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The Variability in Math Motivational Belief Development Across Adolescence: The Role of Social Identities, Cultural Milieu, and Socializers in Multiple Racial/Ethnic Groups

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The Variability in Math Motivational Belief Development Across Adolescence: The Role of Social Identities, Cultural Milieu, and Socializers in Multiple Racial/Ethnic Groups

DISSERTATION

Submitted in partial satisfaction of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

in Education

by

Glona Lee

Dissertation Committee:
Professor Sandra D. Simpkins, Chair
Distinguished Professor of Education Jacquelynne S. Eccles
Distinguished Professor of Psychological Science and Education Chuansheng Chen

2023

DEDICATION

To my family and friends

for being my inspiration

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ACKNOWLEDGEMENTS

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CURRICULUM VITAE

Glona Lee

FIELD OF STUDY

Adolescent development; academic motivation; influence of socializers (e.g., parents, teachers); social identities (e.g., race/ethnicity, gender); resilience

EDUCATION

2018 – Present	Ph.D., Education, **University of California, Irvine**, CA, U.S.A Specialization: Human Development in Context Anticipated Year of Completion: June 2023 Advisor: Sandra D. Simpkins & Co-Advisor: Jacquelynne S. Eccles
2017	M.A., Educational Psychology, **Korea University**, Seoul, South Korea
2012	B.Sc. Honors, Biomedical Sciences, **University of Waterloo**, Waterloo, Canada

PEER-REVIEWED PUBLICATIONS

A. JOURNAL ARTICLES

7. Safavian, N., **Lee, G.,** Dicke, A-L., Karabenick, S., & Eccles, J. S. (2023). Disentangling perceived educational support sources and types in adolescence and Latina's educational attainment in adulthood. *Hispanic Journal of Behavioral Sciences.* Advanced online publication. https://doi.org/10.1177/07399863231153292
6. Rubach, C., **Lee, G.,** Starr, C., Gao, Y., Safavian, N., Dicke, A-L., Eccles, J. S., & Simpkins, S. D. (2022). Is there any evidence of historical changes in gender differences in American high school students' math competence-related beliefs from the 1980s to the 2010s?. *International Journal of Gender, Science and Technology*, *14*, 55–126.
5. Starr, C. R., Gao, Y., **Lee, G.,** Safavian, N., Rubach, C., Dicke, A-L., Eccles, J. S., & Simpkins, S. D. (2022). Parents' math gender stereotypes and their correlates: An examination of the similarities and differences over the past 25 years. *Sex Roles*, 1-17.
4. Yu, M. V. B., Hsieh, T., **Lee, G.**, Jiang, S., Simpkins, S.D., & Pantano, A. (2021). Promoting Latinx adolescents' math motivation through competence support: Culturally responsive practices in an after-school program context. *Contemporary Educational Psychology, 68, 102028.*
3. **Lee, G.** & Simpkins, S.D. (2021). Ability self-concepts and parental support may protect adolescents when they experience low support from their math teachers. *Journal of Adolescence, 88,* 48-57.
2. Simpkins, S. D., Tulagan, N., **Lee, G.,** Ma, T-L., Zarrett, N., & Vandell, D. L. (2020). Youth's developing work habits from middle childhood to early adolescence: Cascading effects for academic outcomes in adolescence and early adulthood. *Developmental Psychology, 56,* 1-15.
1. Yu, M. V. B., Liu, Y., Hsieh, T., **Lee, G.**, Simpkins, S.D., & Pantano, A. (2020). "Working together as a team really gets them fired up": Afterschool program mentoring strategies to promote

collaborative learning among adolescent participants. *Applied Developmental Science,* 1-15.

B. BOOK CHAPTERS & ENCYCLOPEDIA ENTRIES

2. Rubach, C., **Lee, G.,** Lazarides, R. & Simpkins, S. D. (in press). *Adolescence and high School*. In Encyclopedia of Adolescence, 2nd edition.

1. Shin, D., Lee, H. J., **Lee, G.,** & Kim, S. (2019). *The role of curiosity and interest in learning and motivation*. In A. K. Renninger & S. E. Hidi (Eds.), The Cambridge handbook of motivation and learning. Cambridge, UK: Cambridge University Press.

UNDER REVIEW

Lee, G., Simpkins, S. D, & Eccles, J. S. (*revise & resubmit*). Trajectories of adolescents' expectancies for success and values in math in Latinx and Asian students.

