which disturbs young people" (Erikson, 1959, p. 92).Vocational identity has often been described since as a major component of global identity development (Super, 1963). Not only do adults retrospectively say that their choice of career was one of the most important parts of developing their identity (Kroger & Haslett, 1991), adolescents report the importance of finding a career to their identity cross-culturally (Kroger, 1993; Schulenberg, Bachman, Johnston, & O'Malley, 1994). Unfortunately, in many countries, adolescents are currently experiencing substantial challenges in selecting and committing to occupational choices (Fadjukoff, Pulkkinen, & Kokko, 2005; Skorikov, 2007). High school is a key developmental period for the study of such identity development processes due to the necessity of choices such as deciding on future education during this time (McWhirter, Rasheed, & Crothers, 2000).

More recently, James Marcia (1966) has expanded on two major themes in Erikson's original work, the processes of identity exploration and identity commitment. Identity exploration, corresponding to the role experimentation described by Erikson, must precede commitment or selection of a role in order to be psychologically adaptive. Marcia argued that exploration and commitment are independent processes specific to different aspects of identity, and that high or low levels of each create four qualitatively different "identity status" categories. Diffused status, corresponding with low levels of both variables, represents individuals who have not yet considered an area of their identity. Foreclosed status represents high levels of commitment without exploration, usually thought to indicate a role that has been selected prematurely on the basis of social pressure (Danielsen, Lorem, & Kroger, 2000). Moratorium status is indicated by high exploration and low commitment, reflecting a period of ongoing reflection on and reconsideration of identity roles. Finally, achieved status is represented by both high exploration and commitment (Marcia, 1966) and corresponds to Erikson's idea of adaptive "identity resolution". The proposed developmental progression of these stages begins at diffusion, the moves to either foreclosure or moratorium. If in moratorium, the individual may then move to achievement, and if in foreclosure the individual may move first to moratorium and then to achievement (Klimstra et al., 2010, Kroger et al., 2010).

The identity status approach has been further developed by more recent theorists, who have differentiated the ideas of exploration and commitment into subcomponents and developed surveys to assess these constructs rather than the semi-structured interviews used by Marcia. One recent approach has divided exploration into in-breadth and in-depth and commitment into commitment making and identification with commitment (Luyckx et al, 2008). When cluster analyses are performed on these variables, the authors find statuses they call Achieved, Foreclosed, Moratorium, Diffused diffusion, Carefree diffusion, and Undifferentiated. Similarly, another current research group has divided exploration into exploration and reconsideration of commitment (Crocetti, E., Rubini, M., Luyckx, K., & Meeus, 2008). These authors generally identify statuses they describe as Achieved, Foreclosed, Moratorium, Searching moratorium, and Diffused. Therefore, the major themes of exploration and commitment are still present, and the resulting identity statuses are fairly similar to those described by Marcia. The measure of career identity development used in the present study synthesizes both of these global identity theories and applies them to the vocational domain specifically (Porfeli, Lee, & Vondracek, 2011).

Recent research largely supports the proposal that greater levels of commitment and exploration are desirable. In adults, achieved vocational identity is associated with a range of positive mental health outcomes such as self-esteem and life satisfaction (Meeus et al., 1999, Skorikov & Vondracek, 2007) as well as greater engagement and lower burnout (Luyckx et al., 2010). In adolescents, greater exploration and commitment have been linked with persistence in pursuing an undergraduate degree (Krause, 1998), global identity formation (Kroger, 2007; Skorikov, 2007), higher grades and engagement in extracurricular activities (Vondracek, 1994), and fewer problem behaviors (Skorikov & Vondracek, 2007). While both exploration and commitment are generally considered to be adaptive processes, commitment is more strongly related to life satisfaction than exploration (Hirschi, 2011). For example, in several studies the achievement and foreclosure identity statuses are both associated with highest levels of well-being, followed by diffusion, with moratorium associated with the lowest levels (Crocetti et al., 2008; Luyckx et al., 2005).

However, contemporary research on the developmental sequence of the identity status stages has been more inconsistent. While adolescents tend to move from diffused to achieved during adolescence (Kroger, Martinussen, & Marcia, 2010), other studies find little change in identity status throughout middle and late adolescence (Kroger et al., 2010; Meeus, van de Schoot, Keijsers, Schwartz, & Branje, 2010). Compared to the other status categories, individuals with a foreclosed status are most likely to remain unchanged over time (Fadjukoff et al., 2005). When examined as individual constructs rather than combined into status categories, as in the present study, exploration and commitment are positively related (Porfeli et al., 2011) and generally increase from high school to college (Germeijs et al., 2006; Hirschi, 2011; Hirschi, Niles, and Akos, 2011). However, other recent research has suggested that these changes are small (Porfeli et al., 2011) or has found no changes (Hirschi, 2011).

**Career and Gender**

Gender differences may also exist in career identity commitment and exploration. Previous vocational research has found that female college students and adults demonstrate more differentiated RIASEC interests (Fouad & Mohler, 2004; Miner et al., 1997) and that adolescent young women are more advanced in occupational identity status (Klimstra et al., 2010, Goossens, 2001; Solomontos-Kountouri & Hurry, 2008). For example, men are more likely at any age to be in the less adaptive stages of moratorium or foreclosure while women are more likely to indicate identity achievement (Hirschi, 2011). This pattern may be due to the fact that women are more likely to anticipate future conflicts between occupational and family priorities, and therefore feel greater urgency to develop a clear idea of their work goals (Skorikov & Vondracek, 2011). This hypothesis is consistent with findings that men are more likely to focus on occupational goals as opposed to other areas of life (Barnett & Baruch, 1983).

**Career and SES**

Existing evidence relating career development to socioeconomic status has been mixed depending on the aspect of career choice assessed. Some research supports the view that with greater resources to draw from, higher SES adolescents show more advanced or adaptive career development on a number of measures. Higher SES college students have been found to perceive greater social support and fewer educational barriers, leading to greater career decision-making self-efficacy (Ali, McWhirter, & Chronister, 2005). Research on "Differential Status Identity" (DSI) examines self-reported access to economic resources, social prestige, and social power. Higher scores on this measure have also been linked with higher career decision self-efficacy (Thompson & Subich, 2006) and greater certainty about career decisions (Blustein et al., 2002). Higher SES adolescents may also be less likely to report a diffused identity status and engage in more career exploration (Solomontos-Kountouri & Hurry, 2008). However, other studies show no relationship between SES and career outcomes (Huang & Hseih, 2011; Rojewski, 1997), including commitment among high school students (Hirschi & Läge, 2007).

Conversely, some have found that higher SES adolescents and young adults in fact display less career maturity than lower SES peers. In one study, upper class university students displayed a longer moratorium period (Cote & Levine, 1997), supporting the idea that ability to rely on parental resources allows extension of the career decision-making process in some contexts (Berman, Schwartz, Kurtines, & Berman, 2001; Kidwell, Dunham, Bacho, Pastornio, Portes, 1995; Jones, 1992). Similarly, several studies comparing vocational track and university track high schools in Europe have observed that the vocational track students express greater career commitment yet lower levels of career exploration (Beyers & Goossens, 2008; Hirschi, 2011; Luyckx, Schwartz, Goossens, & Pollock, 2008).

**Career and Racial/Ethnic Identification**

In a manner similar to the proposed effects of SES on career identity, some have argued that additional barriers faced by students of color as compared to majority Racial/Ethnic group adolescents might interfere with career identity development (Constantine et al, 2002). In addition to experiences of discrimination and unequal treatment in schools (Chavous, Rivas-Drake, Smalls, Griffin, & Cogburn, 2008; Kearns, Ford, & Linney, 2005; Rosenbloom & Way, 2004), challenges to career development may include lack of accessible role models, institutional discrimination in the job exploration process (Kenny, Blustein, Chaves, Grossman, & Gallagher, 2003) as well as limited opportunities to develop career self-efficacy (Speight, Rosenthal, Jones, & Gastenveld, 1995). In addition to these obstacles, ethnic minority adolescents often navigate racial and ethnic identity development and career identity development simultaneously (Blustein, Juntunen, & Worthington, 2000; Constantine, Kindaichi, & Miville, 2007). For African American students, approaches such as the Culturally Relevant Career Development Model (Cheatham, 1990) emphasize the fact that greater value in the African American community on family and spirituality may also present a challenge to the career development process in clashing with dominant individualist and competitive work values (Sue & Sue, 2008).

Indeed, some research has demonstrated that greater perceived barriers are related to greater career indecision (Constantine, Wallace, & Kindaichi, 2005) as well as lower exploration and commitment (Ladany et al., 1997), and that racial and ethnic minorities perceive more barriers and fewer career opportunities than White individuals (Fouad & Byars-Winston, 2005). However, other work has found no difference by race in career development (Lundberg, Osborne, & Miner, 1997), including a meta-analysis failing to identify an effect of race on career aspirations, exploration, or decision-making self-efficacy (Fouad & Byars-Winston, 2005). Some evidence also suggests that African Americans may have more advanced career development in some contexts. For example, one study suggested that perceived racial discrimination was in fact positively related to career decision self-efficacy (Rollins & Valdez, 2001). In addition, several theorists argue that parent influence (Dillard & Campbell, 1981; Lee, 1984) and emphasis on familial and community goals such as affiliation, interdependence, and respect for elders (Cheatham, 1990; McWhirter, 1997) might be greater among African American than White youth. These contextual factors may provide support for the career commitment process.

## The Present Study

Given the links between academic value beliefs and academic and career outcomes, the conclusion that these beliefs decline steadily throughout middle and high school appears to imply a need for broad interventions or reforms targeting these age groups (Gaspard et al., 2015). However, recent large-scale and longitudinal studies often show stability or improvement in value beliefs for certain subjects during high school (see Table 2-2 and Table 2-3), and several of these analyses are based on the same influential datasets. Further, even for students who decline in value for a certain domain, this pattern may not in fact represent a negative outcome requiring intervention. Specialization of interest in a favorite content area, even accompanied by declining value in less preferred topics, could instead represent an adaptive element of the career decision-making process. In addition, existing research has demonstrated that trajectories and patterns of academic value beliefs may vary based on student demographic factors such as gender, Racial/Ethnic identification, and socioeconomic status. Assessing the potential for intervention among these populations, such as efforts to promote equity in STEM participation, therefore requires an understanding of differences in motivation among underrepresented groups.

**Study Design and Statistical Approach**

The present study uses a new longitudinal dataset from high school that includes academic value beliefs towards math, English, science, and social studies, as well as the career identity variables of career commitment and career exploration. In brief, the major aims of this analysis are as follows:

1) To determine the extent to which students experience declines in value beliefs relating to each of these four subjects, and whether lower levels or greater declines are concentrated in student demographic groups based on gender, Racial/Ethnic identifiation, and parental educational attainment.
2) To determine the extent to which students specialize in academic value over time, and whether this specialization predicts adaptive career development outcomes.

The first aim is addressed using two techniques. First, the variable-centered method of latent curve modeling (LCM) is used to characterize general trends in value beliefs across all students. Second, the person-centered exploratory method of growth mixture modeling (GMM) is used to identify subgroups of students who display similar patterns of value across all four academic domains over time. The results of both methods of identifying developmental trajectories are then linked with gender, Racial/Ethnic identification, and SES as measured by parental educational attainment. For the second aim, additional latent curve analyses are first applied to characterize the development of career commitment and career exploration. Finally, elements of the analysis of academic value that reflect specialization are linked with the career identity variables. As career exploration and commitment are both viewed as positive processes (Skorikov & Vondracek, 2007), if greater specialization is adaptive it will be associated with higher levels of these variables. The hypotheses for the present study are as follows:

**Average trajectories of academic value (LCM):**

1a) Value beliefs will decline in math and science but remain stable in English and social studies (see Table 2-2 and Table 2-3 for a summary of reviewed longitudinal studies).

1b) Specialization in value beliefs between STEM and verbal domains will be evident through negative correlations between slopes in these areas.

**Person-centered analysis of academic value trajectories (GMM):**

2a) Classes will include a group with high value for all subjects and a group with low value for all subjects.

2b) Classes will include a STEM preference group and a humanities preference group.

2c) At least one class will show specialization, represented by declining value for at least one subject with stability in at least one other subject.

**Demographic differences in academic value beliefs:**

3a) *Gender:* Women will value English and social studies more than do men, and will be more likely to belong to classes with relative preference for these subjects. For math and science, men may value these subjects more than do women and be more likely to belong to groups with preference for these subjects, or no gender difference may be present (see Table 2-2 and Table 2-3 for a summary of reviewed longitudinal studies).

3b) *Racial/Ethnic identification*: In any subject, Black/African American and Hispanic/Latinx students will either report lower value than White/Caucasian students, or no difference will be present. Asian/Asian American students will express higher value on math and science than White/Caucasian students.

3c) *Parental educational attainment:* In any subject, students with lower parental educational attainment may indicate lower value, or no difference may be present.

3d) *Educational aspirations:* Differences in value beliefs based on parental educational attainment, if evident, will be similar to differences based on student educational aspirations.

3e) *Demographic category interactions:* Gender differences in STEM subject value, if present, will be smaller among Black/African American students than among White/Caucasian and Hispanic/Latinx students.

**Average trajectories for career identity development:**

4) *Developmental trajectories*: Career identity exploration and commitment will both increase with age.

**Demographic differences in career identity development:**

5a) *Gender:* Women will report higher levels of both variables.

5b) *Parental educational attainment:* Students with lower parental educational attainment will express lower levels of both variables.

5d) *Educational aspirations:* Differences in value beliefs based on parental educational attainment, if present, will be similar to differences based on student educational aspirations.

5e) *Race:* Students identifying as Black/African American or Hispanic/Latinx will indicate lower levels of both variables.

**Relationship of Academic to Career Variables:**

6) Levels of career exploration and commitment will be greater in groups with more specialized value profiles.

## Chapter 2 Tables

Table 2-1

*Summary of Selected Studies Predicting Outcomes from EVT Beliefs*

| | Achievement | Course selection | Career aspirations | Other |
|---|---|---|---|---|
| Interest or Intrinsic Value | | | | |
| Lauermann et al., 2017* | - | - | Yes | - |
| Guo, Parker, et al., 2015 | Yes | Yes | - | Major selection - Yes |
| Watt et al., 2012 - Australia | - | Yes | No | - |
| Watt et al., 2012 - Canada | - | No | No | - |
| Watt et al., 2012 - U.S.* | - | No | No | - |
| Simpkins et al., 2006* | Yes | Yes | - | - |
| Simpkins et al., 2006* - science | No | Yes | - | - |
| Watt, 2006 | - | Yes | No | - |
| Durik et al., 2006* - language | No | Yes | No | Leisure reading - Yes |
| Utility | | | | |
| Lauermann et al., 2017* | - | - | Yes | - |
| Guo, Parker, et al., 2015 | - | Yes | - | Major selection - Yes |
| Watt et al., 2012 - Australia | - | No | Women only | - |
| Watt et al., 2012 - Canada | - | Women only | Men only | - |
| Watt et al., 2012 - U.S.* | - | Women only | No | |
| Simpkins et al., 2006 | No | No | - | - |
| Simpkins et al., 2006* - science | No | Yes | - | - |
| Watt, 2006 | - | No | No | - |
| Durik et al., 2006* - language | Yes | Yes | Yes | Leisure reading - No |
| Overall Value | | | | |
| Wang, Degol, & Ye, 2015 | - | - | - | Career choice - Yes |
| Meece et al., 1990 | No | Yes | - | - |
| Self-concept of Ability | | | | |
| Lauermann et al., 2017* | - | - | Yes | - |
| Guo, Parker, et al., 2015 | Yes | Yes | - | |
| Wang, Degol, & Ye, 2015 | - | - | - | Career choice - No |
| Watt et al., 2012 - Australia | - | No | No | |
| Watt et al., 2012 - Canada | - | Yes | No | - |
| Watt et al., 2012 - U.S.* | - | Yes | No | - |
| Simpkins et al., 2006 | Yes | Yes | - | - |
| Simpkins et al., 2006* - science | Yes | Yes | - | - |
| Watt, 2006 | - | Yes | No | - |
| Durik et al., 2006* - language | No | Yes | Yes | Leisure reading - No |
| Meece et al., 1990 | Yes | No | - | - |

*Note.* All studies related to the domain of Math unless otherwise noted. * indicates that this sample was the Childhood and Beyond (CAB) dataset. Dash indicates that the variable was not included in the study. “Yes” indicates that the EVT belief at an earlier time predicts the outcome at a later time.

Table 2-2

*Summary of Selected Longitudinal Studies of Math Value*

| | Declines before high school | Declines during high school | Gender difference | R/E or SES difference |
|---|---|---|---|---|
| Gaspard et al, 2018 - intrinsic | Yes, 69% | Yes, 69% | Yes | - |
| Scherrer & Preckel, 2018 - intrinsic | Yes | Yes | - | - |
| Gaspard et al, 2017 - overall | Yes | Yes | Yes | - |
| Petersen & Hyde, 2017- utility | Yes | - | No | - |
| Petersen & Hyde, 2017 - interest | Yes | - | No | - |
| Musu-Gillette et al, 2015 , - intrinsic | Yes, 100% | No, 38% | No | - |
| Musu-Gillette et al, 2015 ,,- importance | Yes, 62% | Yes, 52% | No | - |
| Lee & Kim 2014, intrinsic | Yes | Yes | Yes | SES |
| Frenzel et al., 2010 - interest | Yes | - | Yes | SES |
| Chouinard & Roy, 2008 - utility | - | Yes | No | - |
| Watt, 2004 - intrinsic | Yes | No | Yes | - |
| Watt, 2004 utility | Yes | Yes | No | - |
| Ma & Cartwright, 2003 - attitudes | Yes | Yes | Yes | R/E |
| Ma & Cartwright, 2003 - usefulness | Yes | Yes | No | R/E |
| Fredricks & Eccles, 2002 - importance | Yes | No | No | - |
| Fredricks & Eccles, 2002 - intrinsic | Yes | Yes | No | - |
| Jacobs et al., 2002 - overall | Yes | Yes | No | - |
| Gottfried et al., 2001 - intrinsic | Yes | Yes | No | - |
| Köller et al., 2001 - interest | N/a | Yes | Yes | - |

*Note*. R/E = Racial/Ethnic identification. Dash indicates that this variable was not included in the study. Percentages indicate the proportion of participants in a person-centered analysis belonging to a declining subgroup.

Table 2-3

*Summary of Selected Longitudinal Studies of General, Science, Social Studies, and Language Value*

| | Subject | Declines before high school | Declines during high school | Gender difference |
|---|---|---|---|---|
| Scherrer & Preckel, 2018 - intrinsic | General | Yes | Yes | - |
| Dotterer et al., 2009 - overall | General | Yes | No | - |
| Guo et al., 2018 - GMM - overall | Math and science | - | Yes, 67% | Yes |
| Guo et al., 2018 LCA- - overall | Math and science | - | Yes | Yes |
| Gaspard et al., 2017 - biology, utility | Science | Yes | No | Favoring women |
| Gaspard et al., 2017 - physics, utility | Science | Yes | Yes | Yes |
| Wang et al., 2017 - physics/chemistry, overall | Science | No, 11% | No, 10% | Yes |
| Gottfried et al., 2001 - science, intrinsic | Science | Yes | Yes | No |
| Guo et al., 2018 GMM - overall | Social Studies | - | No, 48% | Yes |
| Guo et al., 2018 LCA - overall | Social Studies | - | No | Yes |
| Gottfried 2001 -intrinsic | Social Studies | No | No | No |
| Gaspard et al., 2018, - intrinsic | Language | Yes, 69% | No, 36% | Yes |
| Guo et al., 2018 GMM - Finnish - overall | Language | - | No, 48% | Yes |
| Guo et al., 2018 LCA - Finnish - overall | Language | - | No | Yes |
| Scherrer & Preckel, 2018 - intrinsic | Language | Yes | Yes | N/A |
| Gaspard et al., 2017, - utility | Language | Yes | No | Yes |
| Gaspard et al., 2017, German - utility | Language | Yes | Yes | Yes |
| Lee & Kim, 2014 - intrinsic | Language | Yes | No | Yes |
| Archambault et al., 2010 - overall | Language | Yes, 100% | No, 42% | Yes |
| Watt, 2004 - intrinsic | Language | Yes | No | Yes |
| Watt, 2004 - utility | Language | Yes | No | Yes |
| Jacobs et al., 2002 - overall | Language | Yes | No | Yes |
| Gottfried et al., 2001 - intrinsic | Language | Yes | Yes | No |

*Note*. R/E = Dash indicates that this variable was not included in the study. Percentages indicate the proportion of participants in a person-centered analysis belonging to a declining subgroup. Language is English unless otherwise noted.

Table 2-4

*Summary of Commonly Found Groups in Domain Comparison Cluster Analyses*

| | High in all subjects | Medium in all subjects | Low in all subjects | STEM preference | Humanities preference | Non-academic | Non-academic and language |
|---|---|---|---|---|---|---|---|
| Gaspard et al., 2018 - US | | 31% | | 36% | 33% | | |
| Viljaranta et al., 2018 - Australia | | | 29% | 45% | 26% | | |
| Viljaranta et al., 2018 - Finland | | | 30% | 25% | 45% | | |
| Viljaranta et al., 2018 - Germany | 38% | | | 23% | 39% | | |
| Viljaranta et al., 2018 - US | 26% | | | 30% | 44% | | |
| Guo et al., 2017 - Finland | 48% | | | 33% | 19% | | |
| Lazarides et al., 2016 - Finland | Gr. 7, 30% | | Gr. 7, 9% | Gr. 7, 38% | Gr. 7, 26% | | |
| | Gr. 9, 25% | | Gr. 9, 6% | Gr. 9, 39% | Gr. 9, 26% | | |
| Chow et al., 2012 - US | | 43% | | 41% | 14% | | |
| Chow et al., 2012 - Finland | 53% | | | 20% | 15% | | |
| Chow & Salmela-Aro, 2011- Finland | 55% | | | 20% | 19% | 6% | |
| Viljaranta, et al.,, 2009 - Finland | 38% | 6% | | 15% | 14% | 10% | 18% |

*Note*. Gr. = Grade. Percentages indicate proportion of sample belonging to each cluster.

# Chapter 3

# Method

## Procedure

Five waves of data were collected from 2014 through 2018 in all grades at a public high school in a mid-sized midwestern city. The researchers had been in collaboration with the school for several years, collecting data for research purposes as well as assisting the school administration with collection and interpretation of data for internal school use. The measures used in the present study were embedded in a larger computerized school survey for internal school evaluation and improvement, taking about 18 minutes to complete (see Table 3-1). Although all students were expected to complete this survey, they were presented with a consent form for the research project clearly stating that they could decline to answer any questions and that contributing their data to the research project was voluntary. Parent permission forms were distributed and collected by the school at the beginning of each school year in a packet of other documents requesting parent permission for school activities. The surveys were completed annually during the second class period of the day, with all survey dates falling within the same two-week period of the year during spring. In the first three waves of data collection, students left their classrooms to complete the survey in a computer lab, and in the final two waves of data collection surveys were administered by teachers in their own classrooms using laptops that were moved between classrooms.

**Sample**

Combined across waves, the sample consisted of 2,681 students, including 1,489 students in 9th grade, 1,449 students in 10th grade, 1,245 students in 11th grade, and 1,061 students in 12th grade (see Table 3-2). In longitudinal participation, 1,229 (44%) participants were present in one wave of data collection, 839 (30%) were present in two waves of data collection, 526 (20%) of the sample were present in three waves of data collection, and 187 (7%) of the sample were present in four waves of data collection. Out of about 1,600 students enrolled at the school each year, the final sample consisted of 1,174 (about 70% of the school) in the 2014 wave and declined to 851 (about 50% of the school) in the 2018 wave of data collection (see Table 3-1). This decline in response rate in later years was likely due to the greater logistical difficulties in distributing laptop computers to classrooms, which also led to increased difficulty in tracking which classes had completed the survey. At each time point, seniors were more likely to have scheduling conflicts on the survey date and were least likely to participate.

The sample of students included in the analysis consisted of those who gave personal assent, were given parental permission, and who satisfied several criteria for giving genuine responses. Students were eliminated from the sample who spent less than 5 minutes answering survey questions, gave inappropriate responses on survey open-ended questions, or responded on a multiple-choice measure included in the 2018 wave that they answered “Less than half” or “None or almost none” of the survey questions seriously (item: “How many of the questions on this survey would you say that you answered seriously?”; 1, “None or almost none”; 2, “Less than half”; 3, “About half”; 4, “More than half”; 5, “All or almost all”).

The student population of the school is largely based on local residence, with about 10% of the students having applied to attend the participating school rather than the school closest to their home. The target school and district are among the highest achieving in the state on standardized assessments and college readiness. The target school district is more affluent than the state average, and parents of students in the target school are more educated than the average district and state population (see Table 3-3). The survey sample represented the school and district population in Racial/Ethnic demographics (see Table 3-4).

**Parental educational attainment.** A single-item measure of parental educational attainment was included at all waves, asking students “For your parent, legal guardian, or usual caregiver who has finished the MOST years of education, please choose which level they finished” and the options of “Graduated from high school,” “Associate's degree from a 2 year or community college,” “Bachelor's degree from a 4 year college or university,” “Master's degree,” and “Law, medical, or Ph.D. degree”. The highest level of education reached by a students' parents was less than high school for 1% of students, completion of high school for 3% of students, some college for 7% of students, an Associate's or 2-year degree for 6% of students, a Bachelor's or 4-year degree for 26% of students, a Master's degree for 40% of students, and Law, Medical or Ph.D. degree for 41% of students. Due to the small number of respondents, the levels of education under a Bachelor's degree (16%) were considered together in the following analysis.

**Student educational aspirations.** A single item assessing students' own educational aspirations was included in the 2018 survey wave only, asking “What is the highest level of education that YOU plan to finish?” with the same response options included as in the parental educational attainment question. Students reported high levels of educational aspirations, with 2% ($n$ = 17) students expecting high school graduation to be their highest education level, 3% of students aspiring to a 2-year degree ($n$ = 23), 30% of participants aspiring to a Bachelor's degree ($n$ = 240), 32% of students aspiring to a Master's degree ($n$ = 251), and 33% of students aspiring to a Law, Medical, or Ph.D. degree. For the purposes of analysis, aspirations of Bachelor's degrees or lower were considered together (36%, $n$ = 280).

**Racial/Ethnic identification.** Racial and Ethnic identification was assessed using the item “With which Racial or Ethnic group(s) do you MOST identify? Check all that apply”. Options consisted of “Asian/Pacific Islander,” “Latino/Hispanic,” “American Indian/Native American,” “African American/Black,” “Caucasian/White,” “Prefer not to answer” and “Other”. Due to the “check all that apply” response format, several categorization methods of Racial/Ethnic identification were used in the following analyses. In the five-category, biracial-inclusive measure, students who indicated one minority identification as well as a White/Caucasian identification were included in the minority identification category. According to this categorization, 50% of students identified as White/Caucasian only, 12% of students identified as Asian/Asian American or Asian and White, 18% of students identified as Black/African American or Black/African American and White, 6% of students identified as Hispanic/Latinx or Hispanic/Latinx and White, and 14% of students identified as another race/Ethnicity or combination of categories. See Table 3-5 for more detailed information on the categories used to create this variable. This strategy attempts to avoid losing information on minority group experiences by combining many extremely different identifications into a large “Multiracial” category, yet represents an assumption that students with a White/Caucasian as well as a minority group identification have substantially similar experiences to other members of the minority group.

Therefore, all analyses were repeated with a single-identification measure, which includes all students with more than one identification in an “Other or Multiracial” category. According to this classification, 50% of students identified as White/Caucasian only, 10% of students identified as Asian/Asian American only, 15% of students identified as Black/African American only, 3% of students identified as Hispanic/Latinx only, and 23% of students indicated another identification or multiple identifications. In order to maintain adequate cell sizes, in some of the following analyses a four-category version of the biracial-inclusive version was used that combines the small population of Hispanic/Latinx (5%) students with the "Other" category. For the same reason, in one analysis below a dichotomous variable was used on the basis of current underrepresentation in STEM fields, with White/Caucasian and Asian/Asian American students representing the "majority" category (62%) and students with any other identification the underrepresented minority (URM) category (38%).

**Demographic variable interactions.** A loglinear model was used to assess whether the demographic variables were significantly related. Initially, the five-category race variable was used. No interaction was found between gender and parental educational attainment, $\chi^2(3) = 3.86$, $p = .277$, or gender and Racial/Ethnic identification, $\chi^2(4) = 6.63$, $p = .157$. However, the chi-square test was significant for the parental educational attainment by race interaction, $\chi^2(12) = 198.84$, $p < .001$. A subsequent chi-square test with these two variables demonstrated that White/Caucasian students were underrepresented in the "Less than Bachelor's degree" category (Adjusted Standardized Residual [ASR]= -7.1, $p < .001$) and overrepresented in "Master's degree" category (ASR = 3.8, $p < .001$). Asian/Asian American students were underrepresented in "Less than Bachelor's degree" category (ASR = -5, $p < .001$) and the "Master's degree" category (ASR = -3.5, $p = .001$), but overrepresented in the "Higher than Master's degree" category (ASR = 8.4, $p < .001$). Black/African American students were overrepresented in the "Less than Bachelor's degree" category (ASR = 11.3, $p < .001$) and underrepresented in "Higher than Master's degree" (ASR = -5.8, $p < .001$). Differences for the Hispanic/Latinx group and

Other/Multiple identification group were not significant. Overall, White/Caucasian and Asian students were significantly more likely, and Black/African American students were significantly less likely, to report high educational attainment by their parents. Further, Asian/Asian American students indicated the highest parental educational attainment of any group. The same patterns were found using the single race identification variable.

Relating to educational aspirations, main effects were present of gender ($\chi^2(2) = 30.43$, $n = 773$, $p < .001$), parental educational attainment ($\chi^2(6) = 158.39$, $n = 760$, $p < .001$), as well as Racial/Ethnic identification ($\chi^2(8) = 24.90$, $n = 448$, $p = .002$) but no interactions between these variables: gender and race, $\chi^2(2) = 2.3$, $n = 424$, $p = .317$; gender and parental educational attainment, $\chi^2(2) = 4.94$, $n = 424$, $p = .085$; race and parental educational attainment, $\chi^2(2) = 0.53$, $n = 424$, $p = .768$. Women were overrepresented in aspiring to Law, Medical, or Ph.D. degrees (ASR = 4.1, $p < .001$), and underrepresented in aspiring to Bachelor's degrees (ASR = -3.8, $p < .001$). White/Caucasian students were overrepresented in aspiring to Master's degrees (ASR = 3.2, $p = 0.002$), Asian/Asian American students were overrepresented in aspiring to Law, Medical, or Ph.D. degrees (ASR = 2.7, $p = .010$), and Black/African American students were overrepresented in aspiring to Bachelor's degrees or less (ASR = 3.3, $p = .002$). In relation to parental educational attainment, students with higher parental educational attainment generally aspired to higher levels of education themselves (see Table 3-6), $\chi^2(6) = 158.39$, $n = 760$, $p < .001$.

**Cohort effects.** Cohort and number of waves of participation were weakly but significantly related, $r(2779) = -.04$, $p = .040$, with more recent cohorts less likely to participate. Cohort did not differ by gender, $\chi^2(7, n = 2705) = 10.37$, $p = .168$). While cohort significantly differed by URM identification $\chi^2(6, n = 2319) = 12.58$, $p = .050$), this pattern did not appear to represent a consistent pattern over time, $t(2317) = .375$, $p = .708$. Instead, URM students were less likely be members of cohort eight (ASR = -2.8, $p = .008$) and more likely to be members of cohort four (ASR = 2.0, $p = .054$). Cohort did not differ significantly by parental educational attainment, $\chi^2(21, n = 2481) = 25.63$, $p = .221$. Finally, cohort was significantly related to several constructs of interest (see Table 3-7). The most notable pattern is that more recent cohorts reported lower career exploration.

**Survey attrition.** Number of waves of participation was not related to gender, $t(2703) = -1.80$, $p = .071$. Number of waves of participation was related to race, with dichotomous URM identification related to fewer waves of participation, $t(2317) = 3.64$, $p < .001$. When using the five-category biracial-inclusive race/Ethnicity variable, $F(4, 2314) = 7.16$, $p < .001$), Asian/Asian American students completed the most waves ($M = 2.14$, $SD = 1.03$) followed by other identification ($M = 2.11$, $SD = 0.98$), White/Caucasian, ($M = 2.07$, $SD = 0.93$), Black/African American, ($M = 1.86$, $SD = .84$), and Hispanic/Latinx ($M = 1.78$, $SD = .86$). The same pattern was found with the single Racial/Ethnic identification variable. Number of waves was significantly related to parental educational attainment, $r(2779) = .09$, $p < .001$, with higher levels of parental educational attainment corresponding to more waves of participation. Finally, number of participation waves was significantly related to several variables of interest (see Table 3-7). Consistent patterns included the fact that fewer waves of participation was related to lower math value in every grade and lower science value in all grades except ninth. Therefore, this sample underrepresents Black/African American students, students with higher interest in math and science, and students with higher parental educational attainment.

**Measures**

**Expectancy and value beliefs.** Expectancy and value beliefs were assessed with items adapted from Eccles et al., (1993). Items included a five-point response scale from "Strongly agree" to "Strongly disagree". All items were repeated in relation to the academic subjects of math, English, social Studies, and science. Subscales assessed included interest value (two items, e.g. "I enjoy this subject"), utility value (two items, e.g. "This subject will be useful to me later in life"), and self-concept of ability (two items, e.g. "I am good at this subject"). The interest value and utility value items were averaged to create an overall 4-item value scale (see Table 3-10, Table 3-11, and Table 3-12). These expectancy-value measures demonstrated adequate reliability at all waves (see Table 3-9). The self-concept of ability items were not included in the present analysis. Note that although these items are intended to measure global beliefs about an academic domain, participant responses may be influenced by the specific course they are taking in that content area. See Table 3-8 for typical course progressions at this school in the academic domains included in the present study.

**Career identity development.** Career identity development was assessed with items selected from the scale developed by Porfeli, Vondracek, and Weigold (2011; see Table 3-10 and Table 3-13). Items included a five-point response scale from "Strongly agree" to "Strongly disagree". The measure includes a five-item subscale for career commitment (e.g. "No one will change my mind about the career I have chosen") and six-item subscale for career exploration (e.g. "I know what kind of work is best for me"). The number of items administered from this scale was decreased in later waves, and the scale was not included in the 2016 survey. Reliability for both commitment and exploration scales was adequate at all time points (see Table 3-9).

# Chapter 3 Tables

Table 3-1

*Survey Participation by Wave*

| | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|
| Median survey completion time (minutes) | 16.8 | 13.8 | 17.8 | 18.5 | 18.2 |
| Total school enrollment | 1,622 | 1,601 | 1,667 | 1,648 | 1,694 |
| Number of participants in final sample | 1,174 | 1,118 | 1,111 | 979 | 851 |
| Percent female | 48% | 45% | 46% | 48% | 52% |

Table 3-2

*Survey Participation by Cohort*

| Cohort number | 9th Grade | 10th Grade | 11th Grade | 12th Grade | Cohort Total |
|---|---|---|---|---|---|
| 1 | | | | 268 | 268 |
| 2 | | | 268 | 223 | 308 |
| 3 | | 309 | 266 | 223 | 365 |
| 4 | 331 | 321 | 288 | 203 | 426 |
| 5 | 309 | 301 | 222 | 144 | 423 |
| 6 | 300 | 254 | 201 | | 372 |
| 7 | 301 | 264 | | | 371 |
| 8 | 248 | | | | 248 |
| Grade Total | 1,489 | 1,449 | 1,245 | 1,061 | |
| Grand Total | | | | | 2,781 |

Table 3-3

*Sample and School Achievement and Socioeconomic Demographics*

| Demographic Indicator | School 2018 | District 2018 | County 2018 | State 2018 |
|---|---|---|---|---|
| Not Free or Reduced-Price Lunch Eligible | 80% | 77% | | 54% |
| Free Lunch Eligible | 17% | 20% | | 40% |
| Reduced-Price Lunch Eligible | 3% | 3% | | 6% |
| Persons in poverty, percent | | | 15% | 15% |
| High school graduate or higher | 95% | | 95% | 90% |
| Bachelor's degree or higher | 84% | | 53% | 27% |
| Students Proficient on M-STEP Mathematics, 8th grade | | 50% | | 34% |
| Average SAT score | 1,204 | 1,192 | | 1,000 |
| 4 year Graduation Rate | 93% | 89% | | 81% |

*Note.* The education levels in reference to the school represent the levels of education students indicated about their parents.

Table 3-4

*Sample, School, District, County, and State Racial and/or Ethnic Identification*

| Racial or Ethnic Identification | Sample | School 2018 | District 2018 | County 2018 | State 2018 |
|---|---|---|---|---|---|
| Caucasian/White | 50% | 59% | 51% | 70% | 75% |
| African American/Black | 18% | 14% | 14% | 12% | 14% |
| Asian/Pacific Islander | 12% | 11% | 15% | 10% | 3% |
| Latino/Hispanic | 6% | 6% | 9% | 4% | 5% |
| Other | 14% | 10% | 11% | 4% | 3% |

*Note.* The “Sample” values represent student self-reported race using the biracial-inclusive five category measure.

Table 3-5

*Sample Racial/Ethnic Identification Including Selected Biracial Categories*

| | *n* | Percentage |
|---|---|---|
| White/Caucasian only | 1,155 | 50% |
| Asian/Asian American only | 226 | 10% |
| Black/African American only | 336 | 15% |
| Hispanic/Latinx only | 67 | 3% |
| Other identification only | 67 | 3% |
| Asian/Asian American and White/Caucasian | 57 | 3% |
| Black/African American and White/Caucasian | 82 | 4% |
| Hispanic/Latinx only and White/Caucasian | 65 | 3% |
| Other identification and White/Caucasian | 72 | 3% |
| All other combinations | 96 | 8% |

Table 3-6

*Adjusted Standardized Residuals for Relationship between Parental Educational Attainment and Student Educational Aspirations*

| | Student Educational Aspirations | | |
|---|---|---|---|
| Parental educational attainment | Bachelor's degree or less | Master's degree | Law, Medical or Ph.D. degree |
| Less than Bachelor's degree | 6.8*** | -2.6* | -4.3*** |
| Bachelor's degree | 6.6*** | -1.6 | -5.1*** |
| Master's degree | -4.5*** | 5.4*** | -0.8 |
| Law, Medical, or Ph.D. degree | -6.8*** | -2.1 | 8.8*** |

*Note.*
*** $p$ < .001.
** $p$ < .01.
* $p$ < .05.

Table 3-7

*Significant Relationships between Survey Participation and Analysis Variables*

| | Number of waves | | Cohort | |
|---|---|---|---|---|
| | *r* | *n* | *r* | *n* |
| Grade 9 English value | .07** | 1,451 | | |
| Grade 11 English value | | | .07** | 1,227 |
| Grade 9 math value | | | .06** | 1,448 |
| Grade 10 math value | -.08** | 1,420 | .05* | 1,420 |
| Grade 11 math value | -.07** | 1,226 | .05* | 1,226 |
| Grade 12 math value | | | .06* | 1,010 |
| Grade 10 science value | | | .07** | 1,419 |
| Grade 11 science value | | | .07* | 1,225 |
| Grade 12 science value | .07* | 1,012 | .08* | 1,012 |
| Grade 12 social studies value | | | -.06* | 1,012 |
| Grade 9 career commitment | -.10** | 1,138 | | |
| Grade 12 career commitment | -.08* | 797 | -.07* | 797 |
| Grade 9 career exploration | -.19*** | 1,138 | .16** | 1,138 |
| Grade 10 career exploration | -.23*** | 1,101 | | |
| Grade 11 career exploration | -.14*** | 936 | .14*** | 1,101 |
| Grade 12 career exploration | -.13*** | 791 | -.11*** | 791 |

*Note*. Only significant relationships are displayed.
*** $p < .001$.
** $p < .01$.
* $p < .05$.

Table 3-8

*Typical Course Progression in Academic Content Areas at Target School*

| | English | Math | Science | Social studies |
|---|---|---|---|---|
| 9th grade | English 9 | Geometry, Algebra | Biology | World History and Geography |
| 10th grade | English 10 | Geometry, Algebra II | Earth Science, AP Environmental Science, Health | US History, AP US History |
| 11th grade | English 11, AP English Language | Algebra II, Pre Calculus | Chemistry, AP Chemistry, Physics | US Government, Economics |
| 12th grade | English 12, AP English Literature | AP Statistics, AP AB Calculus, AP BC Calculus, Math elective | (More than three years of science is NOT required) Physics, AP science courses, Science elective | World Humanities, African American Humanities, Economics |

Table 3-9

*Cronbach's α Reliability Scores for Scale Measures by Wave*

| Survey Measure | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|
| Career exploration (2 to 6) | .82 | .84 | - | .84 | .70 |
| Career commitment (3 to 5) | .81 | .82 | - | .77 | .76 |
| Social Studies | | | | | |
| Utility value (2) | .89 | .86 | .85 | .87 | .87 |
| Intrinsic value (2) | .90 | .89 | .90 | .90 | .90 |
| Self-Concept of Ability (2) | .77 | .71 | .73 | .72 | .76 |
| Overall value (4) | .89 | .88 | .87 | .88 | .88 |
| English | | | | | |
| Utility value (2) | .85 | .84 | .86 | .90 | .84 |
| Intrinsic value (2) | .89 | .89 | .90 | .90 | .89 |
| Self-Concept of Ability (2) | .76 | .73 | .73 | .75 | .79 |
| Overall value (4) | .86 | .86 | .85 | .86 | .83 |
| Math | | | | | |
| Utility value (2) | .91 | .87 | .90 | .89 | .91 |
| Intrinsic value (2) | .90 | .91 | .92 | .92 | .92 |
| Self-Concept of Ability (2) | .75 | .76 | .76 | .79 | .79 |
| Overall value (4) | .87 | .88 | .90 | .87 | .87 |
| Science | | | | | |
| Utility value (2) | .91 | .87 | .89 | .90 | .89 |
| Intrinsic value (2) | .90 | .89 | .90 | .91 | .86 |
| Self-Concept of Ability (2) | .77 | .72 | .74 | .80 | .77 |
| Overall value (4) | .91 | .91 | .91 | .90 | .87 |

*Note:* Number of items in each scale are in parentheses.

Table 3-10

*Descriptive Statistics for Survey Measures by Grade*

| | 9 | | | 10 | | | 11 | | | 12 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *N* | *M* | *SD* | *N* | *M* | *SD* | *N* | *M* | *SD* | *N* | *M* | *SD* |
| Career Identity | | | | | | | | | | | | |
| Commitment | 1138 | 3.08 | 0.87 | 1120 | 3.05 | 0.86 | 936 | 3.02 | 0.85 | 797 | 3.10 | 0.84 |
| Exploration | 1138 | 3.63 | 0.79 | 1101 | 3.61 | 0.85 | 936 | 3.65 | 0.78 | 791 | 3.69 | 0.76 |
| Value | | | | | | | | | | | | |
| English | 1451 | 3.67 | 0.95 | 1423 | 3.74 | 0.94 | 1227 | 3.85 | 0.9 | 1015 | 3.88 | 0.91 |
| Math | 1448 | 3.49 | 1.08 | 1420 | 3.39 | 1.11 | 1226 | 3.46 | 1.08 | 1010 | 3.44 | 1.11 |
| Science | 1446 | 3.81 | 1.00 | 1419 | 3.71 | 1.07 | 1225 | 3.70 | 1.11 | 1012 | 3.72 | 1.09 |
| Social Studies | 1448 | 3.19 | 1.08 | 1419 | 3.29 | 1.06 | 1227 | 3.30 | 1.10 | 1012 | 3.43 | 1.07 |

*Note.* The specialization measures are calculated within-person based on value beliefs in the four subject domains.

Table 3-11

*Expectancy-Value Survey Items by Wave from 2014 to 2016*

| | 2014 | | | 2015 | | | 2016 | | |
|---|---|---|---|---|---|---|---|---|---|
| Survey Item | *N* | *M* | *SD* | *N* | *M* | *SD* | *N* | *M* | *SD* |
| English/ Language Arts | | | | | | | | | |
| 1 | 1201 | 3.49 | 1.22 | 1113 | 3.56 | 1.24 | 1105 | 3.50 | 1.26 |
| 2 | 1189 | 3.84 | 1.05 | 1124 | 3.92 | 1.04 | 1117 | 3.87 | 1.06 |
| 3 | 1188 | 4.01 | 1.05 | 1120 | 3.96 | 1.03 | 1116 | 4.05 | 1.01 |
| 4 | 1187 | 3.48 | 1.25 | 1120 | 3.50 | 1.27 | 1111 | 3.46 | 1.26 |
| 5 | 1194 | 4.07 | 0.98 | 1131 | 4.15 | 0.96 | 1124 | 4.09 | 0.96 |
| 6 | 1201 | 4.02 | 1.04 | 1128 | 3.96 | 1.05 | 1124 | 4.06 | 1.03 |
| Math | | | | | | | | | |
| 1 | 1199 | 3.11 | 1.35 | 1112 | 3.09 | 1.41 | 1105 | 2.99 | 1.40 |
| 2 | 1187 | 3.53 | 1.23 | 1122 | 3.47 | 1.27 | 1118 | 3.36 | 1.29 |
| 3 | 1185 | 3.88 | 1.18 | 1117 | 3.82 | 1.17 | 1115 | 3.79 | 1.23 |
| 4 | 1185 | 3.19 | 1.36 | 1116 | 3.20 | 1.38 | 1111 | 3.09 | 1.42 |
| 5 | 1195 | 3.87 | 1.13 | 1131 | 3.90 | 1.14 | 1125 | 3.74 | 1.19 |
| 6 | 1198 | 3.82 | 1.21 | 1128 | 3.73 | 1.20 | 1123 | 3.73 | 1.23 |
| Science | | | | | | | | | |
| 1 | 1197 | 3.48 | 1.29 | 1113 | 3.64 | 1.30 | 1106 | 3.49 | 1.32 |
| 2 | 1187 | 3.72 | 1.15 | 1121 | 3.84 | 1.11 | 1118 | 3.73 | 1.14 |
| 3 | 1185 | 3.79 | 1.23 | 1119 | 3.84 | 1.15 | 1115 | 3.71 | 1.22 |
| 4 | 1188 | 3.73 | 1.28 | 1121 | 3.90 | 1.20 | 1108 | 3.75 | 1.29 |
| 5 | 1195 | 4.00 | 1.06 | 1131 | 4.08 | 0.99 | 1125 | 3.98 | 1.04 |
| 6 | 1199 | 3.74 | 1.28 | 1126 | 3.79 | 1.22 | 1121 | 3.72 | 1.22 |
| Social Studies | | | | | | | | | |
| 1 | 1198 | 3.31 | 1.33 | 1115 | 3.30 | 1.36 | 1105 | 3.26 | 1.33 |
| 2 | 1187 | 3.70 | 1.17 | 1125 | 3.77 | 1.12 | 1116 | 3.63 | 1.14 |
| 3 | 1185 | 3.28 | 1.23 | 1118 | 3.16 | 1.19 | 1116 | 3.18 | 1.20 |
| 4 | 1186 | 3.45 | 1.33 | 1121 | 3.52 | 1.31 | 1111 | 3.43 | 1.32 |
| 5 | 1194 | 4.02 | 1.04 | 1131 | 4.12 | 0.98 | 1122 | 4.00 | 1.02 |
| 6 | 1199 | 3.24 | 1.26 | 1130 | 3.11 | 1.24 | 1123 | 3.11 | 1.22 |

*Note.* Items consist of 1) I ENJOY this subject; 2) I am GOOD AT this subject.; 3) This subject is valuable because it will HELP me in the future.; 4) This subject is INTERESTING to me.; 5) I can MASTER the most difficult material in this subject if I try.; 6) This subject will be USEFUL to me later in life.

Table 3-12

*Expectancy-Value Survey Items by Wave from 2017 to 2018*

| | 2017 | | | 2018 | | |
|---|---|---|---|---|---|---|
| Survey Item | *N* | *M* | *SD* | *N* | *M* | *SD* |
| English/ Language Arts | | | | | | |
| 1 | 897 | 3.40 | 1.22 | 872 | 3.55 | 1.17 |
| 2 | 902 | 3.75 | 1.02 | 871 | 3.91 | 0.94 |
| 3 | 895 | 3.97 | 1.00 | 872 | 4.19 | 0.88 |
| 4 | 900 | 3.32 | 1.22 | 868 | 3.49 | 1.18 |
| 5 | 901 | 3.96 | 1.02 | 872 | 4.13 | 0.89 |
| 6 | 898 | 4.00 | 1.00 | 868 | 4.22 | 0.90 |
| Math | | | | | | |
| 1 | 891 | 3.04 | 1.36 | 864 | 3.00 | 1.35 |
| 2 | 900 | 3.40 | 1.19 | 863 | 3.53 | 1.18 |
| 3 | 899 | 3.73 | 1.16 | 864 | 3.79 | 1.14 |
| 4 | 898 | 3.08 | 1.33 | 860 | 3.12 | 1.34 |
| 5 | 905 | 3.69 | 1.16 | 863 | 3.78 | 1.13 |
| 6 | 900 | 3.71 | 1.21 | 862 | 3.77 | 1.12 |
| Science | | | | | | |
| 1 | 894 | 3.54 | 1.24 | 863 | 3.82 | 1.10 |
| 2 | 903 | 3.74 | 1.06 | 863 | 4.03 | 0.90 |
| 3 | 895 | 3.71 | 1.16 | 864 | 3.85 | 1.04 |
| 4 | 897 | 3.70 | 1.25 | 861 | 3.93 | 1.09 |
| 5 | 901 | 3.97 | 1.04 | 861 | 4.15 | 0.92 |
| 6 | 897 | 3.71 | 1.17 | 861 | 3.84 | 1.09 |
| Social Studies | | | | | | |
| 1 | 891 | 3.23 | 1.27 | 860 | 3.36 | 1.27 |
| 2 | 899 | 3.59 | 1.10 | 863 | 3.76 | 1.01 |
| 3 | 897 | 3.13 | 1.18 | 865 | 3.31 | 1.17 |
| 4 | 900 | 3.28 | 1.30 | 858 | 3.46 | 1.28 |
| 5 | 899 | 3.90 | 1.05 | 863 | 4.08 | 0.94 |
| 6 | 895 | 3.14 | 1.20 | 859 | 3.31 | 1.16 |

*Note.* Items consist of 1) I ENJOY this subject; 2) I am GOOD AT this subject.; 3) This subject is valuable because it will HELP me in the future.; 4) This subject is INTERESTING to me.; 5) I can MASTER the most difficult material in this subject if I try.; 6) This subject will be USEFUL to me later in life.

Table 3-13

*Complete Career Identity Development Survey Items by Wave*

| Survey Item | 2014 | | | 2015 | | | 2017 | | | 2018 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *N* | *M* | *SD* | *N* | *M* | *SD* | *N* | *M* | *SD* | *N* | *M* | *SD* |
| Career Commitment | | | | | | | | | | | | |
| No one will change my mind about the career I have chosen. | 1203 | 2.91 | 1.09 | 1140 | 2.93 | 1.12 | 879 | 2.85 | 1.08 | 848 | 2.75 | 1.13 |
| No other career is as appealing to me as the one I expect to enter. | 1202 | 2.91 | 1.07 | 1139 | 2.89 | 1.09 | 877 | 2.90 | 1.05 | 848 | 2.83 | 1.08 |
| I have invested a lot of energy into preparing for my chosen career. | 1202 | 3.17 | 1.07 | 1140 | 3.21 | 1.09 | 875 | 3.20 | 1.06 | - | - | - |
| I know what kind of work is best for me. | 1198 | 3.48 | 0.99 | 1139 | 3.50 | 1.02 | 878 | 3.37 | 1.01 | - | - | - |
| Career Exploration | | | | | | | | | | | | |
| Right now I am... thinking about how I could fit into many different careers. | 1201 | 3.61 | 0.97 | 1138 | 3.75 | 0.92 | 878 | 3.43 | 1.05 | 848 | 3.26 | 1.07 |
| Right now I am... learning about various jobs that I might like. | 1201 | 3.64 | 1.01 | 1140 | 3.70 | 0.98 | - | - | - | 849 | 3.47 | 1.08 |
| Right now I am... keeping my options open as I learn about many different careers. | 1201 | 3.80 | 0.92 | 1139 | 3.87 | 0.87 | 878 | 3.74 | 0.90 | - | - | - |
| Right now I am... learning as much as I can about the particular educational requirements of the career that interests me the most. | 1201 | 3.62 | 1.05 | 1139 | 3.67 | 1.02 | 881 | 3.46 | 1.08 | - | - | - |
| Right now I am... learning what I can do to improve my chances of getting into my chosen career. | 1202 | 3.84 | 1.01 | 1140 | 3.81 | 1.02 | 875 | 3.57 | 1.07 | - | - | - |
| Right now I am... identifying my strongest talents for careers. | 1199 | 3.92 | 0.87 | 1138 | 3.91 | 0.89 | - | - | - | - | - | - |

# Chapter 4

# Results

## Phase 1: Growth Curve Models

In the first phase of the analysis, multivariate latent growth curve models were used to determine longitudinal trajectories of the academic and career variables over time. A benefit of using the latent growth curve method is the estimation of interindividual variance in the latent parameters, allowing the examination of group differences in these parameters. Two multivariate growth curve analyses were conducted. First, all four academic value variables were included simultaneously in a multivariate model. Next, the two career variables were included together in a second multivariate model. Model fit was assessed based on several indices, the Root Mean Square Error of Approximation (RMSEA), comparative fit index (CFI), Tucker-Lewis index (TLI), and Standard Root Mean Square Residual (SRMR). The standards used for good fit were SRMR values below .08 or below, RMSEA values below .06, and CFI and TLI greater than .95 (Hu & Bentler, 1999). In all following analyses, missing data was addressed using the Full-Information Maximum Likelihood method.

### Academic Value Growth Curve Models

**Model selection.** To estimate latent growth curves for the academic subjects, value beliefs for all four academic subjects were included in a multivariate model. Three models were compared for their fit to the data. The first model included linear growth parameters for all four subjects, and the second model included both linear and quadratic growth parameters for all four subjects. Due to the fact that the quadratic trend in the second model was only significant for the domain of science, a third model was also evaluated that included a quadratic parameter for science and linear parameters for all other subjects. The model with all four quadratic terms ($\chi^2$ (46) = 31.61, $p$ < .001, RMSEA = 0.046, CFI = 0.964, TLI = 0.906, SRMR = 0.027) resulted in better fit than the linear model ($\chi^2$(92) = 628.91, $p$ < .001, RMSEA = 0.046, CFI = 0.928, TLI = 0.907, SRMR = 0.049) or the model with the quadratic term for science only ($\chi^2$ (82) = 590.10, $p$ < .001, RMSEA = 0.048, CFI = 0.932, TLI = 0.901, SRMR = 0.046). Despite the fact that English, math, and social studies value did not show significant quadratic trends (see Table 4-1 and Figure 4-21), variances of the quadratic terms were significant for all subjects. This result indicates that the quadratic model may be a more accurate approach for examining individual differences in trajectories. Therefore, the model with quadratic terms for all subjects was retained for the following analyses.

**Trajectories.** For this portion of the analysis, it was hypothesized (1a) that value beliefs would decline in math and science, yet remain stable in English and social studies. Consistent with expectations, significant negative linear (annual) trends from 9th to 12th grade were found in value for math ($M$ = -0.08, $SE$ = 0.03, $p$ = .020) and science ($M$ = -0.11, $SE$ = 0.03, $p$ < .001; see Table 4-2). However, contrary to expectations, linear trajectories were positive for both English ($M$ = 0.11, $SE$ = .03, $p$ < .001) and social studies ($M$ = 0.07, $SE$ = 0.04, $p$ = .037) value beliefs. The only subject with a significant quadratic term was science ($M$ = 0.02, $SE$ = 0.01, $p$ = .030), with the positive quadratic trend representing a leveling off of the linear decline.

In addition to these average trends, the latent curve analysis demonstrates that individuals in this sample show significant variation in their trajectories of value beliefs. Both the linear and quadratic growth parameters have significant variance between participants for English, math, and social studies (see Table 4-2). For science, individuals varied significantly in the quadratic trend yet not in the slope parameter, demonstrating that the decline in value for science was relatively uniform across individuals. In relation to the topic of declining motivation over time, the variation in linear trajectories is of particular interest. The extent of individual differences in this trend can be clearly seen in histograms of the latent slope parameters (see Figure 4-22). Given the distribution of slope parameters in English (*SE* = .030), 30% of students have a significantly negative slope and 54% of students have a significantly positive slope. For math (*SE* = .033), 51% of students have a significantly negative slope and 30% of students have a significantly positive slope. For science (*SE* = .031), 60% of students have a significantly negative slope and 24% of students have a significantly positive slope. Finally, for social studies (*SE* = .035), 31% of students have a significantly negative slope and 51% of students have a significantly positive slope.

**Parameter relationships.** The multivariate model also allows for the estimation of relationships between intercept, linear, and quadratic growth parameters both within and between academic subjects. Between subjects, it was hypothesized (1b) that specialization in value beliefs between STEM and verbal domains would be apparent through negative correlations between slopes in these areas. Contrary to this hypothesis, all slope parameters were positively related. Although all were significant, the positive correlations between the math and science slopes (*M* = .40, *SE* = .04) and English and social studies slopes (*M* = .04, *SE* = .05) were stronger than the relationships between STEM and humanities disciplines (ranging from .18 to .23). In addition, intercept parameters were positively correlated between subjects and quadratic parameters were positively correlated between subjects (see Table 4-3). Again, although all were significant, the positive correlation between math and science intercept (*M* = .47, *SE* = .03) and English and social studies intercept (*M* = .045, *SE* = .03) were stronger than the relationships between STEM and humanities disciplines (ranging from .08 to .14). Therefore, students who begin high school with a high level of value for one academic subject are likely to value other subjects highly as well; similarly, students who improve or decline in value for a given subject will likely experience a similar trend in the other academic subjects. Within subjects, the only significant relationship found was a negative association between English intercept and slope (*M* = -.36, *SE* = 0.11, *p* = .001). This pattern indicates that students who begin high school with higher value for English do not improve in these beliefs as much, perhaps reflecting a ceiling effect.

## Career Identity Growth Curve Models

**Model selection.** In a procedure parallel to the analysis of academic value beliefs, three latent growth curve models were assessed for their fit to the data for career identity beliefs. Both career identity variables, exploration and commitment, were included simultaneously in the models. First, a model with only linear growth terms was assessed, followed by a model using quadratic terms for both subjects (see Table 4-1 and Figure 4-23). After observing that only career commitment showed a significant quadratic trend in the second model, another analysis including the quadratic term for commitment and excluding this term for exploration was also evaluated. In comparing these three models, the quadratic design ($\chi^2(9) = 20.72$, $p = .014$, RMSEA = 0.022, CFI = 0.976, TLI = 0.958, SRMR = 0.041) demonstrated better fit than the linear model ($\chi^2(22) = 51.26$, $p < .001$, RMSEA = 0.023, CFI = 0.967, TLI = 0.958, SRMR = 0.054) and the model with a quadratic term for commitment only ($\chi^2(16) = 36.98$, $p = .002$, RMSEA = 0.022, CFI = 0.976, TLI = 0.958, SRMR = 0.031). Although the quadratic term for career exploration was not significant, significant variance was present in the linear slope for career exploration when the quadratic term was omitted. Therefore, for the purpose of using the latent parameter scores to compare individuals, the model with both quadratic terms was retained. See Table 4-5 for parameter relationships between the academic value beliefs and career identity models.

**Trajectories.** It was hypothesized for this analysis (4a) that both career commitment and career exploration would increase over the course of high school. This hypothesis was contradicted in the case of commitment, which showed a significant negative linear slope ($M$ = -0.09, $SE$ = 0.04, $p$ = .009). A significant positive quadratic parameter ($M$ = 0.03, $SE$ = 0.01, $p$ = .004) indicates that this negative trend becomes less pronounced over time. The hypothesis was also not supported in the case of career exploration, which did not have either a significant linear term ($M$ = -.03, $SE$ = 0.04, $p$ = .426) or quadratic term ($M$ = 0.01, $SE$ = 0.01, $p$ = .308) and therefore did not show significant change over time.