Rubach, C., Safavian, N., **Lee, G.,** Dicke, A-L., Starr, C. R., Eccles, J. S., & Simpkins, S. D. *(under review).* Do racial/ethnic differences in high school students' math competence-related beliefs replicate across datasets from 9th to 12th grade?

Starr, C. R., Gao, Y., Rubach, C., **Lee, G.,** Safavian, N., Dicke, A-L., Eccles, J. S., & Simpkins, S. D. *(under review).* "Who's better at math, boys or girls?": Changes in adolescents' math gender stereotypes and their motivational beliefs from early to late adolescence.

IN PREPARATION

Lee, G., Simpkins, S. D., & Eccles, J. S. *(in prep).* The changes in math motivational beliefs across high school by race/ethnicity: The role of teachers and parents

Lee, G., Simpkins, S. D., & Eccles, J. S. *(in prep).* Examining the collective role of parents' academic and racial socializations in shaping Black adolescents' motivation.

CONFERENCE PRESENTATIONS

24. **Lee, G.**, & Simpkins, S. D. (2023, April). *Does parent support buffer Latinx and Black adolescents' math motivational beliefs when they perceive teacher unfairness* Paper presented at the annual meeting of the American Educational Research Association, Chicago, Il.

23. Rubach, C., Safavian, N., **Lee, G.,** Dicke, A-L.., Starr, C. R., Eccles, J. S., & Simpkins, S. D. (2023, April). *Math competence-related beliefs in high school: A replication of ethnic/racial differences within gender groups.* Paper presented at the annual meeting of the American Educational Research Association, Chicago, Il.

22. Safavian, N., Dicke, A-L., Gao, Y., Eccles, J. S., **Lee, G.** (2023, April). *Identifying profiles of motivation-signaling language use and its association with social background, interest, and persistence*. Paper presented at the annual meeting of the American Educational Research Association, Chicago, Il.

21. **Lee, G.**, & Simpkins, S. D. (2023, March). *The Patterns of Change in Math Motivation Across High School by Race/Ethnicity: The Role of Teachers and Parents.* Paper presented at the biennial meeting of the Society for Research in Child Development, Salt Lake City, UT.

20. Starr, C. R., Gao, Y., **Lee, G.,** Safavian, N., Rubach, C., Dicke, A. L., Eccles, J. S., & Simpkins, S. D. (2023, March). *Adolescents' Math Ability Gender Stereotypes and Motivational Beliefs: Testing for Replication Across Two Datasets. In S. Zhao & P. Setoh (Chairs), New Perspectives on the STEM Gender Disparities: Children's Interlocking Beliefs about Fields and Social Groups.* Paper presented at the biennial meeting of the Society for Research in Child Development, Salt Lake City, UT.

19. Rubach, C., Starr, C. R., **Lee, G.,** Gao, Y., Safavian, N., Eccles, J. S., & Simpkins, S. D. (2022, August). *Intersectionality in students' motivational-affective learning processes and well-being.* Symposium presentation presented at the International Conference on Motivation 2022, Dresden, Germany.
18. Dicke, A-L., Safavian, N., Gao, Y., **Lee, G.,** Eccles, J. S. (2022, August). *Students' expectancy-value beliefs and STEM persistence intention by gender and ethnicity.* Paper presented at the annual meeting of the American Psychology Association, Minneapolis, MN.
17. Safavian, N., Dicke, A-L., Gao, Y., **Lee, G.,** Eccles, J. S. (2022, August). *Language and physics learning: Investigating undergraduate narratives on physics relevance.* Paper presented at the annual meeting of the American Psychology Association, Minneapolis, MN.
16. **Lee, G.**, & Simpkins, S. D. (2022, July). *Investigating adolescents' motivation development in math by their racial/ethnic and gender membership.* Paper presented at 2022 Network Gender & STEM Conference, München, Germany.
15. Rubach, C., **Lee, G.,** Starr, C. R., Gao, Y., Safavian, N., Dicke, A-L., Eccles, J. S., & Simpkins, S. D. (2022, July). *How meta-analysis, replications, and systematic reviews help us better understand gender and STEM motivational beliefs.* Symposium presentation presented at 2022 Network Gender & STEM Conference, München, Germany.
14. Safavian, N., Dicke, A-L., Gao, Y., **Lee, G.,** Eccles, J. S. (2022, July). *Investigating gender-moderated associations of undergraduate physics goal affordance beliefs, language, and learning over time.* Paper presented at 2022 Network Gender & STEM Conference, München, Germany.
13. Starr, C. R., Gao, Y., Dicke, A-L., Rubach, C., **Lee, G.,** Safavian, N., Eccles, J. S., & Simpkins, S. D. (2022, July). *The Role of Social Contexts in STEM Motivation Gender Differences Across Four Countries.* Symposium presentation presented at 2022 Network Gender & STEM Conference, München, Germany.
12. Safavian, N., Dicke, A-L., Gao, Y., **Lee, G.,** Eccles, J. S. (2022, April). *Investigating undergraduates' physics usefulness narratives: What can words covey about motivated beliefs from various backgrounds?* Paper accepted at the annual meeting of the American Educational Research Association, San Diego, CA.
11. **Lee, G.**, & Simpkins, S. D. (2022, Mar). *Examining the collective role of parents' academic and racial socializations in shaping Black adolescents' math motivation.* Poster presented at the Society for Research on Adolescence Biennial Meeting, New Orleans, LA.
10. Dicke, A-L., Rubach, C., **Lee, G.,** Safavian, N., Gao, Y., Starr, C. R., Eccles, J. S., & Simpkins, S. D. (2021, July). *Perceived teacher support and its associations with math motivational beliefs: Exploring gender differences using three large U.S. datasets.* Conference session presented at the 2021 Network Gender & STEM meeting, Sydney, Australia.
9. Starr, C. R., Gao, Y., Dicke, A-L., Rubach, C., **Lee, G.,** Safavian, N., Eccles, J. S., & Simpkins, S. D. (2021, July). *Parent and child gender stereotypes about math: Findings from four U.S. datasets from 1984 to 2011.* Conference session presented at the 2021 Network Gender & STEM meeting, Sydney, Australia.
8. **Lee, G.,** & Simpkins, S. D. (2021, April). *Talking to fathers might help when African American adolescents experience low support from their teachers.* Paper presented at the annual meeting of the American Educational Research Association, Orlando, Fl.
7. Safavian, N., **Lee, G.,** Dicke, A-L., Moua, C., Karabenick, S. & Eccles, J. S. (2021, April).

Disentangling sources and types of education-related supports and Latina's educational attainment: A mixed methods study. Paper presented at the annual meeting of the American Educational Research Association, Orlando, Fl.

6. Yu, M. V. B., Hsieh, T., **Lee, G.,** Jiang, S., Simpkins, S. D., & Pantano, A. (2021, April). *Promoting adolescents' math motivational beliefs: Competence supportive practices in math enrichment program*. Poster presented at the annual meeting of the American Educational Research Association, Orlando, Fl.
5. **Lee, G.,** Safavian, N., Dicke, A-L., Eccles, J. S., & Karabenick, S. (2020, August). *Exploring perceived supports and barriers in the pursuit of career goals for Latinas in the U.S.* Paper accepted at the American Psychological Association Annual Convention, Washington, DC. (Conference cancelled)
4. **Lee, G.,** & Simpkins, S. D. (2020, March). *Examining individual and family strengths as moderators of the association between low teacher quality and math performance*. Paper accepted at the Society for Research on Adolescence Biennial Meeting, San Diego, CA. (Conference cancelled)
3. **Lee, G.,** Bong, M., & Kim, S. (2020, April). *Revisiting the relationship between achievement goals and perceived competence in achievement goal pursuit*. Paper accepted at the American Educational Research Association Annual Meeting, San Francisco, CA. (Conference cancelled)
2. Simpkins, S. D., Tulagan, N., **Lee, G.,** Ma, T-L., Zarrett, N., & Vandell, D. L. (2020, March). *Changes in youth's work habits and their implications for academic outcomes in adolescence and young adulthood*. Conference session accepted at the Society for Research on Adolescence Biennial Meeting, San Diego, CA. (Conference cancelled)
1. Lee, J., Lee, H. J., **Lee, G.**, Bong, M., & Kim, S. (2016, April). *Characteristics of teaching and academic functioning of students: The mediating role of situational interest*. Poster presented at the annual meeting of the American Educational Research Association, Washington, DC.