**Parameter relationships.** The intercepts, slopes, and quadratic terms were not significantly related within each variable, showing that a participant's initial level of career exploration or commitment was unrelated to the subsequent trajectory in the same variable. However, the intercepts, slopes, and quadratic terms were positively related between the two variables. Therefore, students with high initial levels of commitment tended to report high initial levels of exploration, and students who decline in commitment also tend to decline in exploration. Finally, the variances of the linear and quadratic terms were not significant (see Table 4-4 and Figure 4-24), demonstrating that students followed similar longitudinal patterns for these variables.

**Parameter relationships with academic variables.** Although not related to a specific hypothesis, this analysis also permits the calculation of relationships between the latent growth parameters for the academic value beliefs and the career identity variables. The career exploration intercept was positively related to the intercept terms for all subjects (English ($r(2603) = .09$, $p < .001$; math ($r(2603) = .15$, $p < .001$; science ($r(2603) = .16$, $p < .001$; social studies ($r(2603) = .07$, $p < .001$), meaning that students more engaged in career exploration show slightly higher values for all subjects. Exploration slope was negatively related to English slope ($r(2603) = -.09$, $p < .001$), math slope ($r(2603) = -.09$, $p < .001$), and social studies slope ($r(2603) = -.08$, $p < .001$). This trend could indicate support for the development of differentiation, such that students who are exploring more career options become more selective in which academic subjects they favor as a result. In the case of English and social studies value, which follow positive trajectories overall, this pattern may signify that students high in exploration improve less in their English and social studies value beliefs due to a ceiling effect.

Regarding career commitment, the intercept for this variable was positively related to the intercept for science ($r(2603) = .08$, $p < .001$) and math ($r(2603) = .10$, $p < .001$), and linear slope was positively related to the slope for math value ($r(2603) = .09$, $p < .001$) and science value ($r(2603) = .09$, $p < .001$). Therefore, students reporting greater commitment to a career aspiration tend to place greater value on STEM domains. The present analysis cannot establish the direction of this relationship, which could be consistent either with initial high interest in STEM facilitating later career commitment, or initial high career commitment (possibly to a STEM career) buffering against declining value in these subjects (Lauermann et al., 2017).

## Phase 2: Demographic Group Differences

In the next analysis phase, the latent intercepts and slopes calculated in the growth curve analyses for each participant were used in Analyses of Variance (ANOVAs) to detect group differences based on gender, Racial/Ethnic identification, and parental educational attainment. When analyzing academic variables, all four subjects were included simultaneously in a

Repeated-Measures design in order to allow comparisons between academic subjects. However, the career commitment and exploration variables were not measured using comparable survey scales, and therefore were not included together. Two Repeated-Measures ANOVAs were conducted in total. The first included the latent intercept terms for the four academic subjects simultaneously, and the second included the latent slopes for all academic subjects simultaneously. Next, four univariate ANOVAs were performed to assess the latent career commitment intercepts, career commitment slopes, career exploration intercepts, and career exploration slopes separately. To maintain adequate cell sizes, all analyses were initially conducted using the four-category, biracial-inclusive Racial/Ethnic identification variable. In the presence of interaction effects, further univariate and Repeated-Measures ANOVAs were performed as necessary. When Racial/Ethnic identification effects were significant, all results were verified by repeating the analysis with the four-category single-identification measure, and post-hoc tests on these effects used the five-category variable in order to obtain more detailed information.

**Group Differences in Initial Levels of Academic Value Beliefs**

In the first Repeated-Measures Analysis of Variance, the latent intercepts of value beliefs in all four academic subjects were predicted from gender, Racial/Ethnic identification, parental educational attainment, and all two-way interactions between these variables. In the second Repeated-Measures Analysis of Variance, the latent slopes of value beliefs in all four academic subjects were predicted from the same demographic variables. The hypotheses in the slope analysis are equivalent to those for the intercept analysis, with greater declines in value expected for groups that were hypothesized to show lower value intercepts. The hypotheses for this analysis were as follows:

3a) Gender: Women will value English and social studies more than do men. For math and science, men will value these subjects more than do women or no gender difference will be present.

3b) Racial/Ethnic identification: In any subject, Black/African American and Hispanic/Latinx students will either report lower value than White/Caucasian students, or no difference will be present. Asian/Asian American students will report higher value on math and science than White/Caucasian students.

3c) Parental educational attainment: In any subject, students with lower parental educational attainment will report lower value, or no difference will be present.

3d) Educational aspirations: Differences in value beliefs based on parental educational attainment, if evident, will be similar to differences based on student educational aspirations.

3e) Demographic interactions: Gender differences in STEM subject value, if present, will be smaller among Black/African American students than among White/Caucasian and Hispanic/Latinx students.

In the analysis of academic value intercepts, a significant main effect of academic subject was present using the Greenhouse-Geisser sphericity correction, $F(1.97, 3999.18) = 208.92$, $p < .001$. Pairwise comparisons showed that all subject intercepts significantly differed from each other, with science being the favorite subject overall ($M = 3.78$, $SE = .02$), followed by English ($M = 3.67$, SE = .02), then math ($M = 3.50$, $SE = .02$), then social studies ($M = 3.17$, $SE = .02$). Three significant effects of demographic traits using the Greenhouse-Geisser sphericity correction were evident: a main effect of parental educational attainment, a main effect of gender, a subject by gender interaction, and an interaction between subject and Racial/Ethnic identification. No interactions between demographic variables were present. The main effect of gender on value intercepts, $F(1, 2017) = 5.93$, $p = .015$, indicated that women ($M = 3.57$, $SE = .02$) placed greater value on academic subjects on average than men ($M = 3.5$, $SE = .02$).

**Gender effects.** The significant subject by gender interaction, $F(1.97, 3999.18) = 29.80$, $p < .001$, demonstrates that women's value beliefs differed from men's in some subjects but not in all. As hypothesized, when examining gender differences within each subject with univariate ANOVAs, women valued English more than did men $F(1, 2026) = 62.00$, $p < .001$. However, inconsistent with the hypothesized effect, no gender difference was identified in social studies, $F(1, 2026) = 0.65$, $p = .799$ (see Figure 4-1 through Figure 4-6). For math and science, the present study supports previous research finding gender differences in favor of men in math value, $F(1, 2026) = 11.95$, $p = .001$, and no gender differences in science value, $F(1, 2026) = 0.20$, $p = .657$.

To consider subject preferences within each gender, multivariate Repeated-Measures ANOVAs using the Greenhouse-Geisser correction conducted separately for each group found significant subject differences for both men, $F(1.90, 2007.23) = 100.82$, $p < .001$, and women, $F(1.90, 1957.15) = 125.56$, $p < .001$. Pairwise comparisons showed that all subject intercepts differed significantly (see Figure 4-1 through Figure 4-6) except for English and science for women, and English and math for men. Therefore, women placed the most value on English and science together, followed by math, followed by social studies; meanwhile, men reported the highest value for science, followed by English and math together, followed by social studies. Consistent with the hypothesis, women valued English more than math, while men valued science more than English and math more than social studies. In summary, results consistent with previous research were found in English, math, and science yet not in social studies.

**Racial/Ethnic identification.** The significant subject by Racial/Ethnic identification interaction, $F(1.97, 3{,}999.18) = 4.31$, $p < .001$, signified that value beliefs differed between Racial/Ethnic groups in some academic subjects but not all. This result was verified using the four-category single-identification measure. Subsequent analyses to investigate these differences used the five-category biracial-inclusive measure. Regarding between-group differences, univariate ANOVAs comparing Racial/Ethnic groups within subjects found significant differences for math ($F(4, 2021) = 4.03$, $p = .003$; see Figure 4-8) and science ($F(4, 2021) = 3.90$, $p = .004$; see Figure 4-9) but not English ($F(4, 2021) = 0.28$, $p = .891$; see Figure 4-7) or social studies ($F(4, 2021) = 0.96$, $p = .091$; see Figure 4-10).

Further pairwise comparisons for math found that Asian/Asian American students valued the subject significantly more than all other groups (see Figure 4-8), with no other significant group differences present. In science, Asian/Asian American students again valued the subject more than all other groups, while Black/African American students reported significantly lower value than both White/Caucasian and Asian/Asian American students. Hispanic/Latinx students differed significantly only from Asian/Asian American students. Therefore, the proposal that URM students may place lower value on academics is supported only in the subject of science, and the present results are also consistent with previous findings that Asian/Asian American students report higher value for STEM domains than other groups.

In within-group comparisons of value beliefs, Repeated-Measures ANOVAs were completed separately for each group using the Greenhouse-Geisser correction, with significant effects of subject present in all groups: White/Caucasian, $F(1.91, 2006.52) = 130.84$, $p = < .001$; Asian/Asian American, $F(1.99, 512.22) = 49.2$, $p = < .001$; Black/African American, $F(2.21, 735.8) = 47.35$, $p = < .001$; Hispanic/Latinx, $F(2.02, 216) = 16.06$, $p = < .001$; Other/Multiple,

$F(1.91, 493.84) = 50.57$, $p$ = < .001. Pairwise comparison determining the order of subject preference within Racial/Ethnic groups indicated that all groups generally resembled the overall pattern of valuing science the most, then English, then math, then social studies. However, the magnitude of the differences between these preferences differed between groups (see Figure 4-7 to Figure 4-10). Notably, Asian/Asian American students were the only group who placed significantly more value on science than English. Therefore, URM students were not more likely than White/Caucasian and Asian/Asian American students to value STEM subjects less than other subjects.

**Parental educational attainment.** The significant main effect of parental educational attainment, $F(1.97, 3{,}999.18) = 4.31$, $p < .001$, showed that parental educational attainment is related to average value beliefs across subjects. A linear contrast for this overall effect was significant ($t(2026) = 4.3$, $p < .001$), with the “Less than Bachelor's degree” group reporting the lowest value beliefs on average across subjects ($M = 3.45$, $SE = .04$), the “Bachelor's degree” group indicating higher average value ($M = 3.50$, $SE = .03$), followed by “Master's degree” ($M = 3.56$, $SE = .02$), and “Law, Medical, or Ph.D.” ($M = 3.6$, $SE = .02$). However, this relationship was stronger in some academic subjects than others. Univariate ANOVAs in each subject determined that the effect of parental educational attainment was significant in math ($F(3, 2026) = 2.80$, $p = .039$; see Figure 4-12), science, ($F(3, 2017) = 6.78$, $p < .001$; see Figure 4-13), and social studies ($F(3, 2017) = 4.00$, $t = .007$; see Figure 4-14), but not English ($F(3, 2026) = 1.82$, $p = .140$; see Figure 4-11).

However, these significant effects were not always characterized by a linear pattern. A linear contrast for levels of parental educational attainment was significant in science ($t(2026) = 4.58$, $p$ <. 001) and social studies ($t(2026) = 3.27$, $p = 0.001$), with students reporting higher parental educational attainment placing higher value on the subject (see Figure 4-13). In math, while a linear relationship was not significant, ($t(2026) = 1.81$, $p = 0.069$), pairwise comparisons using the Tukey test found that students reporting the highest parental educational attainment expressed significantly more value for math than students in the two categories of lowest parental educational attainment (“Less than Bachelor's degree”, $t(904) = 3.07$, $p = .011$; “Bachelor's degree”, $t(1061) = 4.1$, $p = .002$). However, as the linear contrast is a more direct test of this hypothesis, this result should be regarded as marginally significant. Overall, in partial support of the contention that lower parental educational attainment may constitute a risk factor for academic value, lower parental educational attainment was associated with lower value beliefs in science and social studies, with a marginally significant trend in math. However, levels of value in English were not affected.

**Educational aspirations.** In order to gain more information into whether the effects of parental educational attainment on value beliefs may also be reflected in the effects of students' own educational aspirations, a single item relating to educational aspirations was included in the final survey wave. As discussed above, this variable was characterized by a strong ceiling effect, with very few students aspiring to fewer years of education than a Bachelor's degree. Therefore, this variable was recoded into three categories, consisting of “Bachelor's degree or less,” “Master's degree,” and “Law, Medical, or Ph.D. degree”. In order to maintain adequate cell sizes in this analysis, other demographic variables were not included and all grades were combined. A Repeated-Measures ANOVA on latent value intercepts using the Greenhouse-Geiser correction established a main effect of educational aspirations, $F(2,790) = 16.84$, $p < .001$, as well as an aspiration by subject interaction, $F(4.20, 1658.63) = 5.53$, $p < .001$. Follow-up univariate ANOVAs to address the aspirations by subject interaction confirmed significant linear contrast effects only for math intercept ($F(1, 790) = 13.51$, $p < .001$), and science intercept ($F(1, 790) = 74.33$, $p < .001$), with lower educational aspirations associated with lower value. Therefore, these results support the hypothesis that student educational aspirations would show the same relationship with academic value beliefs as parental educational attainment in math and science only, providing evidence consistent with the possibility that student aspirations could mediate the negative effect of lower parental educational attainment on these variables.

**Group Differences in Academic Value Trends**

In the analysis of academic value slopes, a significant main effect of academic subject was present using Huynh-Feldt sphericity correction $F(2.40, 4851.88) = 2.48$, $p < .001$). Pairwise comparisons established that all subjects significantly differed in slope, English showing the largest increase ($M = .11$, $SE = .01$), social studies showing a smaller increase ($M = .07$, $SE = .01$), math showing a slight decrease ($M = -.08$, $SE = .01$), and science showing the largest decrease ($M = -.11$, $SE = .01$).

**Parental educational attainment.** The main effect of parental educational attainment on academic value slope on average across academic domains was significant, $F(3, 2026) = 4.438$, $p = .004$). A linear contrast was also significant, ($t(2026) = 3.50$, $p < .001$), with overall average slopes lowest in the “Less than Bachelor's degree” group ($M = -.05$, $SE = .02$), higher in the “Bachelor's degree” group ($M = -.01$, $SE = .02$), and higher still in the “Master's degree” group ($M = .01$, $SE = .02$) and “Law, Medical, or Ph.D. degree” group ($M = .04$, $SE = .02$). The average slope in the “Less than Bachelor's degree” group was significantly negative ($t(311) = -0.06$, $SE = 0.03$, $p = .029$), the average slope in the “Law, Medical, or Ph.D. degree” group was significantly positive ($t(593) = 0.04$, $SE = 0.02$, $p = .005$), and the slopes in the two intermediate groups were not significant (“Bachelor's degree”, *t(*468) = -0.01, *SE* = 0.02, *p* = .445; “Master's degree”, *t(*677) = 0.01, *SE* = 0.02, *p* =0.549).

Further linear contrasts used in univariate ANOVAs separately for each subject were also significant in all subjects (English, *t(*2026) = 2.93, *p* = .003; math, *t(*2026) = 2.09, *p* = .036; science, *t(*2026) = 3.62, *p* = <. 001; social studies, *t(*2026) = 2.92, *p* = .003). In both English and social studies, the linear slope of the “Less than Bachelor's degree” group was not significant (English, *M* = 0.04, *SE* = 0.03, *p* = .207; social studies, *M* = 0.02, *SE* = 0.03, *p* = .484), while the trends for the other three groups were positive. In both Math and science, all groups showed significantly negative trends with a more pronounced decline among the groups with lower parental educational attainment. Again in support of the claim that low parental educational attainment can represent a risk factor, the group with lowest parental educational attainment declined in their level of value on average across all academic subjects while the groups with higher parental attainment instead improved in their average level of value. Therefore, this analysis further supports the claim that low-SES students may have more negative attitudes towards academics, potentially supporting a benefit of intervening with this group.

**Educational aspirations.** For this analysis, it was hypothesized that student educational aspirations would display the same relationship with academic value beliefs found for parental educational attainment. Therefore, it was expected that students with higher educational aspirations would report more positive trajectories in all academic domains. A Repeated-Measures ANOVA with latent value slopes using the Huynh-Feldt sphericity correction did not find a significant main effect of aspirations, *F*(2, 780) = .240, *p* = .787, but resulted in a significant subject by aspirations interaction, *F*(4.67, 1855.59) = 2.48, *p* = .033. Follow-up univariate ANOVAs found significant linear contrast effects only in science, *F*(1, 790) = 8.34, *p*

= .004. Although trends in all groups were significantly negative, groups with lower educational aspirations demonstrated significantly more negative trajectories (Less than Bachelor's degree, *M* = -*.15, SD* = .32*;* Bachelor's degree, *M* = -.12, *SD* = .32; Master's degree, *M* = -.12, *SD* = .32; Law, Medical, or Ph.D. degree, *M* = -.07, *SD* = .28). Therefore, consistent with the hypothesis, both parental educational attainment and student aspirations are linked with declining value beliefs in science. However, this result provides evidence that the effects of parental educational attainment on declining value beliefs in the other academic subjects are not mediated through students' own aspirations.

**Group Differences in Initial Levels of Career Identity**

In the first univariate ANOVA, the latent intercepts for career commitment were predicted from gender, Racial/Ethnic identification, parental educational attainment, and all two-way interactions between these variables. In the second univariate ANOVA, this analysis was repeated with career exploration intercepts as the outcome. The hypotheses for this analysis were as follows:

5a) Gender: Women will report higher levels of both variables.

5b) Parental educational attainment: Students with lower parental educational attainment will report lower levels of both variables.

5d) Educational aspirations: Differences in value beliefs based on parental educational attainment, if present, will be similar to differences based on student educational aspirations.

5e) Race: Students from URM groups will report lower levels of both variables.

In this analysis, no significant effects were observed in either career exploration or commitment intercepts on the basis of gender (see Figure 4-15 and Figure 4-16) or student educational aspirations, and career exploration intercepts also did not differ based on parental educational attainment (see Figure 4-18).

**Racial/Ethnic identification.** Career commitment intercept differed significantly between Racial/Ethnic groups, $F(3, 1930) = 10.05$, $p < .001$ (see Figure 4-19). This result was verified using the four-category single-identification measure. Pairwise comparisons using the five-category biracial-inclusive measure found that students in the Other/Multiple category ($M$ = 3.24, $SE$ = .02) as well as Black/African American students ($M$ = 3.23, $SE$ = .02) reported significantly higher career commitment than Hispanic/Latinx students ($M$ = 3.09, SE = .04), Asian/Asian American students, ($M$ = 3.06, $SE$ = .02), and White/Caucasian students ($M$ = 3.05, $SE$ = .01). This result contradicts previous research finding that individuals with URM identification experience delayed career identity development.

In the analysis of career exploration intercepts, a significant effect of Racial/Ethnic identification was also present, $F(3, 1930) = 4.84$, $p = .002$ (see Figure 4-20). This result was verified using the four-category single-identification measure. Pairwise comparisons using the five-category biracial-inclusive measure found that White/Caucasian students ($M$ = 3.63, $SE$ = .01) reported significantly lower career exploration than students in the Other/Multiple category ($M$ = 3.70, $SE$ = .02; $t(1019) = 4.11$, $p$ = .001), and Black/African American students ($M$ = 6.69, $SD$ = .02, $t(1332) = 4.12$, $p < .001$). This result partially supports the previous research finding that individuals with URM identification experience faster career identity development.

**Parental educational attainment.** In the same analysis of career commitment intercepts, no significant main effect of parental educational attainment was observed $F(3, 1930) = 10.05$, $p = .082$, but a linear contrast on this variable was significant, $t(1930) = 2.46$, $p = .015$. Pairwise comparisons using the Tukey test determined that the lowest parental educational attainment group (*M* = 3.22, *SE* = .04) displayed significantly greater commitment than all other groups ("Bachelor's degree", *M* = 3.12, *SE* = .03, *t*(1930) = 3.76, *p* = .001; "Master's degree", *M* = 3.13, *SE* = .02; *t*(1930) = 4.47, *p* < .001; "Law, Medical, or Ph.D. degree", *M* = 3.11, *SE* = .02, *t*(1930) = 4.69, *p* < .001). Therefore, this result contradicts the more common finding that lower SES relates to less advanced career identity development. A potential explanation for this result is that students with lower parental educational attainment commit to career goals earlier because they plan to complete fewer additional years of education and therefore must make occupational decisions sooner. However, this analysis indicated that student educational aspirations had no relationship with career commitment and is therefore unlikely to be a mediating variable.

**Group Differences in Career Identity Trends.**

In the third and fourth univariate ANOVAs, the analysis above was repeated with the latent slopes for career commitment and then with the latent slopes for career exploration as the outcome variables. Hypotheses were equivalent, with greater declines expected for groups hypothesized to show lower average values. No significant group differences were found for the slope term of career exploration (see Figure 4-16, Figure 4-18, and Figure 4-20). Similarly, no significant group differences were found in career commitment trends for gender (see Figure 4-15) Racial/Ethnic identification (see Figure 4-19), or student educational aspirations.

**Parental educational attainment.** However, for trends in career commitment, a marginally significant effect of parental educational attainment was evident, *F(*3, 1921) = 2.72, *p* = .043. A linear contrast for this effect was marginally significant as well, *t(*1921) = 2.0, *p* = .44. Pairwise comparisons using the Tukey test showed that this effect was caused by the lowest parental education group (*M* = -.06, *SE* = .02) showing a less negative slope in career commitment than the "Bachelor's degree" group (*M* = -.10, *SE* = .01, *t(*866) = 3.5, *p* = .022) and the “Law, Medical, or Ph.D. degree” group ($M$ = -.11, $SE$ = .01, $t(720) = 2.72$, $p$ = .032). However, in a departure from the expected linear trend, the “Master's degree” group ($M$ = -.08, $SE$ = .01) was between the “Less than Bachelor's degree” and the “Bachelor's degree” category. Overall, this result does not show a clear pattern in the effect of parental educational attainment on career exploration slope. In addition, in a pattern similar to the results of the previous analysis, the finding that students' own educational aspirations do not significantly relate to career exploration slope fails to support the possibility of mediation.

## Phase 3: Growth Mixture Modeling

As part of the trend towards person centered analyses, the technique of growth mixture modeling (GMM) has been increasingly used to expand person-centered analyses or the multivariate analysis of within-person patterns to longitudinal data. Similar to a cluster or latent class analysis, growth curve mixture modeling finds subgroups of participants who share patterns across several variables simultaneously. The unique feature of this analysis is that classes are based on latent growth curve parameters, so the subgroups are determined by longitudinal trajectories. This technique is suited to looking for motivation declines as well as specialization, because it does not require the a priori selection of cutoff values demarcating students who are substantially “declining” or “specializing”. For example, a negative linear growth parameter could be used to represent a motivational decline. According to this metric, in this sample 23% of students do not exhibit any significant declines in value beliefs, 22% of students decline significantly in value for one subject, 28% of students decline significantly in value for two subjects, 11% of students decline significantly in value for three subjects, and 16% of students decline significantly in value in all four subjects. However, the practical significance of these categories is unclear, given that the magnitude of the linear parameters in the models for this data is quite small.

In this analysis, value beliefs for all four academic subjects were included in a GMM analysis in order to identify common combinations of longitudinal trajectories over high school. The following hypotheses were proposed for this phase:

2a) Classes will include a group with high value for all subjects and a group with low value for all subjects.

2b) Classes will include a STEM preference group and a humanities preference group.

2c) At least one cluster will show a pattern of specialization, declining in value for at least one subject but stable in at least one other subject.

**Model fit**

When conducting this technique, similar to other class and cluster analyses, models using different numbers of classes must be compared to identify the appropriate number of subgroups. Several commonly used statistical indices of model fit include the Bayesian information criterion (BIC; Schwarz, 1978) and Akaike's information criterion (AIC; Akaike, 1987), for which lower values represent relative better fit. Another model fit metric, entropy (Clark & Muthén, 2009), reflects better fit at higher values. The Lo–Mendell–Rubin likelihood ratio test (LMR-LRT; Lo, Mendell, & Rubin, 2001) is significant if removing a class from the model would result in better fit. In addition, models are more desirable if no classes are smaller than 1% of the total sample. Another desirable trait is that average posterior probabilities of latent class categorization are high, indicating less ambiguity in assigning individuals to classes (Jung & Wickrama, 2008).

In the present analysis, designs with varying numbers of latent classes were estimated for each of three models based on the previous growth curves. The first model tested included only linear growth parameters for each subject. The second model included both linear and quadratic growth parameters. Finally, due to the fact that only science value demonstrated a significant quadratic trend, a third model was assessed including a quadratic parameter for science only. Two- through seven-class solutions were estimated for the linear model, stopping at seven due to the smallest class size decreasing to less than 1% of the sample. Two- through nine-class solutions were estimated for both of the other models. The fit metrics described above were then used to assess the quality of fit for these 22 models (see Table 4-6). Based on similar previous studies, between three (Guo, Wang, Ketonen, Eccles, & Salmela-Aro, 2018; Musu-Gillette, Wigfield, Harring, & Eccles, 2015) and seven (Archambault et al., 2010; Wang, Chow, Degol, & Eccles, 2017) classes were expected.

In this dataset, substantial instability was evident in the patterns found based on different models and numbers of clusters. Considering the four- through six-class solutions for each of the three models (see Table 4-7), only a few value patterns with substantial similarity were regularly found. In every model, the vast majority of students belonged to a group with high, stable, and undifferentiated value in all subjects. In all but one of this subset of cluster solutions, the “High stable” group comprised 67% of participants or more. Every model also included a moderately sized “Humanities preference” class (usually between 300 and 400 students), and most models included a small “Declining” class (between 40 and 70 students). However, all other value patterns were evident in fewer than half of the potential models. For example, small groups of students that were defined as latent classes in two or fewer of these nine GMM models include a group preferring English and science to all other subjects, a group increasing in value for all subjects, a group favoring English with a temporary drop in value for science, and a group placing high value on both English and math. In some models, a subgroup favoring science to all other subjects was identified instead of a subgroup favoring both STEM subjects.

In addition, for the majority of the 22 models, entropy was below the value of .80 considered to reflect good fit. Overall, this dataset does not appear overall to be well characterized by the presence of significant subgroups. Due to the above inconsistencies in subgroup patterns and fact that model fit indicators conflicted, the six-class model with only linear parameters was selected to use in further analyses based substantially on theoretical meaning (see Figure 4-25 and Table 4-8).

**Description of class solution**

The “STEM Decline” class consisted of 107 students or 3.9% of the sample. The latent slope for English was significantly positive and for science significantly negative. Pairwise comparisons of the subject intercepts found that all differed significantly aside from math and social studies. Therefore, students in this cluster placed the most initial value on English, followed by social studies and math together, then followed by science as the least favorite.

The “High stable” class consisted of 2,060 students or 75.1% of the sample. The only subject in this class with a significant linear slope was English, which followed a positive trend. Intercepts in all subjects differed significantly, with science as the most valued subject, followed by English, then math, then social studies.

The “Increasing” class represented 106 students or 3.9% of the sample. All content areas had a significantly positive linear slope, and the intercepts were not significantly different.

The “STEM preference” class included 174 students or 6.3% of the sample. No subjects had a significant slope, and all subject intercepts differed significantly. In this class, science was the most valued subject, followed by math, then social studies, then English.

The “Humanities preference” class consisted of 221 students or 8.1% of the sample. Only social studies had a significant slope, which was positive. All subject intercepts were significantly different with English being the favorite, then social studies, then math, then science.

Finally, the “Decline” class included 76 students or 2.8% of the sample. All subjects had a significant negative slope. The social studies value intercept was significantly lower than the intercepts for all other content areas.

Therefore, in partial support of hypothesis (2a), a class emerged with high value on all subjects (75% of participants) but a corresponding class with low value on all subjects was not evident in this model. Hypothesis (2b) was supported, as a class preferring English (8% of participants) and a class preferring STEM subjects (6% of participants) were both found. Hypothesis (2c) was supported in finding a class with increasing specialization over time, but membership in this group was low (4% of participants). Notably, only a small minority of students (7%) belonged to one of the two class that showed declining value beliefs.

A comparison of the average longitudinal trends to those found in these classes shows several differences. While 54% of students had a significant positive slope in English, 83% fell into a class with a significant positive trend (“High stable,” “Increasing,” and “STEM decline”). A significant negative trend in math was found for 51% of students, but only 3% of students fell into a class with a significant negative trend (“Decline)”. A significant negative slope in science value was observed for 60%, but only 7% of students fell into a class with a significant negative trend (“STEM decline” and “Decline”). Finally, while 51% of students had a significant positive slope in social studies, only 12% fell into a class with a positive trend in social studies (“Humanities preference” and “Increasing”).

## Phase 4: Demographic Differences in Group Membership

Next, Loglinear models and chi square analyses were used to predict class membership based on the growth mixture model classes. Loglinear model was fit using parental educational attainment, Racial/Ethnic identification, gender, and class membership. In order to have adequate cell sizes to examine three-way interactions, parental educational attainment was dichotomized into "Less than Bachelor's degree" ($n$ = 315) and "Bachelor's degree or higher" ($n$ = 2,481), and Racial/Ethnic identification was dichotomized based on URM ($n$ = 881) and non-URM ($n$ = 1,438) identification. Significant effects were followed up with more detailed analysis. The hypotheses for this analysis are as follows:

3a) Gender: Women will be more likely to belong to groups with relative preference for English and social studies. For math and science, men will be more likely to belong to groups with relative preference for these subjects, or no gender difference will be present.

3b) Racial/Ethnic identification: In any subject, Black/African American and Hispanic/Latinx students will either report lower value than White/Caucasian students, or no difference will be present. Asian/Asian American students will report higher value on math and science than White/Caucasian students.

3c) Parental educational attainment: In any subject, students with lower parental educational attainment will report lower value, or no difference will be present.

3d) Educational aspirations: Differences in value beliefs based on parental educational attainment, if evident, will be similar to differences based on student educational aspirations.

3e) Demographic interactions: Gender differences in STEM subject value, if present, will be smaller among Black/African American students than among White/Caucasian and Hispanic/Latinx students.

In the loglinear model, all interactions were initially included. Partial effects represent chi square difference between the saturated model and the model without this effect. Significant main effects were found of parental educational attainment, $\chi^2(5) = 18.90$, $p = .002$, URM identification, $\chi^2(5) = 15.59$, $p = .008$, and gender, $\chi^2(5) = 58.78$, $p < .001$ on class membership, but no interactions. When parental educational attainment was dichotomized into "Bachelor's degree or lower" ($n = 964$) and "Higher than Bachelor's degree" ($n = 1{,}517$), the same pattern of effects was seen (parental educational attainment, $\chi^2(5) = 21.39$, $p = .001$; URM identification, $\chi^2(5) = 20.023$, $p = .008$; gender, $\chi^2(5) = 58.51$, $p < .001$).

**Gender**

A Chi-Square test determined that group membership differed significantly by gender, $\chi^2(5, n = 2678) = 58.01$, $p < .001$. As hypothesized, women were overrepresented in the "STEM decline" class (ASR = 4.2, $p < .001$), underrepresented in the "STEM preference" class (ASR = -4.4, $p < .001$), and overrepresented in the "Humanities preference" class (ASR = 2.1, $p = .035$). In addition, women were underrepresented in the "Increasing" class (ASR = -2.9, $p = .006$), and the "Decline" class (ASR = -3.2, $p = .001$).

**Parental educational attainment**

To obtain more detail, the four-category parental educational attainment variable was used rather than the dichotomous variable in the follow-up analysis. Latent class membership differed significantly, $\chi^2(15, n = 2461) = 53.31$, $p < .001$ (see Figure 4-26), with only the "Less than Bachelor's degree" category and the "Law, Medical, or Ph.D." category showing uneven distributions across classes. The “Less than Bachelor's degree” group was underrepresented in the “High stable” class (ASR = -3.4, $p = .044$) and overrepresented in the “Humanities preference” class (ASR = 3.0, $p = .004$) as well as the “Decline” class (ASR = 4.2, $p < .001$). The “Law, Medical, or Ph.D. degree” group was overrepresented in the “High stable” class (*ASR* = 4.1, $p < .001$) and underrepresented in the “Humanities preference” class (*ASR* = -3.1, $p = .002$). Therefore, students with parents who had completed fewer years of education appeared more likely to demonstrate less adaptive patterns of value beliefs.

**Racial/Ethnic Identification**

For Racial/Ethnic identification, the follow-up analysis used the four-category biracial-inclusive variable, finding significant differences in class membership, $\chi^2(5, n = 2292) = 33.17$, $p < .001$ (see Figure 4-27). The five-category variable could not be used due to inadequate cell sizes. Asian/Asian American students were underrepresented in the “STEM decline” class (ASR = 2.1, $p = .044$), and overrepresented in “STEM preference” class (ASR = 2.2, $p = .035$). White/Caucasian students were overrepresented in “High stable” class (ASR = 3.0, $p = .004$). Black/African American students were underrepresented in the “High stable” class (ASR = -3.2, $p = .002$) and overrepresented in the “Humanities preference” class (ASR = 2.4, $p = .022$) and decline (ASR = 2.1, $p = .044$) classes. No significant effects regarding the “Hispanic/Latinx/-Other/Multiple” category were present. When this analysis was repeated using the single-identification variable, all previous effects were still present and additionally Black/African American students were underrepresented in “STEM preference” group (ASR = 2.3, $p = .028$). Therefore, the proposal that URM students are more likely to devalue academics is partially supported by the result that Black/African American students are underrepresented in the “High stable” class.

## Phase 5: Value Profile Differences in Career Identity

Finally, in order to evaluate whether GMM class membership was related to career identity development, univariate ANOVAs were conducted to predict career commitment latent intercepts, career commitment latent slopes, career exploration latent intercepts, and career exploration latent slopes from class membership. The hypothesis for this analysis (5) was that intercepts and slopes of both variables would be greater in more specialized classes. Therefore, class membership was dichotomized into “Specialized” ($n$ = 502) and “Not specialized” ($n$ = 2,242), with “Specialized” classes consisting of “STEM decline,” “STEM preference,” and “Humanities preference”. Gender, Racial/Ethnic identification, and parental educational attainment were included as covariates. Significant differences were found in both commitment intercept ($F$(1, 1889) = 5.43, $p$ = .020) and slope ($F$(1, 1889) = 4.28, $p$ = .039). Members of more specialized classes displayed higher commitment intercepts ($M$ = 3.13, $SE$ = .02) than members of less specialized classes ($M$ = 3.12, $SE$ = .02). Similarly, members of more specialized classes ($M$ = -.064, $SE$ = .02) exhibited less negative commitment slopes than members of less specialized classes ($M$ = -.10, $SE$ = .01). No group differences were found in exploration intercept, $F$(1, 1889) = 1.36, $p$ = .243, or slope, $F$(1, 1889) = 1.26, $p$ = .262.

Additional ANOVAs using the full six-category latent class variable replicated significant class differences in career commitment intercept ($F$(5, 1940) = 3.61, $p$ = .003) as well as slope ($F$(5, 1940) = 4.46, $p$ < .001). For commitment intercept, the classes were ordered such that the “STEM Decline” ($M$ = 3.28, $SE$ = 0.06) class exhibited the greatest career commitment, followed by “STEM preference” ($M$ = 3.28, $SE$ = 0.05), “Humanities Preference” ($M$ = 3.19, $SE$ = 0.04), “High Stable” ($M$ = 3.13, $SE$ = 0.01), “Improving” ($M$ = 3.04, $SE$ = 0.06), and “Decline” ($M$ = 2.8, $SE$ = 0.08). However, pairwise comparisons determined that only the lowest class on this variable, “Decline,” and the second to highest class, “STEM preference” differed significantly.

Respecting the career commitment slope, in a similar ordering, the “STEM Preference” class displayed the least negative trend (*M* = -0.05, *SE* = 0.02), followed by the “STEM Decline” class (*M* = -0.05, *SE* = 0.02), “Humanities Preference” class (*M* = -0.09, *SE* = 0.01), “High Stable” class (*M* = -0.09, *SE* = 0.004), “Decline” class (*M* = -0.16, *SE* = 0.03), and finally the “Improving” class (*M* = -0.16, *SE* = 0.02). Pairwise comparisons established that the only significant differences were between the class with the least decline, “STEM Preference,” and the two classes with the greatest declines, “Improving”, $t(198) = 3.50$, $p = .005$, and “Decline”, $t(185) = 3.20$, $p = .017$. Generally, the hypothesis was partially supported in this analysis, with members of more specialized classes exhibiting greater career commitment but not exploration.

## Chapter 4 Tables

Table 4-1

*Model Fit Assessment for Latent Curve Analyses*

| | χ2 | χ2 *df* | χ2 *p* | RMSEA | CFI | TLI | SRMR | Chi-Square difference |
|---|---|---|---|---|---|---|---|---|
| Academic | | | | | | | | |
| Linear | 628.90 | 92 | <.001 | 0.046 | 0.928 | 0.907 | 0.049 | |
| Quadratic science | 590.10 | 82 | <.001 | 0.048 | 0.932 | 0.901 | 0.046 | with linear = 38.80, df = 10, $p$ < .001 |
| Quadratic all | 316.60 | 46 | <.001 | 0.046 | 0.964 | 0.906 | 0.027 | with linear = 312.30, df = 46, $p$ <.001<br>with quad. sci. = 273.49, df = 36, $p$ <.001 |
| Career | | | | | | | | |
| Linear | 51.25 | 22 | <.001 | 0.023 | 0.967 | 0.958 | 0.054 | |
| Quadratic commitment | 36.97 | 16 | 0.002 | 0.022 | 0.976 | 0.958 | 0.041 | with linear: 14.28, df = 6, $p$ = .0266 |
| Quadratic all | 20.71 | 9 | 0.014 | 0.022 | 0.987 | 0.958 | 0.031 | with linear = 30.541 df = 13, $p$ = .004<br>with quad. com. = 16.25, df = 7, $p$ = .022 |

*Note.* RMSEA = Root Mean Square Error Of Approximation; CFI = comparative fit index; TLI = Tucker-Lewis index; SRMR = Standardized Root Mean Square Residual

Table 4-2

*Latent Curve Analysis Parameters for Academic Value Beliefs*

| | Parameter Means | | Parameter Variances | |
|---|---|---|---|---|
| | *M* | *SE* | *M* | *SE* |
| English | | | | |
| Intercept | 3.68*** | 0.02 | 0.79*** | 0.09 |
| Linear | 0.11*** | 0.03 | 0.51*** | 0.14 |
| Quadratic | -0.02 | 0.01 | 0.03* | 0.01 |
| Math | | | | |
| Intercept | 3.49*** | 0.03 | 0.88*** | 0.11 |
| Linear | -0.08* | 0.03 | 0.38** | 0.14 |
| Quadratic | 0.01 | 0.01 | 0.03* | 0.01 |
| Science | | | | |
| Intercept | 3.79*** | 0.02 | 0.68*** | 0.09 |
| Linear | -0.11*** | 0.03 | 0.20 | 0.14 |
| Quadratic | 0.02 | 0.01 | 0.03** | 0.01 |
| Social Studies | | | | |
| Intercept | 3.21*** | 0.03 | 0.80*** | 0.12 |
| Linear | 0.07* | 0.04 | 0.41* | 0.18 |
| Quadratic | 0.00 | 0.01 | 0.03* | 0.02 |

*Note.*
*** $p < .001$
** $p < .01$.
* $p < .05$.

Table 4-3

*Correlations of Latent Parameters between Academic Domains*

| | Estimate | S.E. |
|---|---|---|
| Intercept | | |
| Math and English | 0.10*** | 0.03 |
| Science and English | 0.14*** | 0.03 |
| Science and Math | 0.47*** | 0.03 |
| Social Studies and English | 0.45*** | 0.03 |
| Social Studies and Math | 0.08** | 0.03 |
| Social Studies and Science | 0.14*** | 0.03 |
| Slope | | |
| Math and English | 0.22*** | 0.04 |
| Science and English | 0.20*** | 0.04 |
| Science and Math | 0.40*** | 0.04 |
| Social Studies and English | 0.43*** | 0.05 |
| Social Studies and Math | 0.18*** | 0.05 |
| Social Studies and Science | 0.23*** | 0.05 |

*Note.*

*** $p < .001$

** $p < .01$.

* $p < .05$.

Table 4-4

*Latent Curve Analysis Parameters for Career Identity Variables*

| | Parameter Means | | Parameter Variances | |
|---|---|---|---|---|
| | *M* | *SE* | *M* | *SE* |
| Commitment | | | | |
| Intercept | 3.09*** | 0.02 | 0.47** | 0.17 |
| Linear | -0.09** | 0.03 | 0.25 | 0.29 |
| Quadratic | 0.03** | 0.01 | 0.01 | 0.02 |
| Exploration | | | | |
| Intercept | 3.63*** | 0.02 | 0.03 | 0.16 |
| Linear | -0.02 | 0.03 | -0.29 | 0.26 |
| Quadratic | 0.01 | 0.01 | -0.02 | 0.02 |

*Note.*

*** $p < .001$

** $p < .01$.

* $p < .05$.

Table 4-5

*Correlations between Academic and Career Variable Latent Parameters*

| | N | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1) Gender | 2,705 | | | | | | | | | | | | | | |
| 2) URM identification | 2,319 | .02 | | | | | | | | | | | | | |
| 3) Upper two parental educational attainment categories | 2,481 | .02 | -.14** | | | | | | | | | | | | |
| 4) English intercept | 2,744 | .18** | -.02 | .043* | | | | | | | | | | | |
| 5) English slope | 2,744 | -.02 | .04* | .034 | -.45** | | | | | | | | | | |
| 6) Math intercept | 2,744 | -.09** | -.04* | .086** | .09** | -.17** | | | | | | | | | |
| 7) Math slope | 2,744 | -.01 | <.01 | .009 | -.20** | .49** | -.02 | | | | | | | | |
| 8) Science intercept | 2,744 | .01 | -.12** | .145** | .17** | -.11** | .62** | -.07** | | | | | | | |
| 9) Science slope | 2,744 | -.05** | -.01 | .060** | -.27** | .56** | .23** | .64** | .26** | | | | | | |
| 10) Social studies intercept | 2,744 | -.01 | -.056** | .068** | .62** | -.19** | .05** | -.22** | .13** | -.14** | | | | | |
| 11) Social studies slope | 2,744 | <.01 | .03 | .027 | -.20** | .79** | -.32** | .48** | -.22** | .51** | .036 | | | | |
| 12) Commitment intercept | 2,609 | -.03 | .16** | -.076** | .02 | <.01 | .09** | -.04* | .08** | .03 | -0.01 | -.03 | | | |
| 13) Commitment slope | 2,609 | <.01 | .03 | -.026 | .01 | .03 | .04* | .09** | .04* | .08** | <.01 | .03 | .11** | | |
| 14) Exploration intercept | 2,609 | -.03 | .10** | -.035 | .08** | .06** | .15** | .05** | .15** | .14** | .07** | .07** | .69** | .19** | |
| 15) Exploration slope | 2,609 | -.03 | .04* | .029 | .12** | -.08** | .12** | -.08** | .14** | -0.02 | .09** | -.08** | .21** | .16** | .05* |

Table 4-6

*Fit Indices for GMM Models*

| # of Classes | LL | AIC | BIC | saBIC | Smallest class size | Entropy | *p*-value for LMR LRT |
|---|---|---|---|---|---|---|---|
| Linear model | | | | | | | |
| 2 | -26106.8 | 52351.69 | 52759.98 | 52540.74 | 475 | 0.726 | 0.0026 |
| 3 | -26006.3 | 52168.65 | 52630.19 | 52382.36 | 59 | 0.778 | 0 |
| 4 | -25935.1 | 52044.15 | 52558.95 | 52282.52 | 72 | 0.676 | 0.0455 |
| 5 | -25886.4 | 51964.87 | 52532.92 | 52227.89 | 71 | 0.718 | 0.273 |
| 6 | -25838.8 | 51887.58 | 52508.88 | 52175.26 | 76 | 0.739 | 0.3625 |
| 7 | -25788.1 | 51804.24 | 52478.8 | 52116.59 | 9 | 0.777 | 0.0177 |
| Quadratic term for all subjects | | | | | | | |
| 2 | -25943.4 | 52124.78 | 52828.92 | 52450.82 | 449 | 0.736 | 0.0008 |
| 3 | -25859.2 | 51982.49 | 52763.56 | 52344.15 | 66 | 0.808 | 0.0004 |
| 4 | -25773.8 | 51837.62 | 52695.61 | 52234.89 | 96 | 0.783 | 0.0291 |
| 5 | -25718.6 | 51753.13 | 52688.04 | 52186.03 | 48 | 0.686 | 0.2332 |
| 6 | -25643.5 | 51628.95 | 52640.79 | 52097.47 | 46 | 0.738 | 0.6774 |
| 7 | -25598 | 51564.01 | 52652.76 | 52068.14 | 54 | 0.738 | 0.373 |
| 8 | -25532.1 | 51458.11 | 52623.8 | 51997.86 | 31 | 0.738 | 0.393 |
| 9 | -25501.3 | 51422.69 | 52665.29 | 51998.06 | 11 | 0.703 | 0.221 |
| Quadratic term for science | | | | | | | |
| 2 | -26145.9 | 52451.84 | 52925.21 | 52671.02 | 413 | 0.685 | 0.0013 |
| 3 | -26027.5 | 52234.91 | 52767.45 | 52481.5 | 188 | 0.716 | 0.0119 |
| 4 | -25932.7 | 52065.32 | 52657.04 | 52339.31 | 53 | 0.806 | 0.0744 |
| 5 | -25837.3 | 51894.53 | 52545.42 | 52195.92 | 60 | 0.744 | 0.1869 |
| 6 | -25821.3 | 51882.64 | 52592.7 | 52211.42 | 42 | 0.732 | 0.7281 |
| 7 | -25732.4 | 51724.83 | 52494.06 | 52081.01 | 62 | 0.721 | 0.2398 |
| 8 | -25732.9 | 51745.77 | 52574.18 | 52129.35 | 64 | 0.676 | 0.7329 |
| 9 | -25676.6 | 51653.19 | 52540.76 | 52064.16 | 68 | 0.677 | 0.7689 |

*Note.* LL = Loglikelihood; AIC = Akaike Information Criteria; BIC = Bayesian Information Criteria; saBIC = Sample-Size Adjusted BIC; LMR-LRT = Lo-Mendell-Rubin Adjusted Likelihood Ratio Test.

Table 4-7

*Prevalence and Size of Classes in Four to Six Class Solutions*

| GMM class membership and description |
|---|
| High stable - 1914, 1901, 2060, 2244, 2160, 909, 1884, 1928, 1859 |
| Humanities preference - 325, 292, 349, 427, 378, 389, 327, 221, 306 |
| Decline - 58, 72, 71, 46, 60, 48, 65, 76 |
| Science preference - 317, 355, 332, 1420 |
| STEM preference - 161, 174, 163 |
| High English with science temporary decrease - 75, 42 |
| High English and science - 346, 204 |
| Increase - 106, 92 |
| English preference with math decline - 81, 72 |
| STEM improvement - 53 |
| High English and math - 131 |
| STEM decline -107 |
| Low stable - 96 |

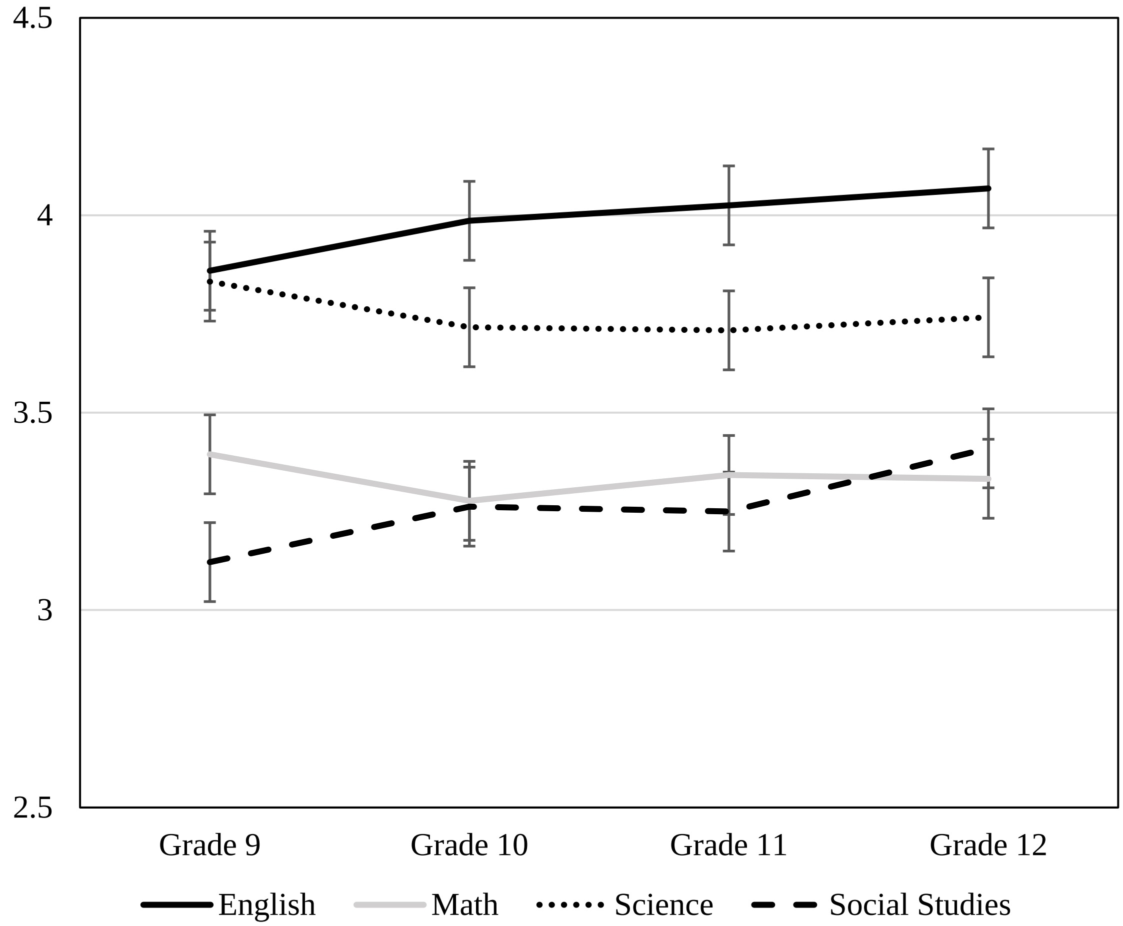
Table 4-8

*Intercept and Slope Parameters for GMM Classes*

| Latent Class | English | Math | Science | Social Studies |
|---|---|---|---|---|
| Intercept | | | | |
| STEM decline | 4.02*** | 3.55*** | 3.77*** | 3.55*** |
| High stable | 3.89*** | 3.59*** | 4.1*** | 3.33*** |
| Increasing | 1.97*** | 2.3*** | 1.79*** | 2.05*** |
| STEM preference | 2.17*** | 3.55*** | 4.28*** | 2.65*** |
| Humanities preference | 4.21*** | 3.02*** | 2.04*** | 3.2*** |
| Declining | 3.47*** | 3.7*** | 3.69*** | 3.17*** |
| Slope | | | | |
| STEM decline | 0.15* | -0.32 | -0.67*** | -0.1 |
| High stable | 0.05* | -0.02 | -0.02 | 0.07*** |
| Increasing | 0.59* | 0.27* | 0.37*** | 0.5*** |
| STEM preference | 0.17 | 0.05 | 0.05 | 0.12 |
| Humanities preference | 0.03 | 0.01 | 0.15 | 0.12* |
| Declining | -0.62*** | -0.73*** | -0.79*** | -0.51*** |

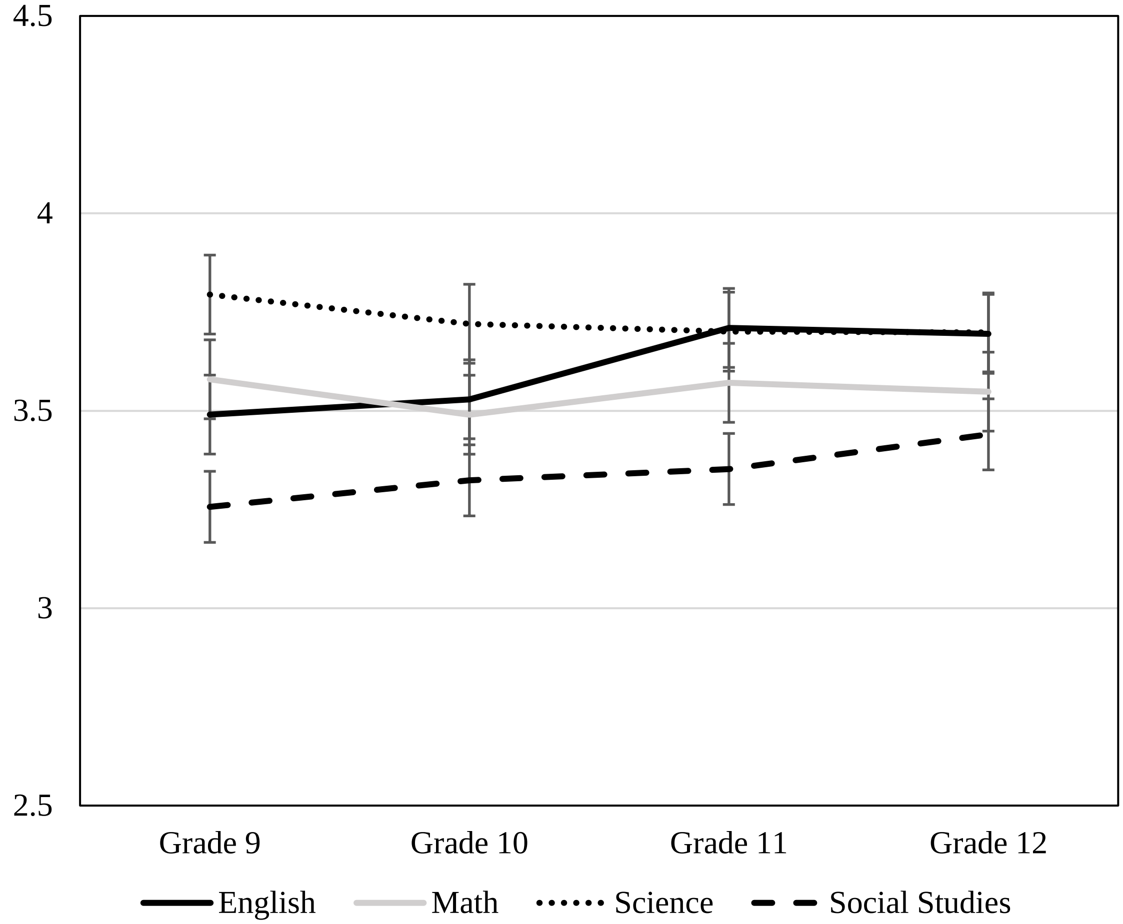
**Chapter 4 Figures**

Figure 4-1. Academic Value Beliefs among Women



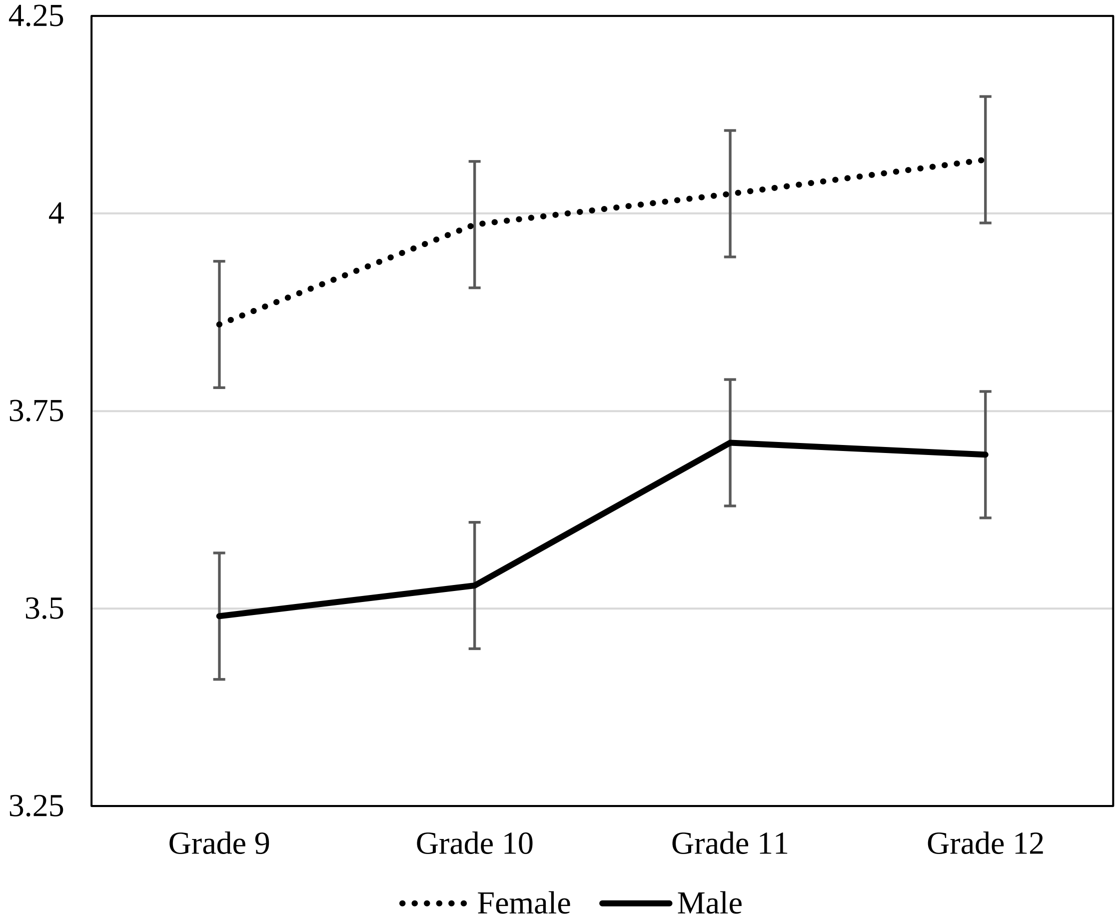

*Note.* Error bars ± 2xS.E.

Figure 4-2. Academic Value Beliefs among Men



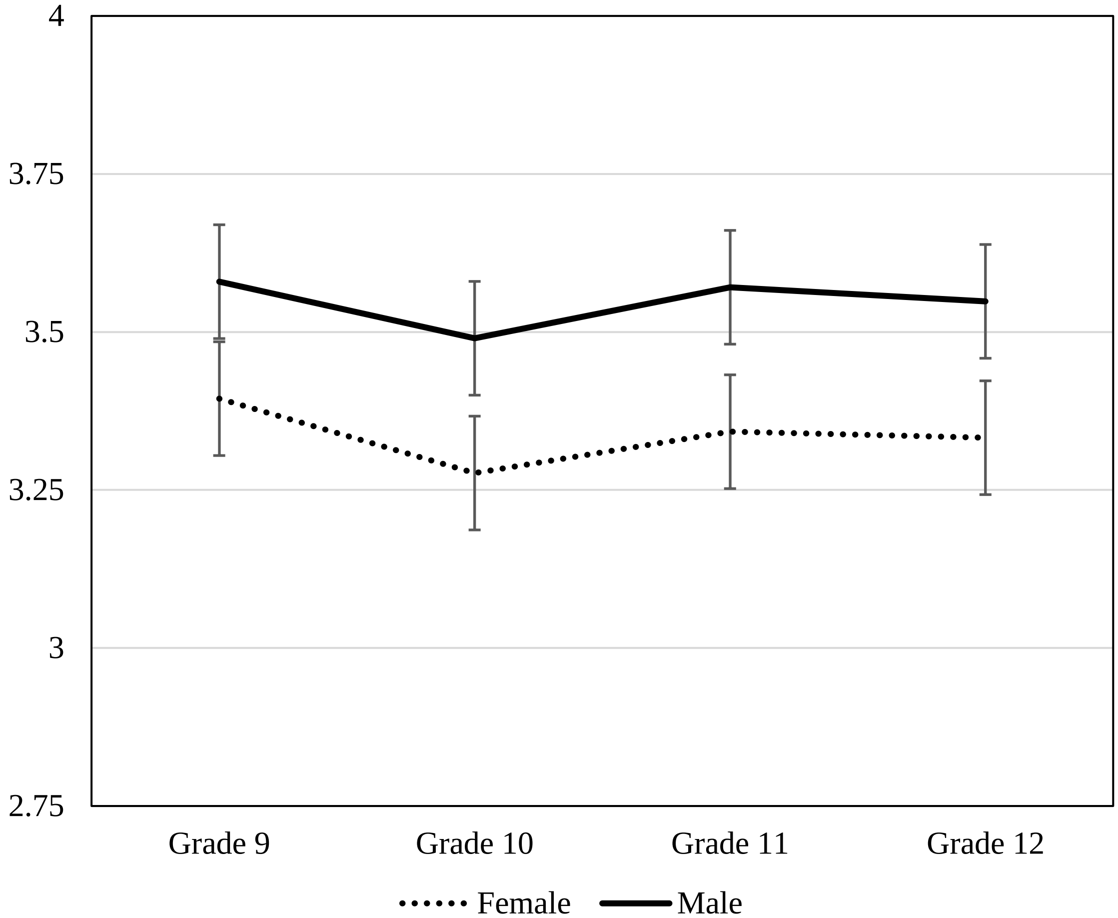

*Note.* Error bars ± 2xS.E.