RESEARCH EXPERIENCE

2022 – Present	Researcher, Adolescent STEM Motivation, Intersectionality, and Families Project, University of California, Irvine (Supervisor: Sandra D. Simpkins)
2021 – 2022	Researcher, Utility Value Intervention Project, University of California, Irvine (Supervisors: Jacquelynne Eccles, Anna-Lena Dicke, Nayssan Safavian)
2019 – 2021	Researcher, California Achievement Motivation Project, University of California, Irvine (Supervisors: Jacquelynne Eccles, Nayssan Safavian, Anna-Lena Dicke)
2014 – 2017	Researcher, Brain and Motivation Research Institute (*b*MRI), Korea University (Supervisors: Mimi Bong, Sung-il Kim)

TEACHING EXPERIENCE

2023	Guest Lecturer, *Exploring Psychology,* Northwestern College
2021	Certificate in Teaching and Learning (Associate level), Division of Teaching Excellence, University of California, Irvine
2021	Guest Lecturer, *Cognition and Learning in Educational Settings,* University of California, Irvine
2018 – 2019	Teaching Assistant, *ED 160: Foundations of Out-of-School & Summer Learning*, University of California, Irvine (Instructor: Jenel Lao)

2016	Teaching Assistant, Korea University (Supervisor: Mimi Bong)
2015 – 2016	Teaching Assistant, Korea University (Supervisor: Sung-il Kim)
2017 – 2018	Instructor, Avalon Institute, Korea
2013 – 2014, 2011	Instructor, Haju elementary school, Korea

AWARDS

2022	Graduate Dean's Dissertation Fellowship Award, University of California, Irvine
2021	Research Fund, UC Adolescent Consortium
2020	Associated Graduate Student Travel Grant, University of California, Irvine
2016	Academic Scholarship, Department of Educational Psychology, Korea University
2015	Academic Scholarship, Department of Educational Psychology, Korea University
2014 – 2016	Brain Korea 21 Plus (BK21 Plus) Scholarship, Korea University and Ministry of Education, Korea
2014	Foreign Student Scholarship, Korea University
2009 – 2012	Dean's Honors List, University of Waterloo
2011	Dr. Jack Carlson Memorial Award, University of Waterloo
2008	Entrance Scholarship, University of Waterloo
2008	Queen Elizabeth Aiming for the Top Scholarship, Ministry of Training, Colleges, and Universities, Canada

SERVICE EXPERIENCE

A. PROFESSIONAL SERVICE

Ad hoc journal reviewer: *Journal of Character Education, Journal of Youth and Adolescence*

Conference proposal reviewer: 2022, 2020 SRA Biennial Meeting – School/Educational Context

B. UNIVERSITY SERVICE

2021 – 2022	President, Associate Doctoral Students in Education (ADSE), University of California, Irvine
2020 – 2021	Vice President, Associate Doctoral Students in Education (ADSE), University of California, Irvine
2020 – 2021	Member, School of Education Climate Council University of California, Irvine
2020, 2021	Graduate Student Panel for Cross-Cohort Conversation, University of California, Irvine
2019 – 2020	Cohort Representative, Associate Doctoral Students in Education (ADSE), University of California, Irvine
2020, 2019	Recruitment Weekend Volunteer, University of California, Irvine
2019	Invited Graduate Student Panel for Undergraduate Student Club, University of California, Irvine

C. COMMUNITY SERVICE

2018	Math CEO, University of California, Irvine, CA., U.S.A

PROFESSIONAL AFFILIATIONS

2022 – Present	Society for Research in Child Development (SRCD)
2019 – Present	Society for Research on Adolescence (SRA)
2015 – Present	American Educational Research Association (AERA)
2014 – 2017	Korean Educational Psychology Association (KEPA)
2015 – 2016	Korean-American Educational Research Association (KAERA)

ABSTRACT OF THE DISSERTATION

The Variability in Motivational Belief Development Across Adolescence: Investigating the Role of Social Identities, Cultural Milieu, and Socializers in Multiple Racial/Ethnic Groups