Figure 4-3. English Value by Gender



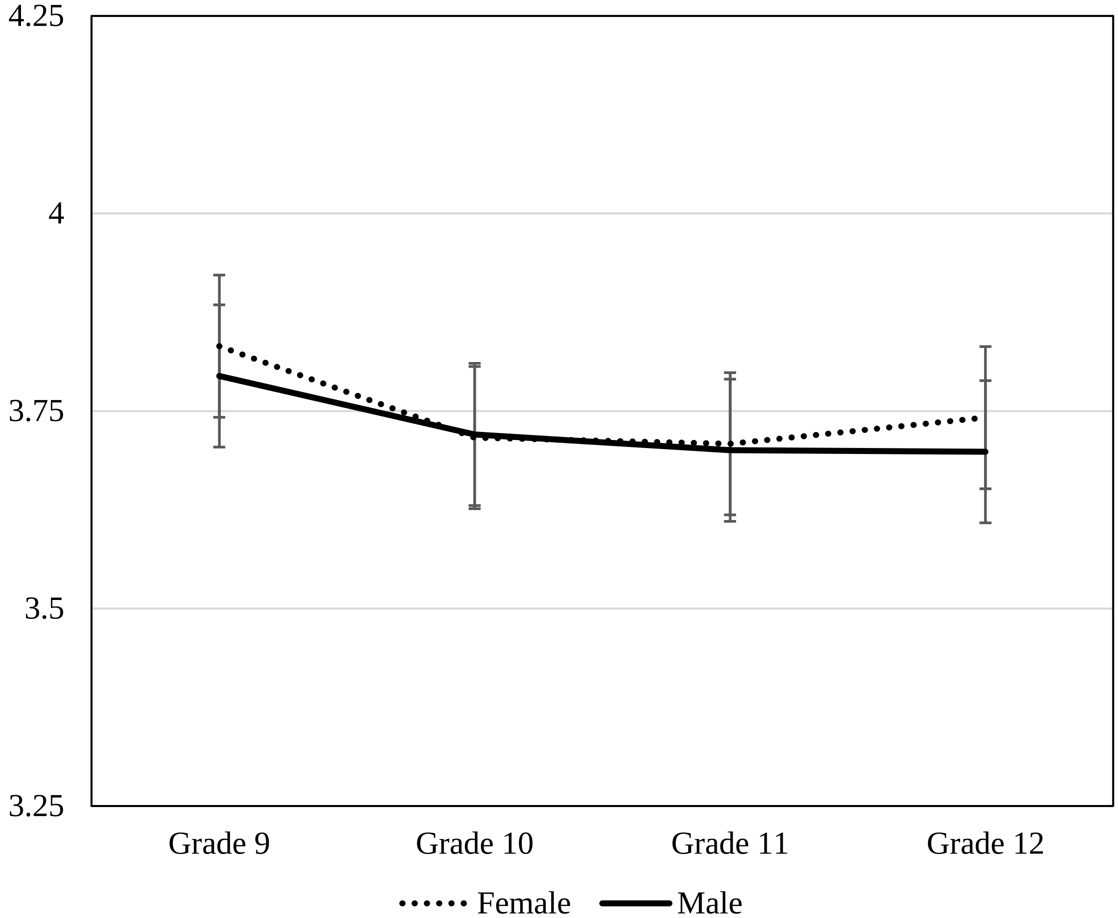

*Note.* Error bars ± 2xS.E.

Figure 4-4. Math Value by Gender



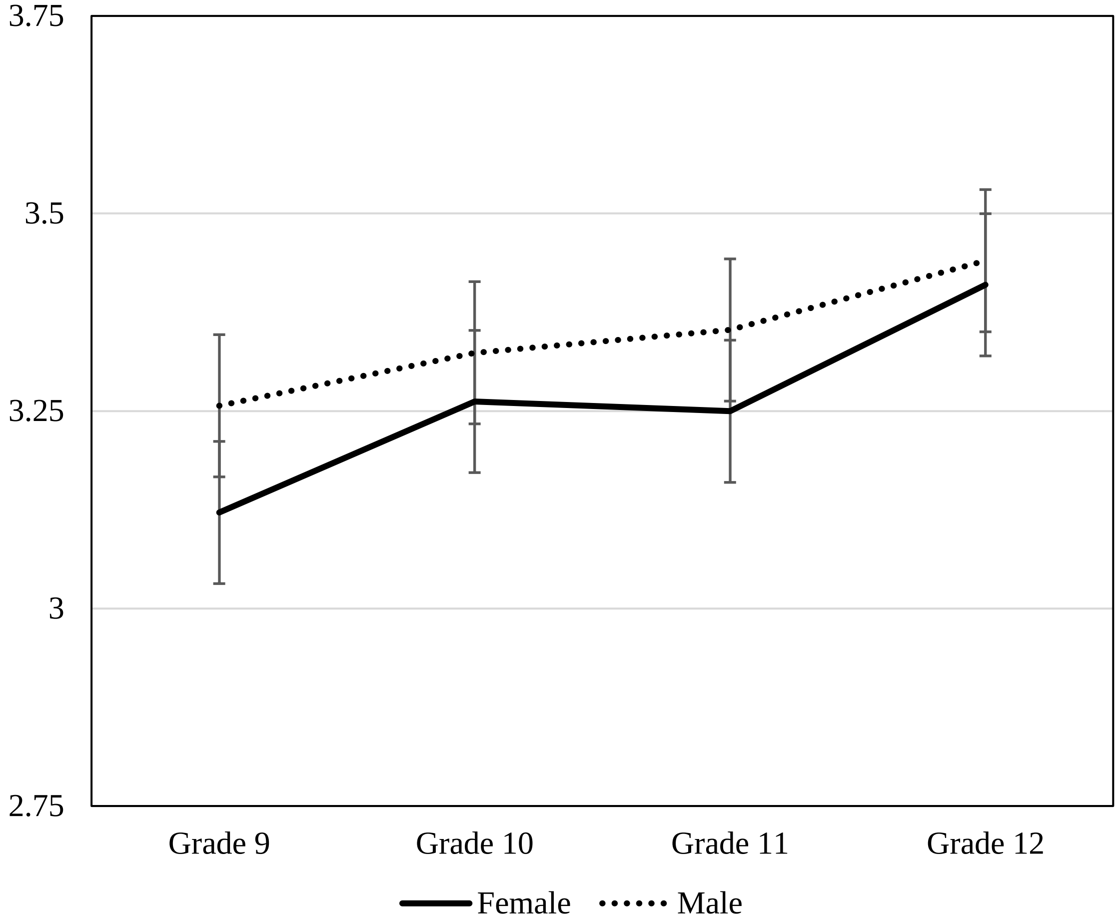

*Note.* Error bars ± 2xS.E.

Figure 4-5. Science Value by Gender




*Note.* Error bars ± 2xS.E.

Figure 4-6. Social Studies Value by Gender




*Note.* Error bars ± 2xS.E.

Figure 4-7. English Value by Five-Category Race

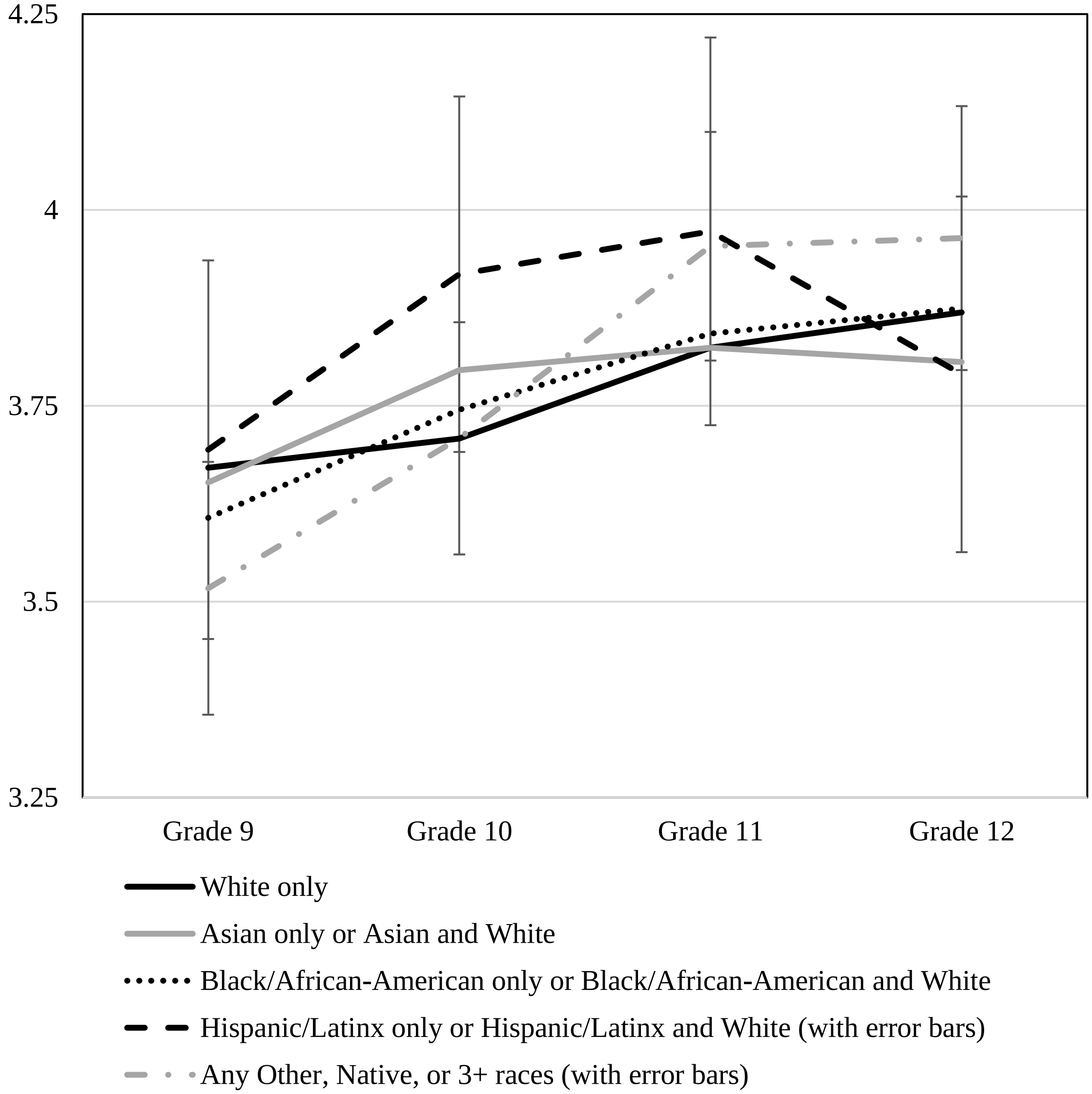


Figure 4-8. Math Value by Five-Category Race

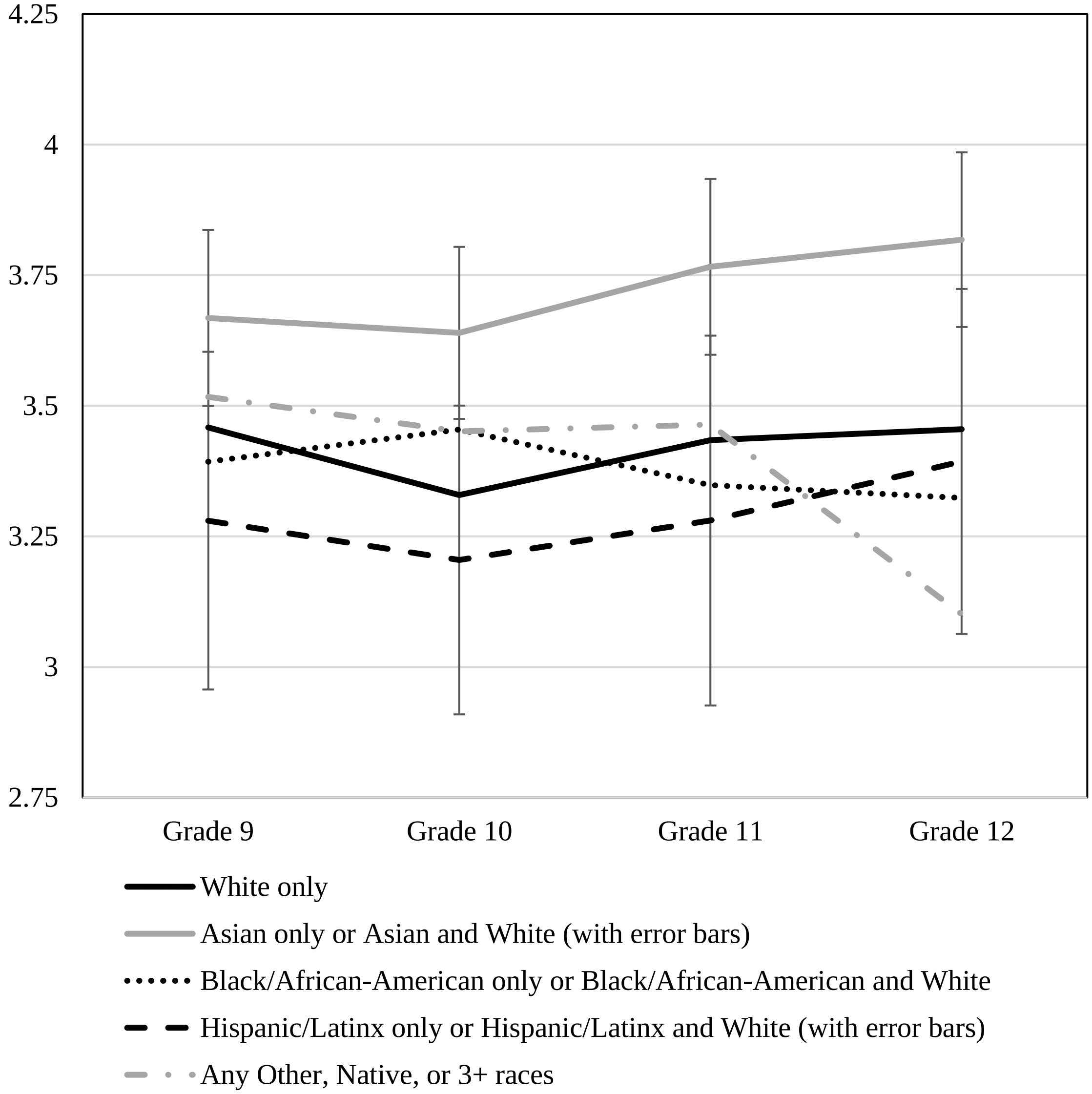


Figure 4-9. Science Value by Five-Category Race

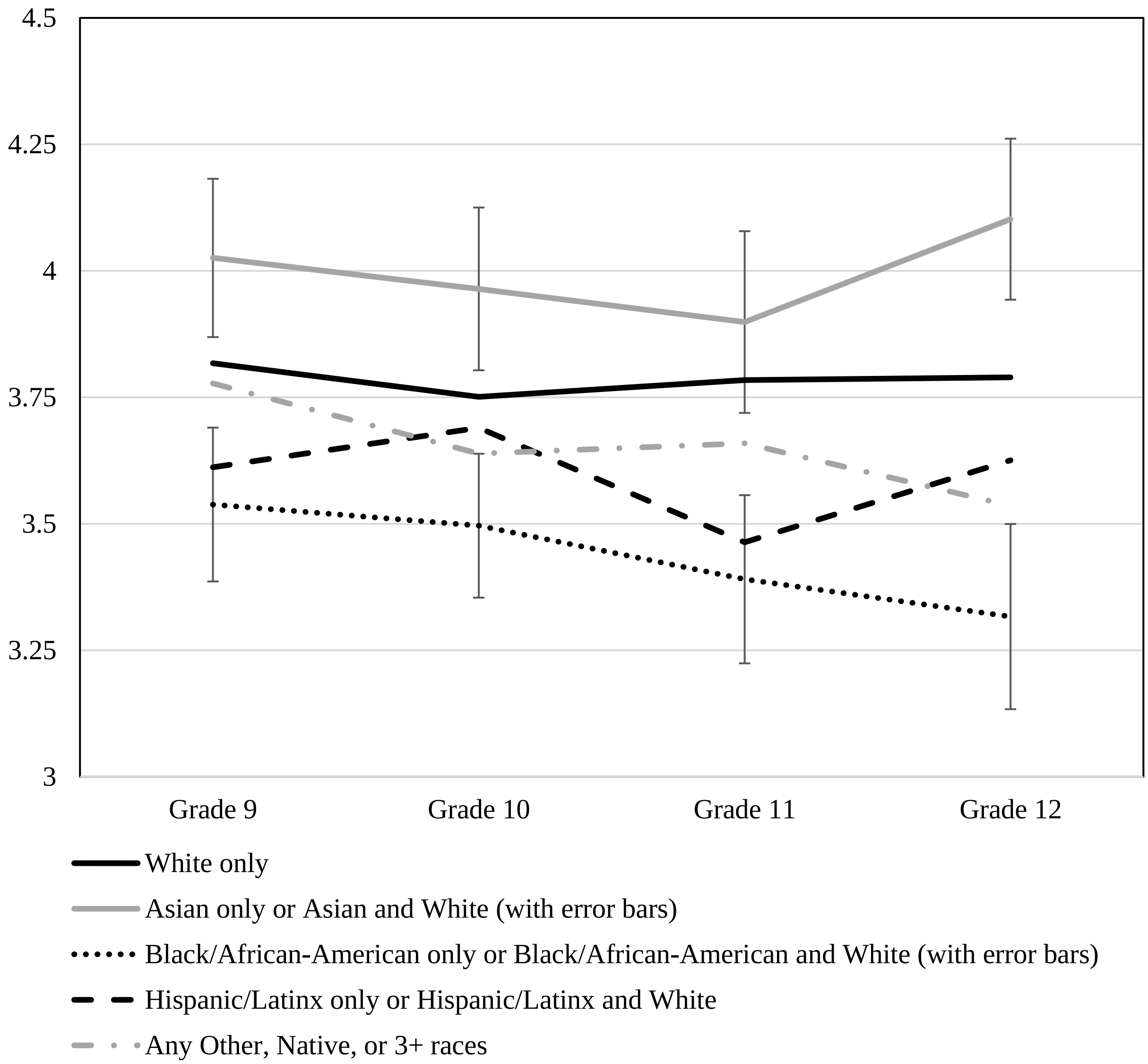


Figure 4-10. Social Studies Value by Five-Category Race

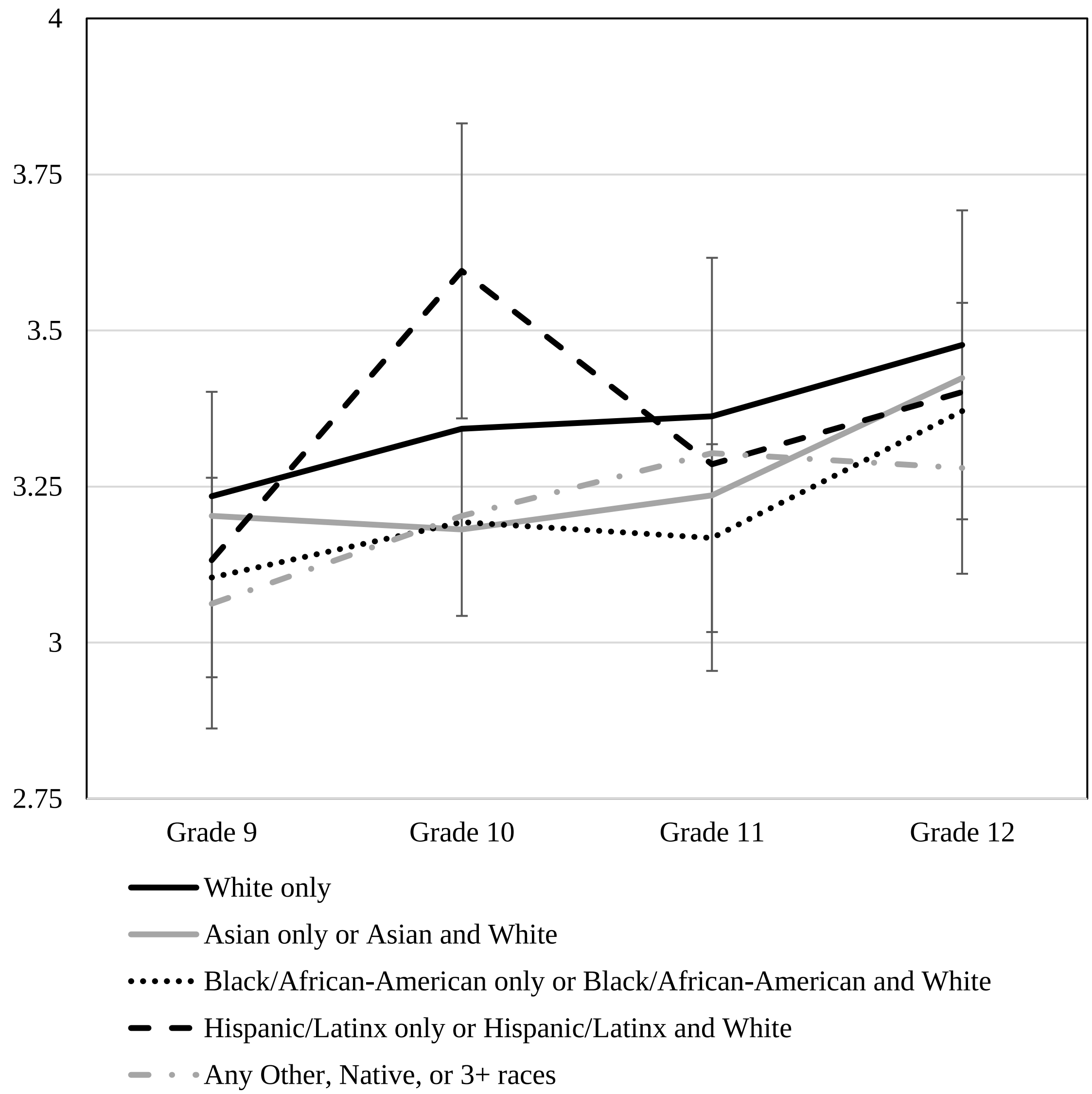


Figure 4-11. English Value by Parental Educational Attainment

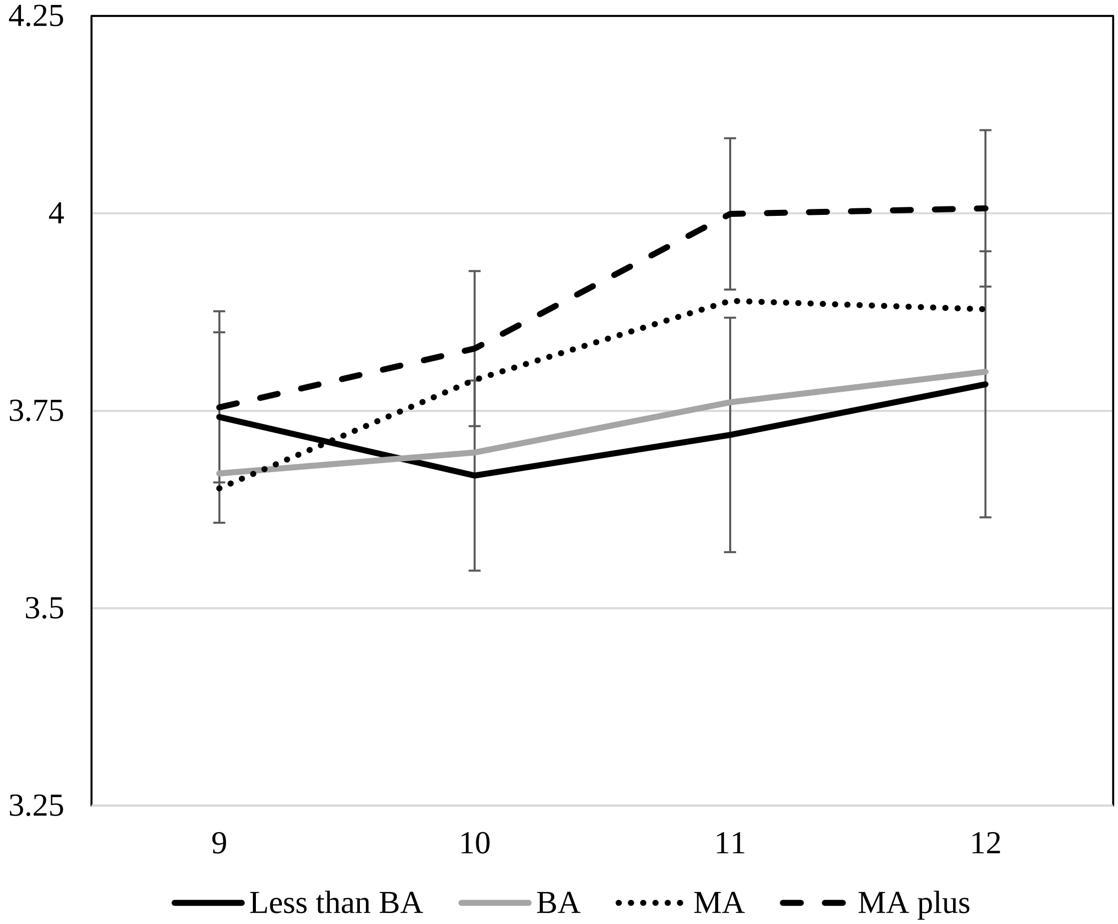


Figure 4-12. Math Value by Parental Educational Attainment

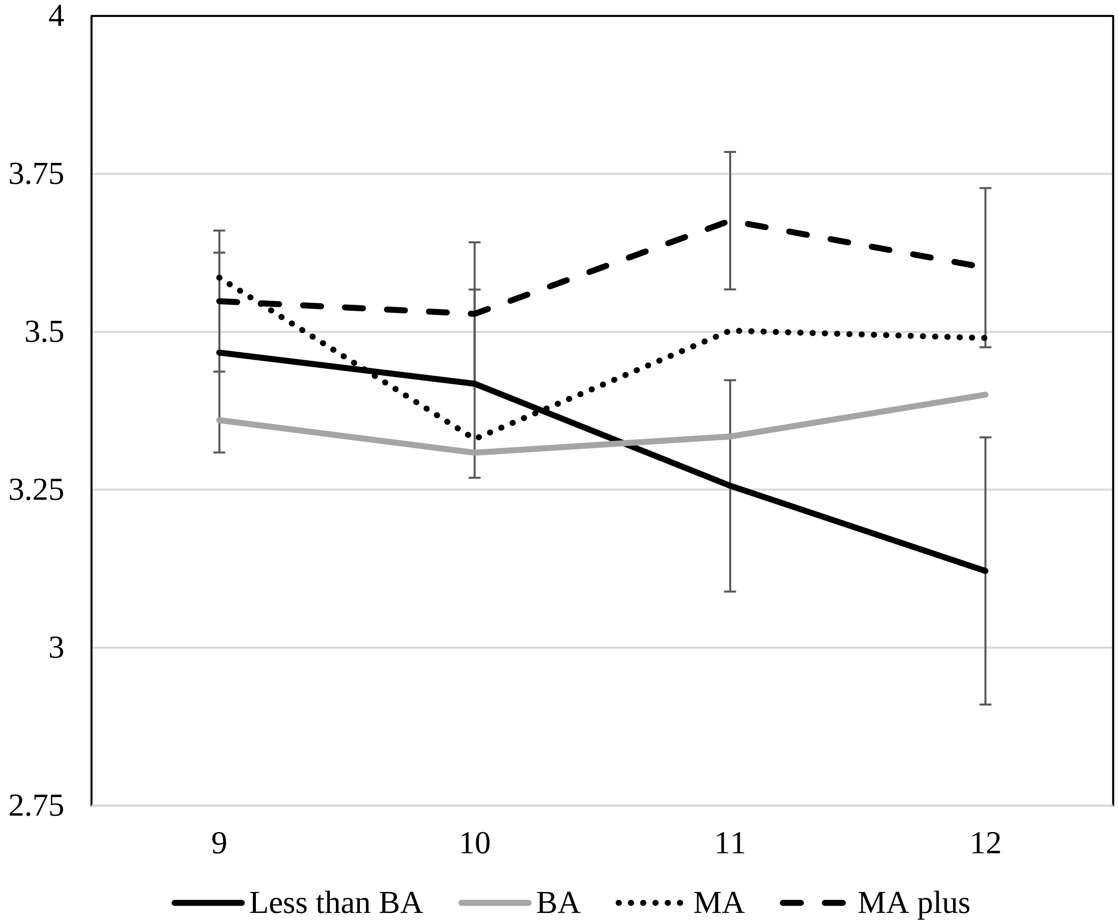


Figure 4-13. Science Value by Parental Educational Attainment

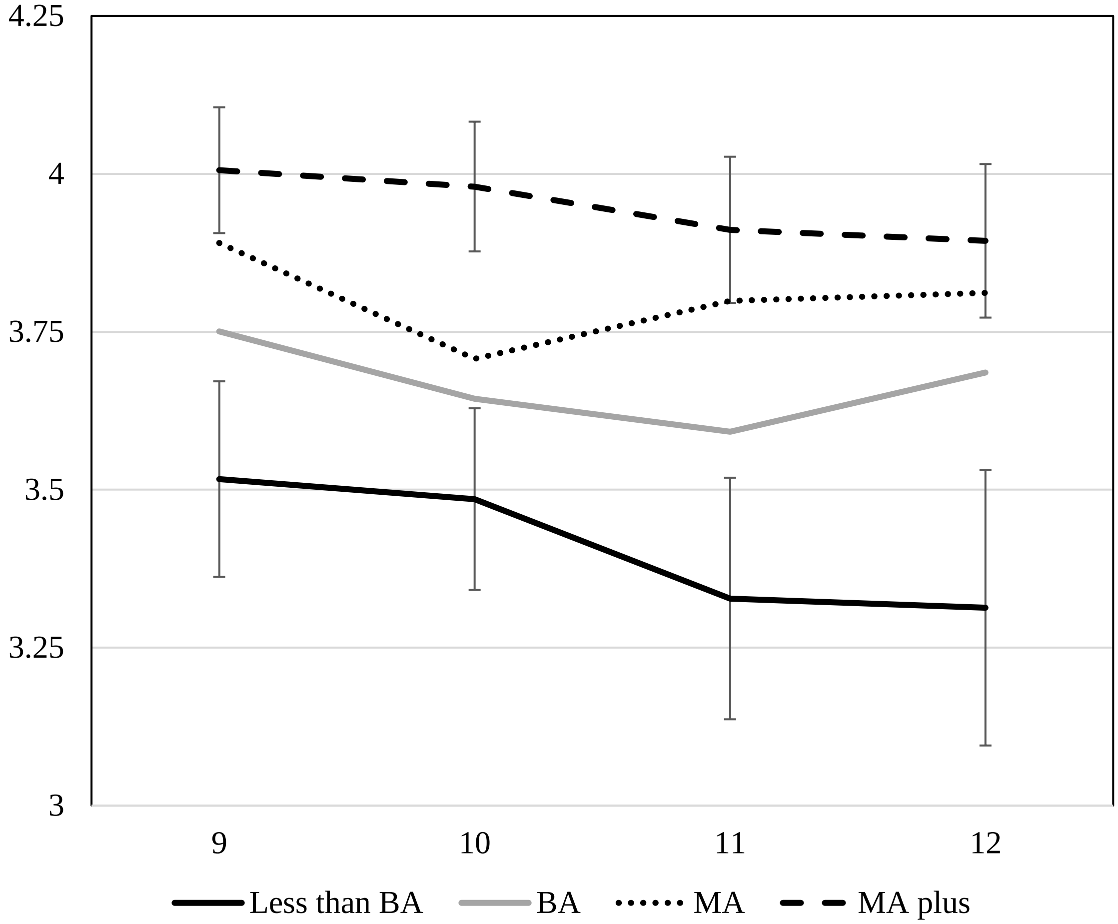


Figure 4-14. Social Studies Value by Parental Educational Attainment

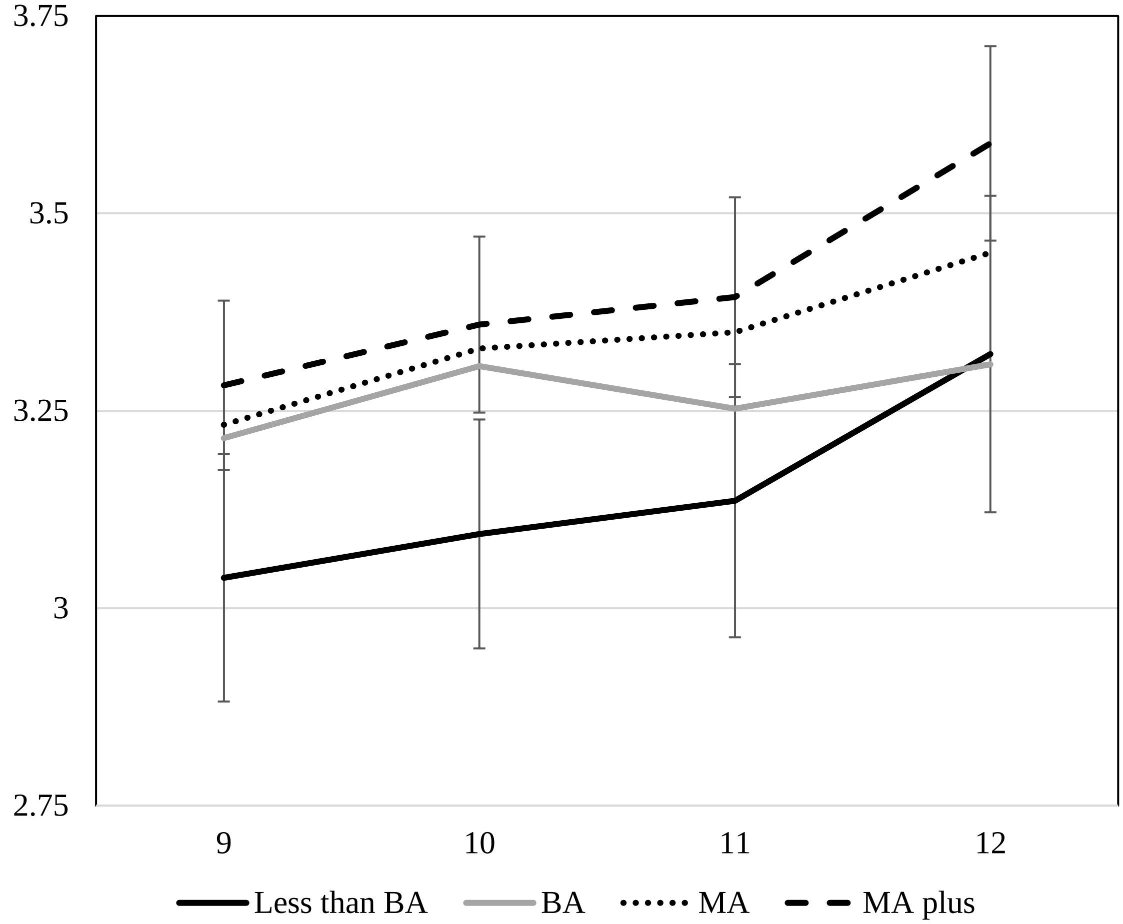


Figure 4-15. Career Commitment by Gender

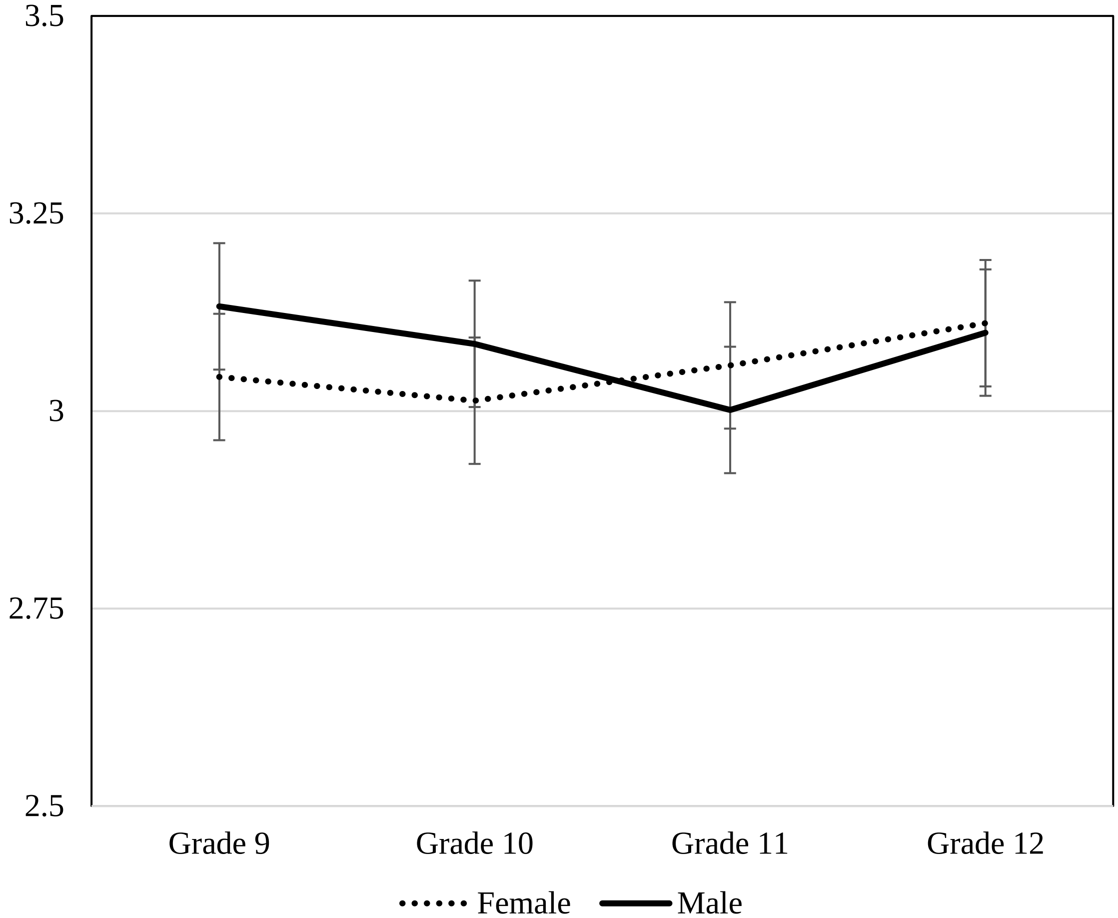


Figure 4-16. Career Exploration by Gender

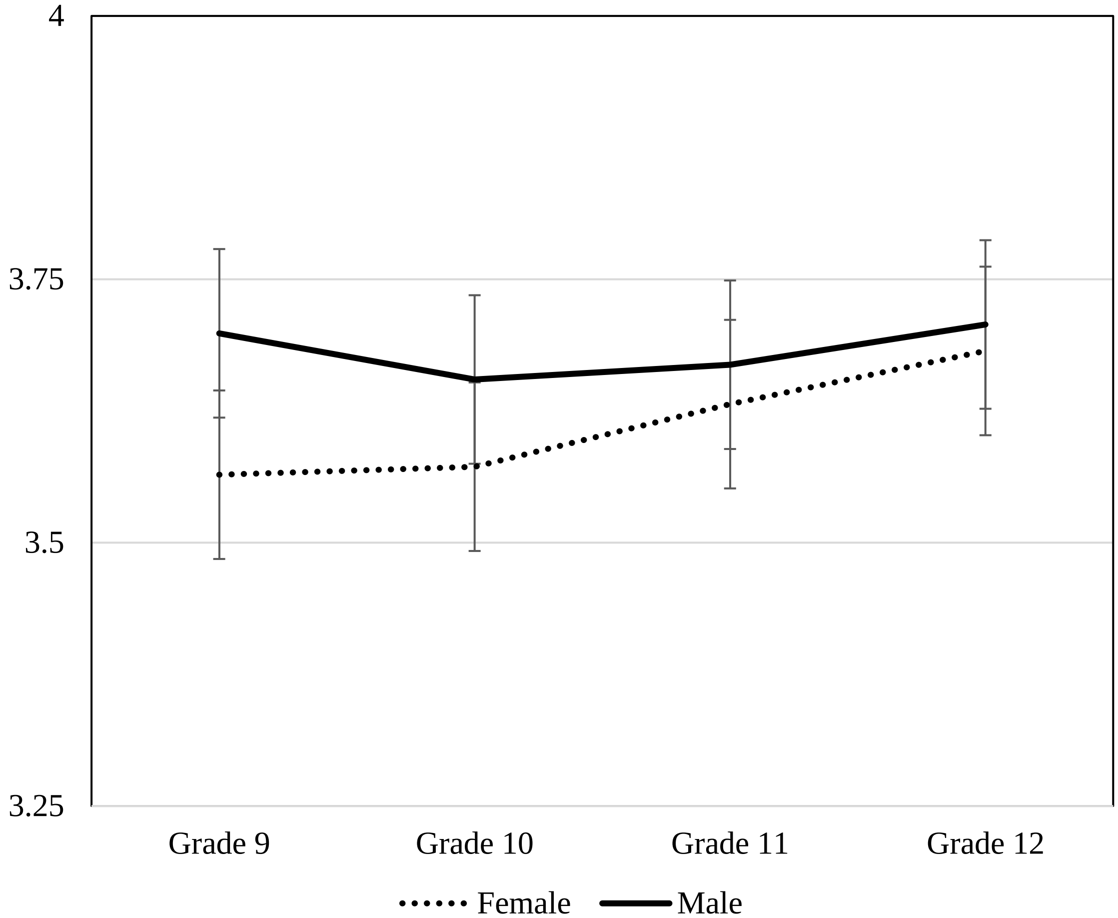


Figure 4-17. Career Commitment by Parental Educational Attainment

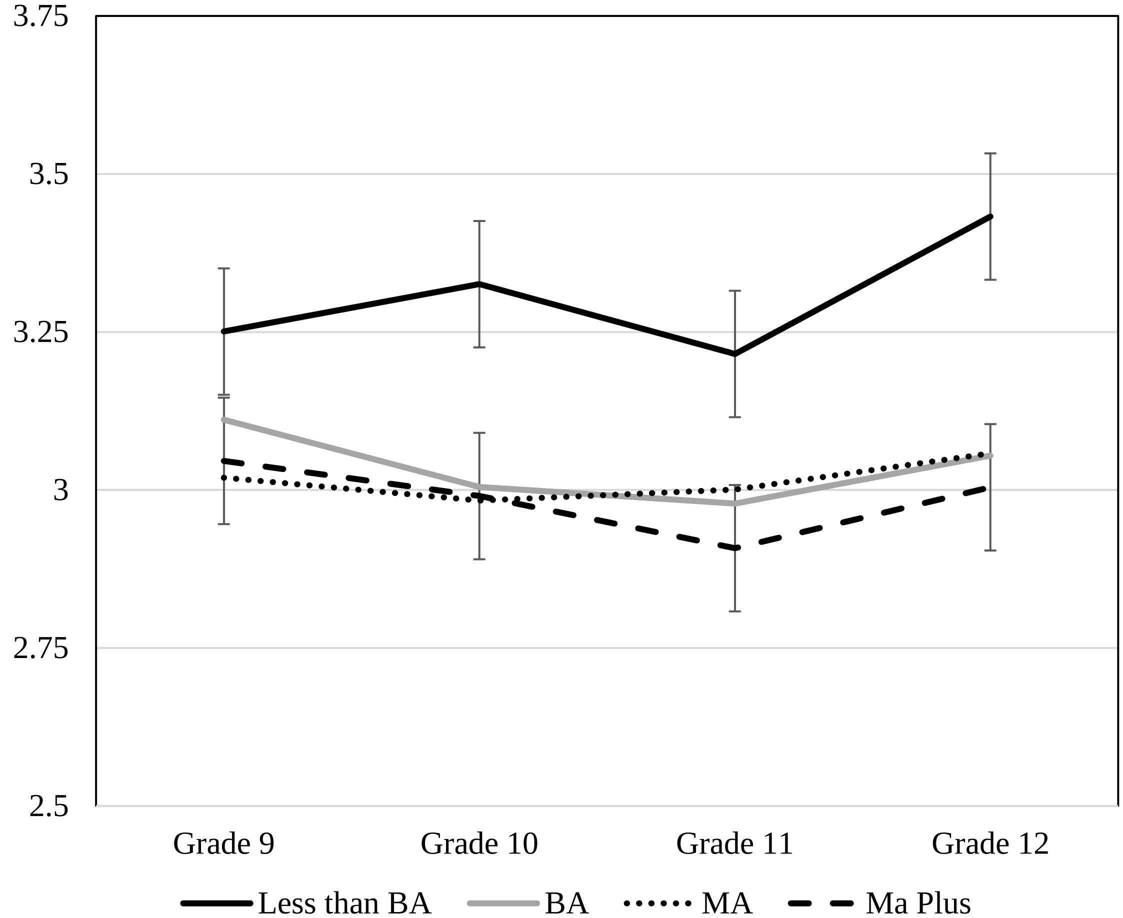


Figure 4-18. Career Exploration by Parental Educational Attainment

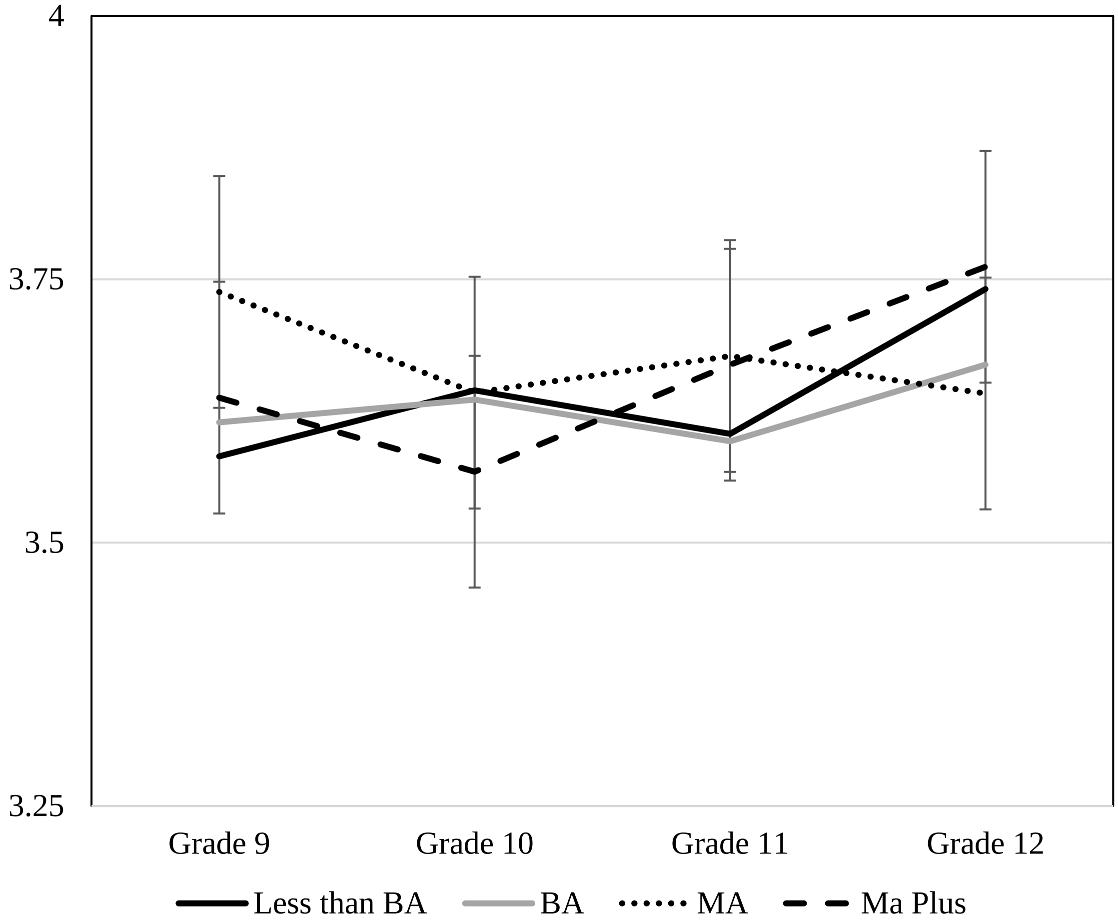


Figure 4-19. Career Commitment by Five-Category Race

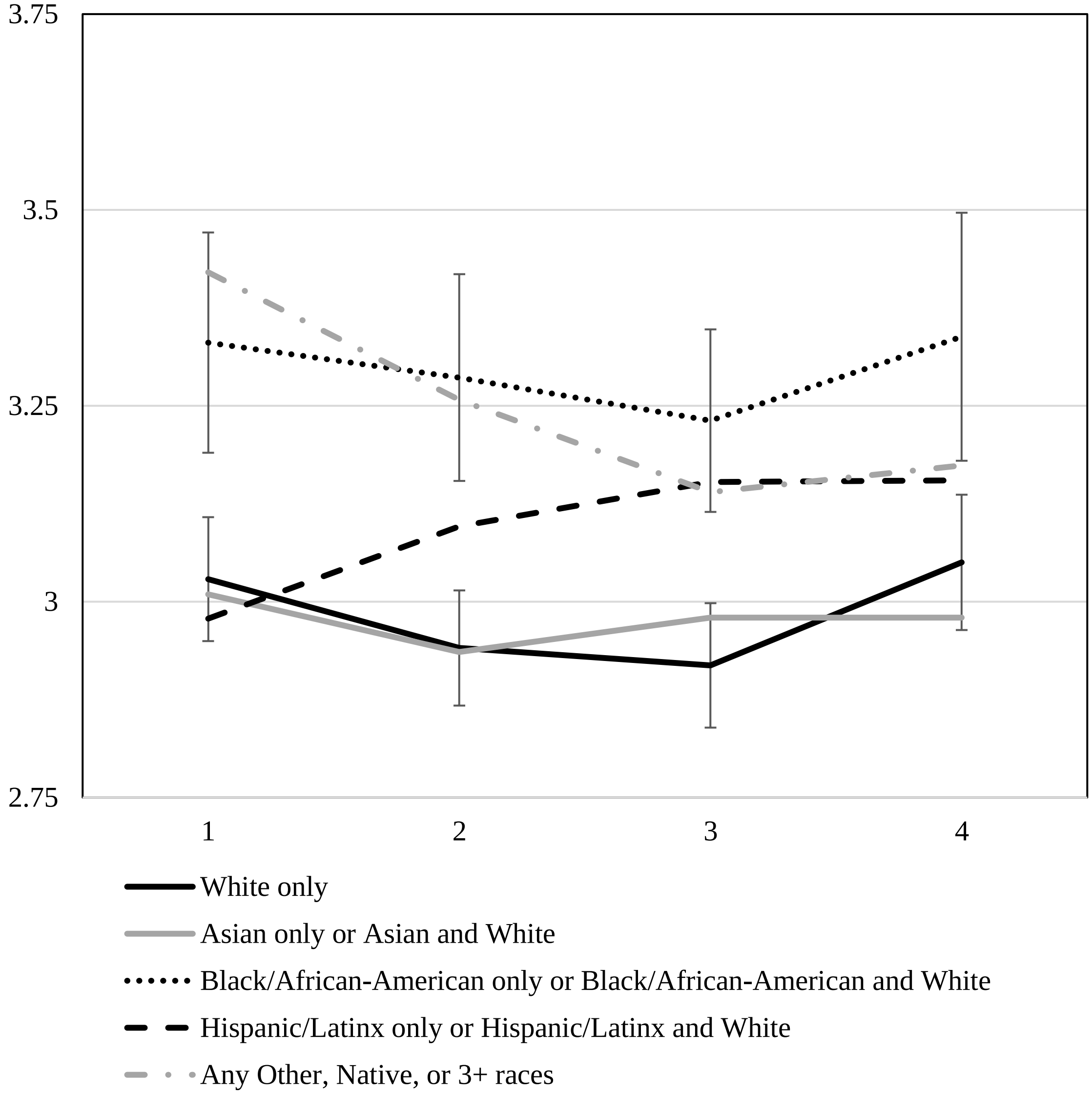


Figure 4-20. Career Exploration by Five-Category Race

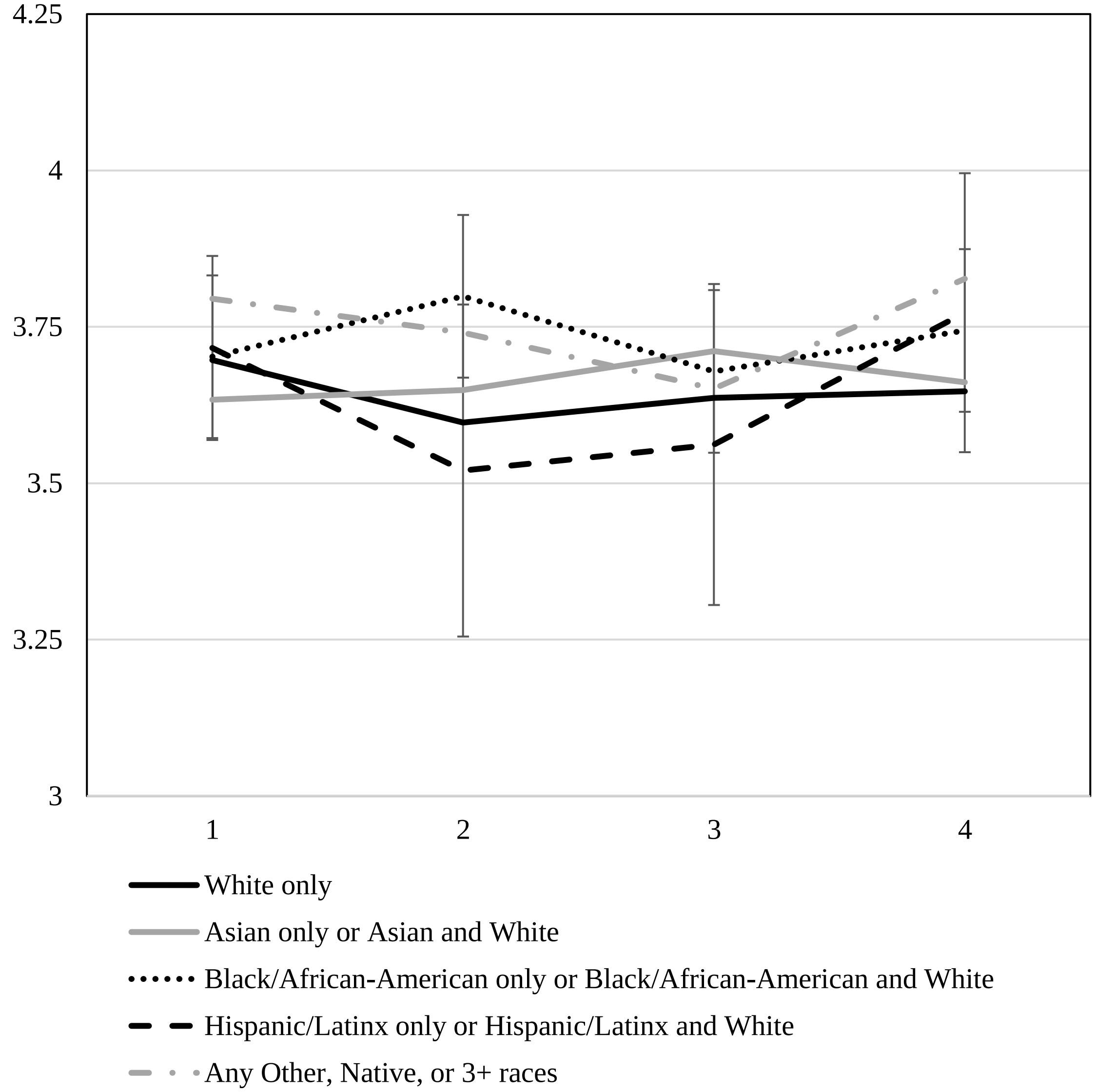


Figure 4-21. Model Comparison for Academic Value Beliefs

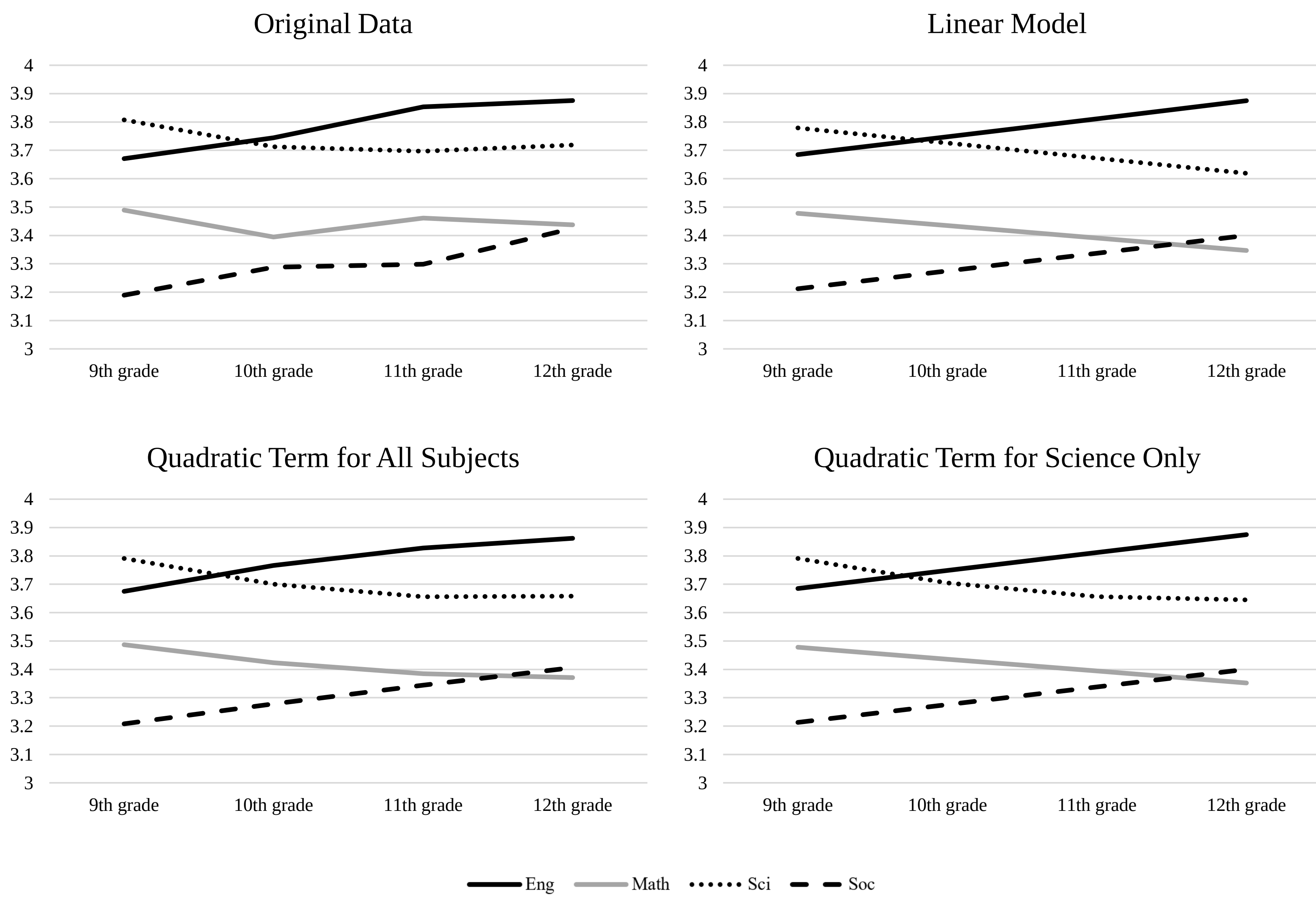


Figure 4-22. Distribution of Linear Slope Parameters for Academic Value Beliefs

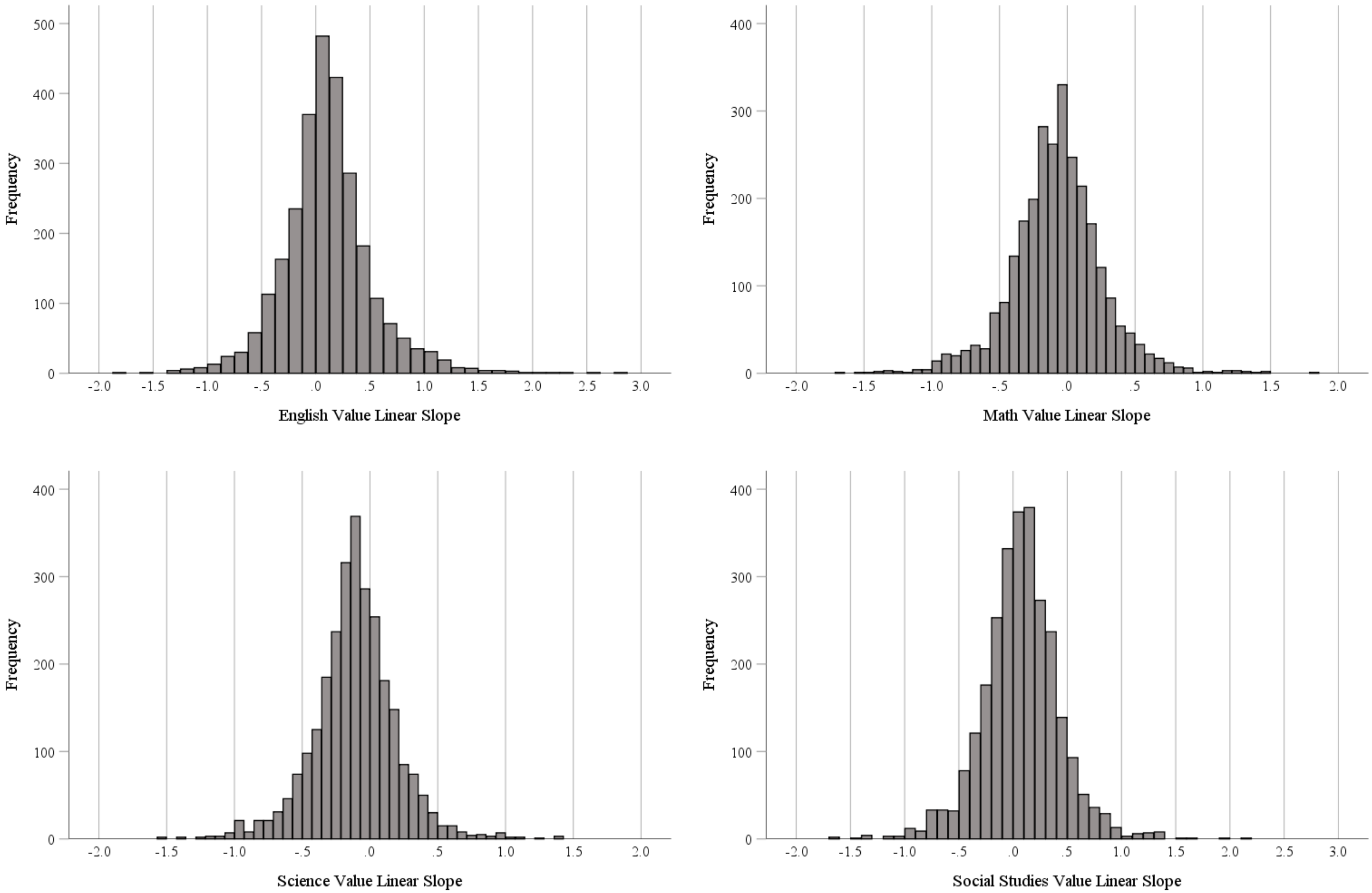


Figure 4-23. Model Comparison for Career Identity Variables

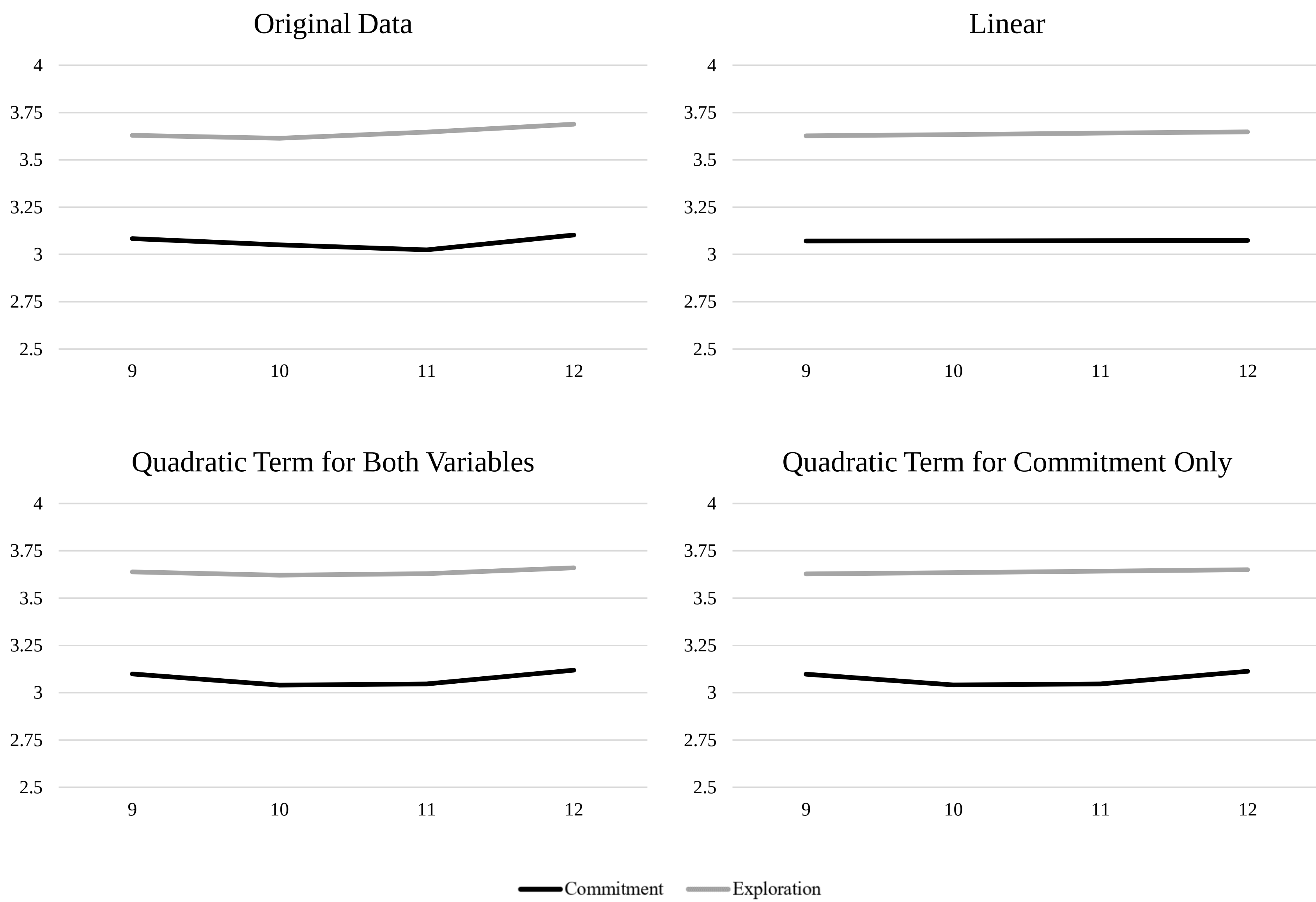


Figure 4-24. Distribution of Slope Parameters for Career Identity Variables

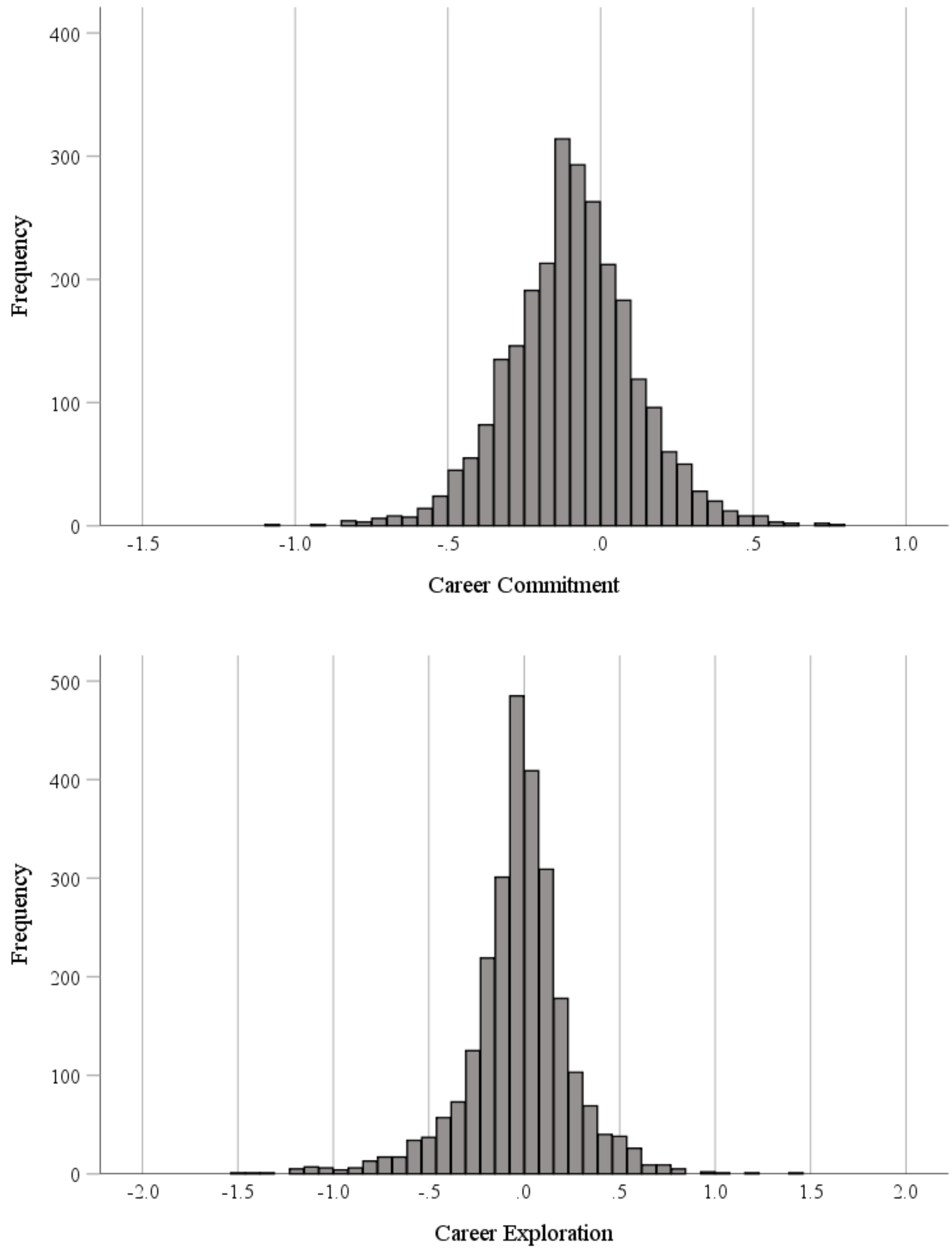


Figure 4-25. GMM Classes

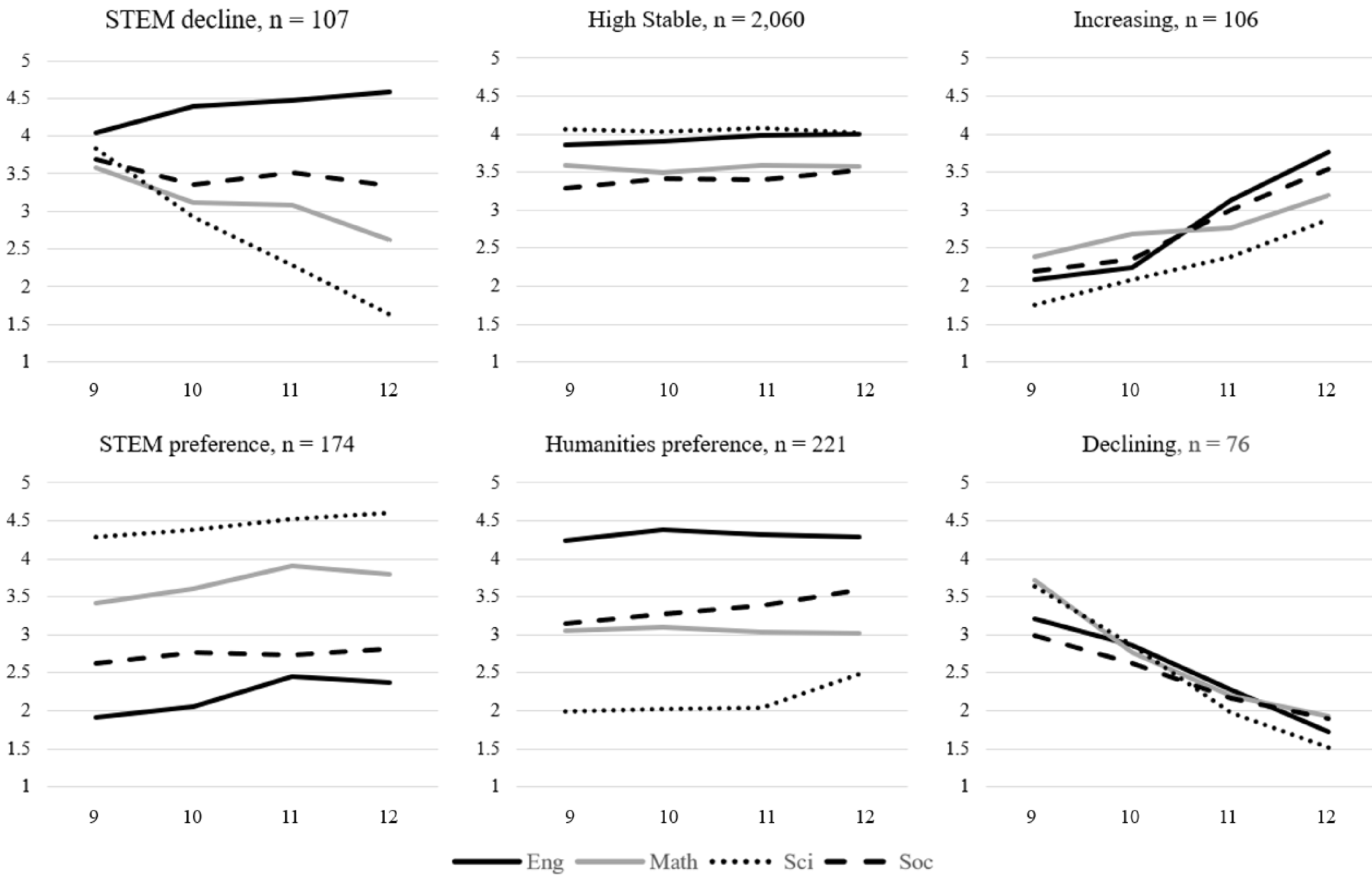


Figure 4-26. GMM Class Membership by Parental Educational Attainment

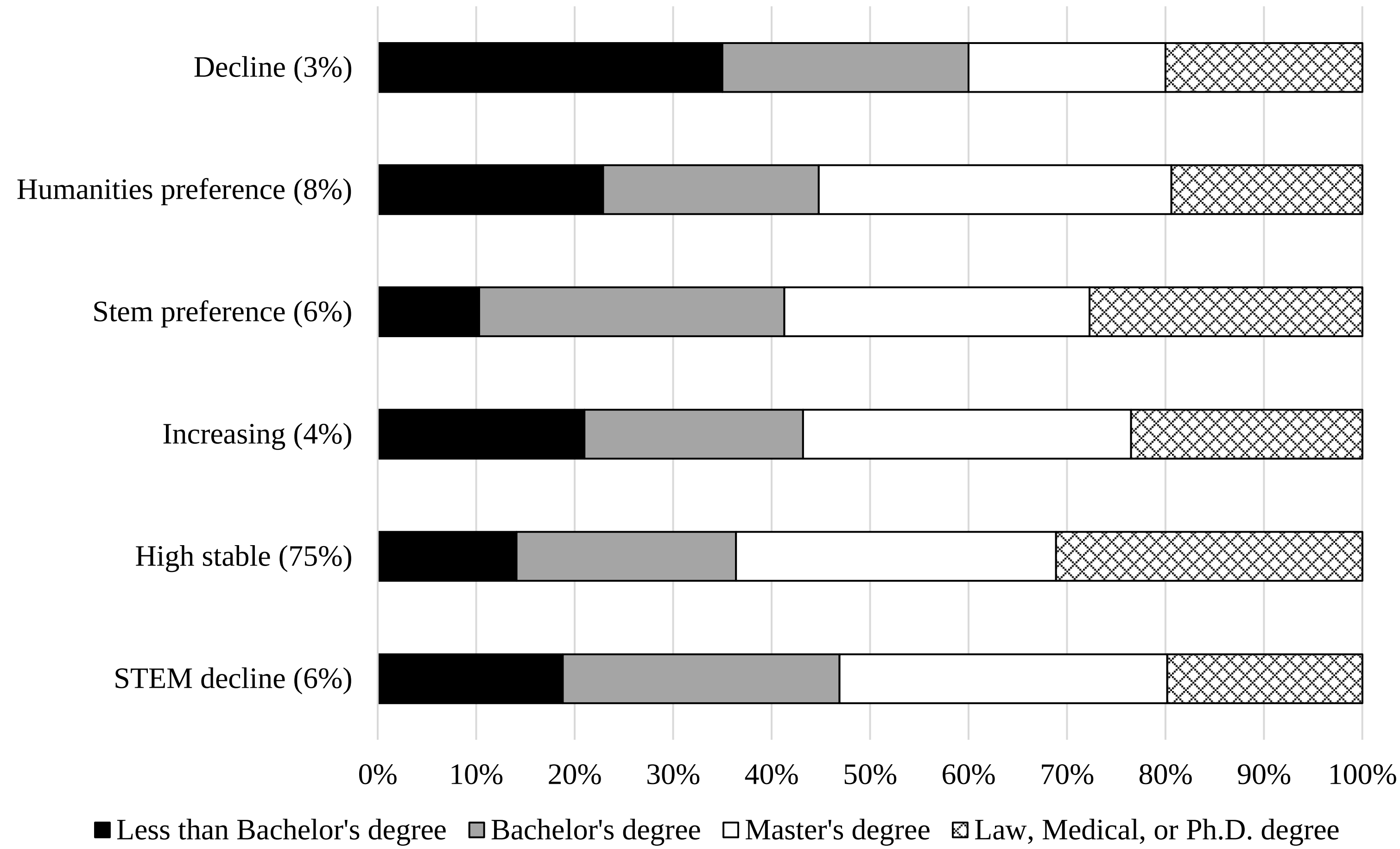
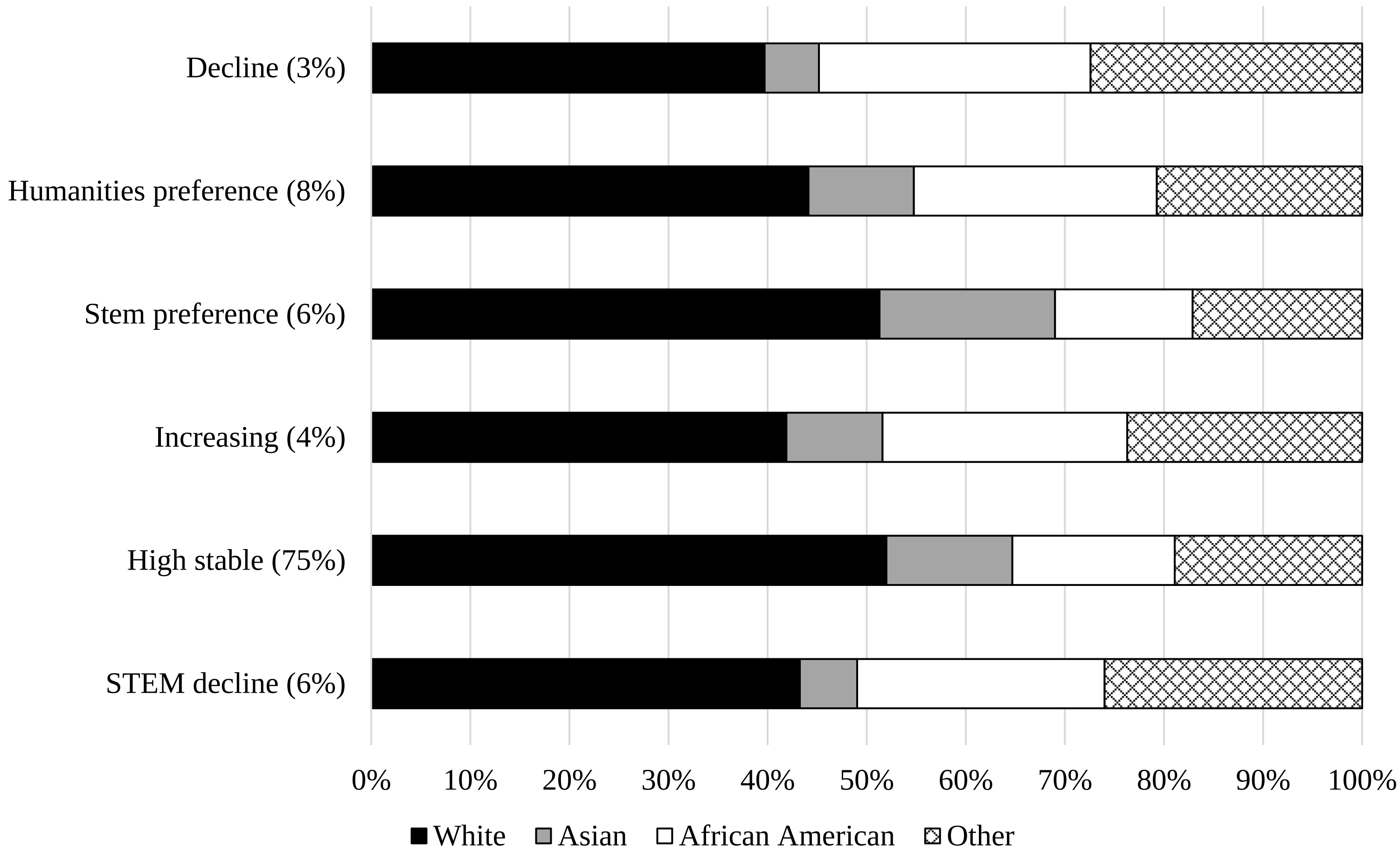


Figure 4-27. GMM Class Membership by Four-Category Racial/Ethnic Identification



# Chapter 5

## Discussion

The first major aim of the present study was to determine how many students experience declines in academic value beliefs during high school and whether these trends differ based on gender, race, and parental educational attainment. This analysis included four academic subject areas (math, English, science, and social studies) and used a variable-centered method (Latent Curve Analysis; LCA) and an exploratory person-centered method (Growth Mixture Modeling; GMM) to identify general trends in each subject as well as common profiles across subjects. The second aim was to assess how many students specialize in value for one specific academic domain and whether greater specialization is positively associated with career identity development. This question was addressed by modeling the development of career identity and exploration with LCA, then linking these variables with several indicators of academic specialization. The study was conducted with a new dataset ($N$ = 2,681) representing five waves of data collection from all grades in a high-performing and predominantly white high school, with 50% White/Caucasian students, 12% Asian/Asian American students, 18% Black/African American students, 6% Hispanic/Latinx students, and 14% of students with another identification.

Notable results from the analysis of academic value beliefs include the finding that value in English and social studies improved on average, while value for math and science declined through the students' high school years. Gender differences in initial levels of value were observed favoring women in English and men in math, but no differences were evident in science, social studies, or rates of change in any domain. Students with lower parental educational attainment reported lower initial levels of value in math, science, and social studies, experienced greater declines in value for all subjects, and were less likely to belong to the group of students with high and stable value in all subjects. Students with higher personal educational aspirations indicated greater initial levels of value in both math and science, as well as less decline in value for science. Relating to Racial/Ethnic identification, Black/African American students expressed the lowest initial levels of value for science and were also less likely to belong to a “High stable” group, while Asian/Asian American students indicated the highest levels of value for math and science and were more likely to belong to groups favoring STEM. However, no interactions between gender, Racial/Ethnic identification, and parental educational attainment were apparent.

In the examination of career identity development, career commitment decreased over time while career exploration remained stable, patterns inconsistent with previous research finding that these variables increase during adolescence. Also in contradiction of previous results, students with lower parental educational attainment as well as Black/African American students reported higher levels of career commitment than other students. In addition, more positive trends in value for math and science were related to more positive trends in career commitment. However, although initial levels of career exploration were positively related to initial levels of value in all academic subjects, the career exploration slope was negatively related to value in all subjects aside from science. Finally, participants in this sample largely did not display specialization in value beliefs. Nevertheless, the students who belonged to profiles with more specialized value across subjects showed higher initial levels of and slower decline in career commitment.

Therefore, high-performing schools wishing to improve equity in subject area value beliefs may consider focusing on students with lower parental educational attainment in relation to all content areas, Black/African American students in science, women in math, and men in English. Notably, no gender differences in value beliefs were apparent in the domain of science, although results may have differed if the term “science” had been further divided into topics such as biology or physics. Based on the finding that student educational aspirations are positively related to value for math and science, future research could inform potential interventions for both of these topics by establishing the direction of this causal relationship. In addition, to promote career identity development among their students, schools could further investigate the results that greater career commitment was reported by students with higher value for math and science, students with more specialized profiles of value beliefs across subjects, Black/African American students, and students with lower parental educational attainment. Potential explanations of these patterns are discussed below, but interventions based on these trends would also require further research establishing causal relationships.

## Description of academic value trajectories

### Variable-centered approach

In the analysis of average developmental trajectories using LCA, it was hypothesized based on previous research that value beliefs would decline in math and science while remaining stable in English and social studies (1a). This hypothesis was confirmed for the subjects of math and science, with a significant quadratic trend in science indicating a leveling of this decline over time. The hypothesis was not confirmed in English and social studies, for which levels of value in fact increased. Increases in English value over high school were also found by one of the studies reviewed (Lee & Kim, 2014) as well as in the CAB data for women only (Jacobs et al., 2002). Other research has occasionally observed value improvements as well, such as in general academic intrinsic value (Dotterer, McHale, & Crouter, 2009) and math usefulness/importance (Fredricks & Eccles, 2002). Social studies value has been stable in past research (A. E. Gottfried et al., 2001; Guo, Wang, et al., 2018).

However, the significant variance terms for latent intercepts and slopes in all subjects demonstrate that students are not all well described by these average trajectories. This finding is consistent with several studies that reported significant variance in trajectories for general academic value (Dotterer et al., 2009), language (Guo, Wang, et al., 2018; Marcoulides, Gottfried, Gottfried, & Oliver, 2008), math (Marcoulides et al., 2008; Petersen & Hyde, 2017), science (Guo, Wang, et al., 2018; Marcoulides et al., 2008), and social studies (Guo, Wang, et al., 2018). Conversely, a few other analyses have failed to find any significant variance in trajectories for math (Frenzel et al., 2010; Ma & Cartwright, 2003). In the present study, the variation in longitudinal patterns is demonstrated by the fact that about 30% of students exhibited significant trends in each subject that were counter to the overall average. Therefore, the next analysis steps were conducted for the purpose of determining how many students and which demographic groups followed the general trends established by the LCA.

While not related to a specific hypothesis, value beliefs significantly differed between subjects in intercept as well as slope. For intercepts, science was the favorite subject followed by English, then math, then social studies. However, for slopes, English showed the largest increase, social studies showed a smaller increase, math showed a slight decrease, and science showed the largest decrease. Although the rates of change varied based on the demographic factors discussed below, the order of subject preference did not differ between demographic groups. Another study that reported order of subject preference in Germany had found that for most value subcomponents, English was generally the favorite subject, followed by math, then German, then biology, then physics as the least favorite (Gaspard et al., 2017). However, intrinsic value levels were higher for biology, placing it as the second favorite for that facet. Guo and colleagues (2018) determined that Finnish was the favorite, followed by math/science, then social studies. Schools may be interested in determining the factors causing science to initially be students' favorite subject, and social studies to be the least favorite both in the present study and a Finnish population.

**Person-centered approach**

In an attempt to further understand the individual variation in these results, the next stage of the analysis used the exploratory Growth Mixture Modeling (GMM) technique. Expectancy-Value Theory emphasizes the importance of within-person hierarchies of value across perceived available options in decision-making (Eccles, 1994), and recent research supports this view by showing that such profiles predict choices even when accounting for average levels of value beliefs (Guo, Wang, et al., 2018). Therefore, an aim of this analysis phase was to assess combinations of value beliefs across all four subjects. In a manner similar to a cluster or latent class analysis, GMM isolates groups of participants who share patterns on several variables simultaneously. However, the unique feature of this method is that classes are based on longitudinal trajectories rather than a single time point. An advantage of such exploratory techniques is that the a priori selection of criteria to divide participants into meaningful groups is not necessary. It was expected that the analysis would identify (2a) a class with high value in all subjects and a class with low value in all subjects, (2b) a STEM preference class and a humanities preference class, and (2c) at least one class with a pattern of domain specialization, or declining value for at least one subject combined with high or increasing value in at least one other subject.

Overall, this dataset did not appear to be well characterized by the presence of distinct classes. Substantial instability was evident in the patterns found based on different models and numbers of classes, with only a few similar value classes regularly observed. In every model, the majority of students belonged to a class with high, stable, and undifferentiated value in all subjects. Most models also included a moderately sized “Humanities preference” class (between about 300 and 400 students), and a small “Declining” class (between about 40 and 70 students). However, all other value patterns were evident in fewer than half of the potential models. In addition, for the majority of the 22 models, entropy was below the value of .80 considered to reflect good fit. Due to the above inconsistencies in group patterns and fact that model fit indicators conflicted, the six-class model with only linear parameters was selected for use in further analyses based substantially on theoretical meaning.

In partial support of expectations (2a), the largest class identified was a “High stable” group consisting of 2,060 students or 75% of the sample, in which the only significant trend in value beliefs was a positive slope in English. This group was not entirely undifferentiated, as intercepts for all subjects differed significantly with science as the most valued subject, followed by English, then math, then social studies. However, these differences were small. The second element of this hypothesis was not confirmed, as a group with low stable value beliefs was not apparent. The second hypothesis for this portion of the analysis was confirmed (2b), with the presence of a “STEM preference” class including 6% of the sample, a “STEM decline” group representing 4% of the sample, and a “Humanities preference” representing 8% of the sample.

As mentioned above, the identification of the “Humanities preference” group was more robust across different classification solutions. Next, the third hypothesis (2c) was also confirmed, as the “STEM decline” group represents students with high and increasing value for English along with lower and decreasing value for math and science. However, with just one class representing 4% of participants showing this pattern, specialization was not a common occurrence in this sample. Finally, two additional classes were present in the model. The “Improving” class with significant positive slopes for all subjects represented 4% of the sample, and the “Decline” class with significant negative slopes in all subjects included 3% of the sample. Overall, only a small minority of students (7%) belonged to one of the two classess that showed significant declines in value beliefs in any subject.

The identification of classes with high value for all subjects, STEM preference, and humanities preference was expected and corresponds with previous research (Chow et al., 2012). Groups that sharply decreased in value throughout high school have also been observed previously. Declines have been identified for math intrinsic value (38% of participants) and math usefulness/importance (13% of participants; Musu-Gillette, Wigfield, Harring, & Eccles, 2015), overall value for physics/chemistry combined (11% of participants; Wang, Chow, Degol, & Eccles, 2017), as well as overall value for English (41% of participants; Archambault, Eccles, & Vida, 2010). Similarly, improving groups have been found for overall value for physics/chemistry (11% of participants; Wang, Chow, Degol, & Eccles, 2017), and overall value for English (27% of participants; Archambault, Eccles, & Vida, 2010). Finally, groups specializing over time have also been observed previously (Guo, Wang, et al., 2018), with one class specializing in combined math/science (33% of participants) combined and the other specializing in language (19%). However, while the present analysis serves as a replication of these earlier results in some respects, other aspects differ. The sizes of these groups are not equivalent, several patterns were only present in the present study or the previous research, and each study included different combinations of variables and age groups. Therefore, generalizing results across all studies is challenging.

These analyses therefore provide several approaches to the question "how many students decline in value beliefs"? First, the growth curve model demonstrated that on average, declines were evident in science and math only. In addition, the results of this analysis indicate that 30% of students displayed a significant negative trend in English, 51% in math, 60% in science, and 31% in social studies. Combining across subjects, 23% of students do not exhibit any significant declines in value beliefs, 22% of students show significant negative linear trends for one subject, 28% for two subjects, 11% for three subjects, and 16% of students for all four subjects. Next, according to the GMM analysis, 7% of students fell into classes with a significant negative trend in science ("STEM decline" and "Decline"), and the "Decline" group representing 3% of participants was the only class with a significant negative trajectory in the other three subjects. Therefore, unlike the previous study that had compared the LCA and GMM methods (Guo, Wang, et al., 2018), the two techniques here produce substantially different results.

## Demographic Differences in Academic Value

### Gender

It was hypothesized (3a) that women would place higher value on English and social studies than did men, and that either no gender difference or a difference favoring men would be present for math and science. The results were consistent with expectations for initial levels of English value but not in social studies, for which no gender difference was evident. In math, a gender difference in initial levels was found favoring men, and again no gender difference was apparent for science. No gender differences in slopes were evident, indicating that women and men both show the overall trend of improving in value for English and social studies while declining in value for math and science. In the within-group analysis, women placed the most value on English and science together, followed by math, followed by social studies; men reported the highest value for science, followed by English and math together, followed by social studies. In addition, an overall main effect of gender was observed in which women indicated slightly greater value beliefs on average across all subjects than men. In the GMM analysis, as hypothesized (3a), women were overrepresented in the "Humanities preference" and "STEM decline" groups while underrepresented in the "STEM preference" group. In addition, women were underrepresented in the "Improving" and "Decline" classes and no gender differences were evident in the "High stable" class.

Therefore, results replicate consistent previous research determining that women place higher value on language subjects than do men (Archambault et al., 2010; Lee & Kim, 2014). However, the lack of difference in social studies value contradicts earlier work (Guo, Wang, et al., 2018). In previous research, women often express greater interest in verbal and language domains than do men. Further, social studies has been proposed to fall close to the "verbal" side of a "verbal to math continuum" (Marsh & Shavelson, 1985), suggesting that gender differences favoring women would be apparent. However, the curriculum referred to as "social studies" at the school involved in the present study largely consisted of history, with some students taking economics as well. These two college majors remain male-dominated (National Center for Education Statistics, 2017), indicating that interest in these topics may be influenced differently by gender than other verbal domains.

In addition, while recent research has not always found gender differences in math value (Fredricks & Eccles, 2002; A. E. Gottfried et al., 2001), the present study conforms with other past results that have identified differences favoring men (Köller et al., 2001; Lee & Kim, 2014). Both patterns have received considerable support, calling into question whether gender differences in STEM participation are truly mediated by value beliefs as proposed by Expectancy-Value Theory. Further, gender differences in behavior may still be mediated through value beliefs despite a lack of group-level differences if men and women exhibit different within-person hierarchies of preference. Indeed, consistent with previous research on the topics of math and science (Chow et al., 2012; Viljaranta et al., 2018), the present study determines that while genders do not differ on science value, women are more likely to belong to profiles that place relatively higher value on humanities than STEM domains. However, as discussed below, the implications for promoting women's participation in STEM may differ based on the specific science topics assessed (Gaspard et al., 2017) or specific components of math value beliefs (Lee & Kim, 2014).

**Parental educational attainment**

Due to conflicting previous research, it was hypothesized that lower parental educational attainment would either have a negative relationship or no relationship with value for any subject (3c). Although it is commonly proposed that students with low-SES backgrounds and negatively stereotyped Racial/Ethnic identifications will place lower value on academic domains as a result of facing barriers to academic success (Steele et al. 2002), some research has found that students and parents in these communities in fact place equal or higher value on academics than more advantaged groups (Wigfield et al., 2012) . In the present study, lower parental educational attainment was related to lower student initial value beliefs (intercepts) in science and social studies with a marginally significant trend in math. Change over time in academic value beliefs was also significantly related to parental educational attainment. On average across all academic subjects, students with the highest parental educational attainment experienced a significant increase while students with the lowest parental educational attainment demonstrated a significant decline. For the middle two groups, the trajectory over time was not significant. When examined in each subject individually, the group with lowest parental educational attainment did not show the significant positive trend in English and social studies present for the other groups. In math and science, the negative trend for the group with lowest parental educational attainment was greater than the negative trend for the other groups.

It was further hypothesized that effects of student educational aspirations may mirror any relationship found between parental educational attainment and value beliefs. The results indicated that students with higher personal educational aspirations reported greater initial levels of value in math and science and experienced less decline in science value. Therefore, aspirations could potentially mediate the effects of parental educational attainment on science slope, science intercept, and math intercept, but not the trends found in English and social studies. Mediation was not tested in the present analysis due to the limited data available for this survey question, but represents an avenue for future research.

For the GMM analysis, no direction was hypothesized for the influence of parental educational attainment. However, the analysis again provided support for the view that lower-SES students may devalue academic domains. The group with lowest parental educational attainment was underrepresented in the "High stable" class and overrepresented in the "Humanities preference" and "Decline" classes, while the "Law, Medical, or Ph.D. degree" group was overrepresented in the "High stable" class and underrepresented in the "Humanities preference" class. However, despite average level differences by parental educational attainment in STEM domains, no differences in STEM class membership were apparent.

**Racial/Ethnic Identification**

In a similar manner to the research on student socioeconomic status, previous theory and results have conflicted on the issue of whether students of color place lower value on academic domains than White/Caucasian and Asian/Asian American students. In the present analysis, which included the categories of White/Caucasian, Asian/Asian American, Black/African American, Hispanic/Latinx, and Other/Multiple, differences were only present in the subjects of math and science. In math, Asian/Asian American students valued the subject significantly more than all other groups with no other significant group differences present. In science, Asian/Asian American students valued the subject more than all other groups, Black/African American students reported significantly lower value than both White/Caucasian and Asian/Asian American students, and Hispanic/Latinx students differed significantly only from Asian/Asian American students. No effects of Racial/Ethnic identification were found for slopes.

Similar results were evident in GMM group membership. Asian/Asian American students were underrepresented in the "STEM decline" class and overrepresented in "STEM preference" class, while White/Caucasian students were overrepresented in "High stable" class. Black/African American students were underrepresented in the "High stable" and overrepresented in the "Humanities preference" and "Decline" classes. Corresponding to the results for parental educational attainment, Black/African American students were not underrepresented in the "STEM preference" class despite reporting lower value for science on average than other groups.

**Interactions.** Notably, no interactions were identified between demographic variables in this analysis. Therefore, the present study supports neither the “double jeopardy” proposal (Beal, 1970) that women of color may report especially negative attitudes towards STEM, nor recent findings that gender differences in STEM motivation are smaller among Black/African American than White/Caucasian or Hispanic/Latinx students. In addition, while interactions between parental educational attainment and other demographic factors would strongly imply that average trends observed at this high-SES school would not generalize to other settings, such a pattern was not evident. However, it still remains the case that all findings from this sample may be influenced by the high-SES and high achieving school context. Overall, this lack of interactions implies that any perceived need for intervention based on disparities in value beliefs for one demographic factor exists across all other demographic differences. For example, gender differences in math and English value are present on average in all SES and Racial/Ethnic identification groups.

## Summary and Implications

In summary, the present analysis has found disparities in academic value beliefs based on gender, parental educational attainment, and Racial/Ethnic identification, yet no interactions between these variables. Women reported lower value for math than did men and were more likely to belong to GMM groups with a humanities preference, while men indicated lower value for English than did women. In addition, women showed an overall advantage in academic value beliefs by expressing slightly higher value on average across all subjects than did men and being less likely to belong to the “Declining” value profile. For parental education level, students with lower parental educational attainment placed lower value on math, science, and social studies, declined more in value for all subjects, and were less likely to belong to the “High stable” value profile. In a similar pattern, students with lower personal educational aspirations placed lower value on math and science. Finally, for Racial/Ethnic identification, Asian/Asian American students expressed the highest value of any group for both math and science and were more likely to belong to value profiles preferring STEM subjects. However, Black/African American students placed the lower value on science than other groups and were less likely to belong to the “High stable” value profile.

Therefore, high-performing schools wishing to improve equity in subject area value beliefs may consider focusing on students with lower parental educational attainment in relation to all content areas, Black/African American students in science, women in math, and men in English. While women generally have an advantage in academic achievement compared to men (Voyer & Voyer, 2014), other group differences in value beliefs could potentially be influenced by lower achievement and lower self-concept of ability (Arens, Schmidt, & Preckel, 2019; Marsh et al., 2005). For example, lower-SES and Black/African American students often receive lower grades in math class and are less likely to enroll in challenging math courses (Grigg, Donahue, & Dion, 2007; McGee & Martin 2011). Low-SES students are less likely to question or challenge teachers or benefit from intervention by their parents when facing problems at school (Lareau, 2002; Useem, 1991). Similarly, families of Black/African American students often face challenges interacting with schools and lack of trust due to a history of experiencing institutional discrimination (Fields-Smith, 2005). Such barriers facing low-SES and Black/African American students often overlap, as in the present sample, with Black/African American families earning less and in possession of less wealth on average than majority groups (McKernan, Ratcliffe, Steuerle, & Zhang, 2013). Therefore, instructional support for lower-SES and Black/African American students may help address disparities in value beliefs as well.

In order to intervene with both low parental educational attainment and Black/African American students in science or low-SES students in math, the link found in the present study between educational aspirations and value for these two subjects could be considered. In this sample, students with low parental educational attainment and Black/African American students reported lower personal educational aspirations than other groups. In addition, as discussed below, value beliefs for math and science are linked to career commitment. Current research supports both the pattern that establishing STEM career aspirations then leads to improved value in these domains (Eccles, 2009; Lauermann, Tsai, & Eccles, 2017) as well as the converse - that higher STEM value beliefs lead to STEM aspirations (Durik et al., 2006; Simpkins et al., 2006; Tai, Liu, Maltese, & Fan, 2006; Wang, 2012). These reciprocal relationships have informed a recent expansion of research into “utility value interventions,” which encourage students to reflect on usefulness of course material in brief writing exercises (Gaspard et al., 2015; Hulleman, Godes, Hendricks, & Harackiewicz, 2010; Hulleman & Harackiewicz, 2009). These interventions, which have often been conducted in STEM classes, frequently involve students making connections between class material and future careers. However, current studies have begun to demonstrate that such interventions must be implemented with caution. Students with low self-concept of ability in a domain or who perceive the intervention as controlling or patronizing may experience no benefit or even declines in performance and value (Albrecht & Karabenick, 2018; Durik, Shechter, Noh, Rozek, & Harackiewicz, 2015).

A similar approach to improving value beliefs by linking course content to career aspirations, the “role incongruity” perspective, was initially applied to women in STEM fields but is broadly related to career aspirations for groups experiencing negative stereotypes in an academic domain (Diekman, Brown, Johnston, & Clark, 2010; Diekman & Steinberg, 2013).

Research on this topic has found that women express more communal goals and a greater desire for social interaction in their careers then men (Guo, Eccles, Sortheix, & Salmela-Aro, 2018; Su & Rounds, 2015) while incorrectly perceiving STEM fields and careers as unrelated to these values (Bennett & Hogarth, 2009; Cleaves, 2005; Miller, Blessing, & Schwartz, 2006). Therefore, interventions from the role incongruity perspective include approaches such as explaining how physics is involved in helping professions such as medicine (Hoffmann, 2002) and correcting misconceptions that work as a scientist is usually solitary (Greenfield, 1997). Indeed, although value beliefs related to “science” did not differ between genders in the present study, disparities in interest in the specific topic of physics may still exist (Gaspard et al., 2017). Due to the fact that low-SES (Brown, Smith, Thoman, Allen, & Muragishi, 2015) as well as Black/African American individuals (Daly, Jennings, Beckett, & Leashore, 1995; DeFrancisco & Chatham-Carpenter, 2000) tend to express more collectivist and community-oriented values than the predominating culture in the U.S., similar changes to curricula may be effective in these populations as well.

Finally, all of the group disparities in value beliefs found in the present analysis are in stereotype-consistent directions (Durante, Tablante, & Fiske, 2017; Moss-Racusin, Dovidio, Brescoll, Graham, & Handelsman, 2012; Sinclair, Hardin, & Lowery, 2006). Therefore, although schools may have limited ability to combat generally prevailing stereotypes, any efforts to do so may also help address these value differences. A number of methods can be applied in the classroom to address the effects of negative stereotypes, such as inclusion of diverse role models and culturally responsive teaching (Rowley, Kurtz-Costes, & Cooper, 2010; Ware, 2006). In addition, instructors can be careful to avoid unintentionally communicating lower expectations for negatively stereotyped groups of students, including well-intentioned actions such as excessive praise for correct responses (Graham, 1990; Henderlong & Lepper, 2002; Thompson, 1997). In addition, the promotion of a positive Racial/Ethnic identity among minority students buffers against perceived bias and promotes academic achievement (Chavous et al., 2003; Rowley et al., 2010; Wong, Eccles, & Sameroff, 2003). Notably, promoting gender equity requires attention to gender differences in English as well as math. While women are more likely than men to succeed academically in both STEM and verbal domains, men are more likely to succeed only in STEM (Wang, Eccles, & Kenny, 2013). A perception among men that their career options are limited to STEM fields presents a barrier to equal gender representation in these sectors, possibly causing greater competition for positions or even resistance among men towards efforts to include women.

## Career identity development

The development of career identity represented the second major focus of the present analysis. Although previous research on expectancy and value beliefs has often included career aspirations (Chow et al., 2012; Guo, Wang, et al., 2018; Musu-Gillette et al., 2015), the assessment of career identity variables is novel in the present study. First, developmental trajectories of career commitment and career exploration were characterized using LCM and demographic group differences in these variables were identified. Next, the career identity variables were linked with academic value beliefs as well as specialization in these beliefs.

### Trajectories

It was hypothesized that (4) both career commitment and career exploration, which are considered to be adaptive elements of the career decision-making process in previous research (Kroger, 2007; Skorikov and Vondracek, 2007), would increase over the course of high school. This hypothesis was not supported in the case of career exploration, which showed no significant trend, and was in fact contradicted in the case of commitment, which exhibited a significant negative slope. Further, the variances of the linear and quadratic terms were not significant, demonstrating that these trends were largely similar among students. Consistent with previous research, intercepts and slopes were positively related between the two variables (Hirschi, 2011), indicating that students with high initial levels of commitment tended to report high initial levels of exploration and students who decline in commitment also tend to decline in exploration. The unexpected result that career commitment declines over time contradicts previous research (Germeijs et al., 2006; Hirschi, 2011) and was examined further in the following demographic group analyses. Although a potential explanation for the decline in commitment could be that students are reconsidering their initial, and perhaps unrealistic, career aspirations, an increase in exploration would be expected. However, such a pattern was not found in the present study.

**Demographic Differences**

**Gender.** In previous research, young women are often more advanced in the career decision-making process during adolescence than young men (Klimstra et al., 2010, Goossens, 2001; Solomontos-Kountouri & Hurry, 2008). It was therefore hypothesized (5a) that women would report both greater career exploration and commitment, but no gender effects were found.

**Parental educational attainment and educational aspirations.** Past research has generally determined that lower socioeconomic status generally corresponds to less advanced career decision-making, due to the experience of increased institutional barriers as well as lower social and cultural capital compared to other groups. However, in contradiction to this hypothesis, the group with lowest parental educational attainment reported significantly higher initial levels of career commitment then all other groups. This result is consistent with a smaller body of research finding that higher-SES college students, with greater parental resources to rely on, are able to engage in an “extended moratorium” and therefore delay career commitment (Arnett, 2000; Berman, Schwartz, Kurtines, & Berman, 2001; Cote & Levine, 1997). It was next hypothesized that the effect of student educational aspirations would correspond to the pattern seen for parental educational attainment. For example, students who expect to remain in school for longer may plan to postpone committing to a career choice until closer to the end of their education. However, no significant differences based on educational aspirations were found for either variable. Therefore, the positive influence of parental educational attainment on career commitment is unlikely to be mediated through student aspirations in this sample. Students in this population aspiring to high levels of future education may represent a mix of students who plan to advance a specific career choice, such as becoming a doctor, and those with a generalized intention to attain a high-level degree. Another influence on the effect of parental educational attainment on career commitment may be the fact that lower-SES adolescents are more likely to work for pay (LeFebvre, 2017; Staff & Mortimer, 2008), perhaps drawing attention to the career decision-making process.

**Race.** In a pattern similar to the research on SES and career identity development, most previous theory and research has proposed that adolescents of color are less advanced in career decision-making due to facing several additional obstacles in the process compared to majority groups. However, students in the Other/Multiple category as well as Black/African American students reported significantly higher initial career commitment than Hispanic/Latinx students, Asian/Asian American students, and White/Caucasian students. Therefore, the results for Black/African American students contradict this hypothesis. Note that although Black/African American students in this sample were more likely to have lower parental educational attainment, that variable was controlled for in this analysis. Based on the contention that parental, family, and community influences play a stronger role in career development for Black/African American adolescents than other groups (Cheatham, 1990; Lee, 1984; McWhirter, 1997), perhaps such social influences have helped these students advance in career decision-making more rapidly.

**Interactions.** No interactions between any demographic variables were found.

## Relationships Between Academic and Career Variables

### Parameter relationships

For career commitment, intercept was positively related to science intercept, and slope was positively related to math and science slope. This pattern could be consistent either with initial high interest in STEM facilitating later career commitment, or initial high career commitment (possibly to a STEM career) buffering against declining value in these subjects. In either case, these findings may indicate that schools wishing to improve value beliefs as well as career commitment could combine the two topics in the same intervention or set of curricular changes. However, the present analysis cannot establish the direction of this relationship, which could be examined in the future with cross-lagged analyses.

For career exploration, the intercept was positively related to the intercept terms for all academic subjects, but the slope was negatively related to the slopes for English, math, and social studies. These results indicate that students entering high school with interest in more subjects also begin with high exploration. However, the implications of the negative slope relationships are unclear. In the case of English and social studies value, which follow positive trajectories overall, this pattern may signify that students high in exploration improve less in their English and social studies value beliefs due to a ceiling effect. Again, the direction of causality is unclear, with increases in exploration possibly preceding declines in academic value beliefs or the reverse.

**Specialization**

Two indicators of specialization in academic value were expected in this project. First, that slopes for humanities subjects and STEM subjects would be negatively related, indicating for example that an increase in value for humanities tends to accompany a decrease in value for STEM. Second, it was hypothesized that at least one group would be identified in the GMM analysis with a specializing pattern, consisting of maintaining high value for at least one subject while declining in value for at least one other subject. In contradiction to the first hypothesis, slope terms for all academic subjects were in fact positively related. Therefore, students generally improved or declined in value beliefs for all academic domains simultaneously, which contradicts previous findings that improving value for one domain predicts declining value in the other (Guo et al., 2017; Möller, Helm, Müller-Kalthoff, Nagy, & Marsh, 2015; Schurtz, Pfost, Nagengast, & Artelt, 2014). While the correlations between slope terms were strongest between math and science and between English and social studies, these differences were not significant. In relation to the second hypothesis, the expectation was confirmed by the identification of the "STEM decline" group. This group, representing 4% of the sample, declined significantly in value for math, showed nonsignificant negative trends in science and social studies, and improved in value beliefs for English. As expected, women were overrepresented in this group. However, this group was quite small and rarely identified across the different classification models tested. Overall, specialization was not a prominent pattern in this sample of students.

## Specialization and Career Identity

Based on theory and existing results in the vocational development literature, in particular based on Holland's theory of vocational interests (Holland, 1985; Nauta, 2010; Tracey, 2002), it was expected that students with more specialized patterns of value beliefs would demonstrate more advanced career identity development. From this perspective, focusing on a favorite subject is in fact an adaptive and normative element of the career decision-making process. If true, such a relationship may imply that intervening to improve declining value beliefs is unnecessary or ineffective, given that students may have an alternate favorite subject related to their career goal. This hypothesis was tested by comparing the three classes with specialized interests, "STEM decline," "STEM preference," and "Humanities preference," to the other classes. Consistent with expectations, students in the specialized classes reported greater initial levels and experienced less decline in career commitment. However, inconsistent with expectations, the more specialized groups did not also indicate greater career exploration. Therefore, these results do not necessarily support the claim that specialization is a positive outcome. In the identity development literature, the "achieved" status with high levels of both exploration and commitment simultaneously is linked with the most positive career and mental health outcomes (Luyckx et al., 2010; Skorikov & Vondracek, 2007). In contrast, high levels of commitment without corresponding high levels of exploration represent the "foreclosed" status, which is thought to represent a premature decision and therefore less desirable (Brown, Glastetter-Fender, & Shelton, 2000; Marcia, 1966; Skorikov & Vondracek, 2007).

# Limitations

In addition, the results of the present analysis should be viewed in light of several limitations. First, despite the intention of the survey measures to assess beliefs in relation to the academic subject overall, trends may instead reflect responses to curricula specific to the class the student is currently taking. For example, it is well established that women prefer the topic of biology to physics (Gaspard, Häfner, Parrisius, Trautwein, & Nagengast, 2017; Miller, Blessing, & Schwartz, 2006). In the present study, students took biology in ninth grade, earth science in 10th grade, chemistry in 11th grade, and either no science course or a range of AP or elective courses in 12th grade. In social studies, students took world history in ninth grade, U.S. history in 10th grade, U.S. government and economics in 11th grade, and a variety of AP or focused history courses in 12th grade. Therefore, influences of these different courses based either on content or the quality of teaching could be causing the appearance of developmental trends.

Further, patterns found in the present study may have differed if value beliefs were divided into subcomponents. Several examples currently exist of results that differed dramatically between such subcomponents. For example, one study of the CAB dataset concluded that math value beliefs declined steadily during high school (Jacobs et al., 2002), while another analysis of the same data demonstrated that math usefulness/importance in fact increased when examined separately (Fredricks & Eccles, 2002). Two other studies have observed an identical pattern, with declines in math intrinsic value yet stability in beliefs about math usefulness (Ma & Cartwright, 2003; Watt, 2004). Similarly, in a recent analysis of an expanded Expectancy-Value survey measure (Gaspard et al., 2017), overall utility value for math decreased; yet, when each facet of utility value was analyzed separately, utility for daily life decreased dramatically, utility for job decreased for women but not men, utility for school remained stable for both genders, and social utility in fact increased slightly. Another concern with the interpretation of the survey data used in the present study is that students may have dramatically different understandings of the terms “English,” “math,” “science,” and “social studies” broadly. Therefore, for the purposes of separating these influences from students’ global attitudes towards academic subject areas, future research may gather information on specific courses and teachers, use more specific terminology to refer to academic subjects, or conduct cognitive interviews to investigate students' definitions of the academic domains or other key terms (Karabenick et al., 2007).

Future research may also benefit from the inclusion of both self-concept of ability beliefs and academic achievement. Existing research suggests that value beliefs are influenced by these two variables (Arens, Schmidt, & Preckel, 2019; Marsh et al., 2005; Wigfield & Eccles, 1992), and therefore efforts to intervene in group disparities in value beliefs may require addressing self-concept or achievement rather than value directly. The addition of academic achievement also may help interpret the unexpected patterns evident in career identity development, such as declining career commitment over time, negative relationships between the slope of career exploration and most academic variables, and the lack of influence of educational aspirations on either variable.

Several additions to the present analysis could also help to further understand career identity development as an outcome of academic value beliefs. First, cross-lagged analyses could be conducted to further examine several results that could have implications for intervention. For example, the positive relationships found between the slopes of math and science value beliefs and the slope of career commitment, or the positive relationship between the slope of science value and educational aspirations could indicate causal relationships in either direction. It may be the case that encouraging students to raise their educational aspirations or commit to a career aspiration would facilitate placing greater value on math and science (Eccles, 2009; Lauermann, Tsai, & Eccles, 2017), that improving value for math and science could lead students to aspire to more education and more definite career goals (Durik et al., 2006; Simpkins et al., 2006; Tai, Liu, Maltese, & Fan, 2006; Wang, 2012), or that all variables demonstrate reciprocal relationships. Academic achievement, if included, could also mediate these relationships, as well as specific career aspirations.

In addition, institutions that wish to promote career commitment could use further measures to determine the reasons for low-SES and Black/African American students reporting greater career commitment than other students. Potential mediators of this relationship could then be evaluated, including the greater likelihood of low-SES students to work for pay (LeFebvre, 2017; Staff & Mortimer, 2008) the greater influence of parents and family for career decision-making among Black/African American students (Cheatham, 1990; Lee, 1984; McWhirter, 1997), and the lower educational aspirations found in both groups. Further, alternate measures of adaptive career development outcomes could be included. Based on the vocational identity development theory that the best outcomes result from high exploration combined with high commitment, these two variables could be examined together. Similarly, alternate measures of career development outcomes such as career indecision (Brown et al., 2012) or career decision-making self-efficacy (Betz, Hammond, & Multon, 2005) could be included.

A continuing methodological concern in the expanding topic of exploratory, person-centered research is the synthesis of conclusions across studies and evaluation of which results represent replications. For example, eight patterns of value trajectories over time as well as seven patterns of subject area value profiles were identified in recent studies on this topic, yet most of these patterns were difficult to classify as similar. While the present analysis corresponded to several previous studies finding “High stable,” “Humanities preference,” and “STEM preference” groups, other patterns were not similar, and the previous research used varying combination of subject area, value subcomponent, and self-concept beliefs. Therefore, the interpretation of future research using these person-centered methods would be facilitated by consistency across studies in the motivational beliefs and academic domains included.

Finally, these results were found in the context of a school with high achievement, quite high levels of parental educational attainment, and a predominantly white student population. While a high-SES context may be assumed to help reduce demographic group disparities in academic value beliefs through availability of additional resources, in some cases high-SES settings can in fact increase group differences. For example, a recent study of third to eighth grade state standardized test scores in about 10,000 U.S. school districts from 2008 to 2016 found that gender differences in math achievement were greater in high-SES districts (Reardon, Fahle, Kalogrides, Podolsky, & Zárate, 2019). In order to assess school context effects, future research could compare schools as well as collect data on possible school-level influences such as racial climate (Byrd & Chavous, 2011). In addition, significant differences in value beliefs were not generally observed in the present analysis for Hispanic/Latinx students, which were not well represented in the sample. A continuing effort to include diverse samples remains critical to the effort to promote equity in academic value, achievement, and career choices.

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