By

Glona Lee

Doctor of Philosophy in Education

University of California, Irvine, 2023

Professor Sandra D. Simpkins, Chair

Across development, students' motivational beliefs have been found to typically decrease. A few recent studies have noted that not all individuals may display declines (e.g., stability). Nevertheless, these studies often involved mostly White participants and we know less about the motivational belief development in other racial/ethnic groups. In my dissertation, I examined the heterogeneity in the expectancies for success and subjective task value development in multiple races/ethnicities. Additionally, I examined potential factors that may lead to varying developmental patterns among students, such as the role of various social identities and the socializers. In Study 1, I estimated growth mixture models and examined the underlying patterns that may be hidden in the average trends. I found two classes of stable trajectories for expectancies for success; five classes of stable, decreasing, or increasing trajectories for interest and utility value; and three classes of stable, decreasing, or increasing trajectories for attainment value among Asian and Latinx students from Southern California across Grades 8 through 10. Additionally, group comparisons were made at the intersection of race/ethnicity and gender. Findings suggested that students from marginalized groups (e.g., Latina students) do not always display more negative motivational belief development compared to those privileged in math (e.g., Asian female students). In Study 2, I estimated latent transition models and examined the varying change patterns in motivational beliefs in four racial/ethnic groups (i.e., White, Asian, Latinx, and Black) across Grades 9 to 11 using a nationally representative sample in the U.S. Additionally, I examined the role of parents and teachers in shaping students' motivational beliefs. Findings suggested diverse patterns of stability, decreases, and increases in motivational beliefs in all racial/ethnic groups. Parent socialization and perceived teacher unfairness were significantly associated with some changes in motivational belief development (e.g., perceived teacher unfairness and negative development of interest among Black students). My dissertation demonstrates the variability in motivational belief development among students within the same racial/ethnic group. Overall, my findings challenge the traditional racial/ethnic stereotypes that exist in STEM, suggest ways for researchers to highlight the strengths of marginalized groups, and present ways to create a more equitable learning environment to foster positive motivational beliefs in all youths.

CHAPTER 1

Overarching Introduction

Racial/ethnic disparities remain in most math-intensive Science, Technology, Engineering, and Math (STEM) fields, such as computer science and engineering, where Black and Latinx individuals are underrepresented relative to White and Asian individuals (NSF, 2019). These disparities are prevalent even in high school where despite the increase in the number of racially/ethnically marginalized students taking various math courses in the past two decades, Asian and White students still take more advanced courses and perform better in math compared to Black and Latinx students (NCES, 2022; NSF, 2019). Understanding these disparities in high school is important as high school math performance and coursework serve as a gateway to many STEM courses, college majors, and occupations (Wang, 2013; Watt et al., 2017).

Students' motivational beliefs, specifically their expectancies for doing well on a task (i.e., expectancies for success) and value of a task (i.e., subjective task values), directly influence their academic performance and choices (Eccles, 2009; Eccles & Wigfield, 2020). Prior studies noted that motivational beliefs, on average, decrease across development (Fredricks & Eccles, 2002; Jacobs et al., 2002; Watt, 2004). A few recent studies, however, demonstrate that not all individuals follow the decreasing trends, but display qualitatively different developmental trends of stability or increasing trends (e.g., Gaspard et al., 2020; Guo et al., 2018). Though preliminary studies suggest that these unique trends may emerge among racial/ethnic minority students (Hsieh et al., 2021; Starr, Carranza, Simpkins, 2022; Umarji et al., 2021), more studies are needed that highlight the variability in motivational belief development in diverse races/ethnicities as the majority of the studies on developmental trajectories have been conducted with White participants.

Additionally, there is a need to explore what factors contribute to these unique developmental trends in motivational belief development (e.g., Starr, Tulagan, Simpkins, 2022). For example, motivational beliefs in math may vary based on the intersection of multiple social identities (e.g., race/ethnicity and gender). Math is a domain where not only racial/ethnic stereotypes, but also gender stereotypes are prevalent, where White, Asian, and male students have been privileged and Black, Latinx, and female students have been marginalized (Hsieh et al., 2021; Wang & Degol, 2017). Theoretically, those who are marginalized in math may display more negative motivational belief development compared to those who are privileged in math (Eccles & Wigfield, 2020; McGee, 2018; Wigfield et al., 2015). In adolescence, students can more accurately evaluate their own skills and become more aware of their own identity and the socio-cultural expectations toward them (Brown & Bigler, 2005; Wang & Degol, 2013). As these beliefs become internalized, adolescents' motivational beliefs may change (Fredricks & Eccles, 2002; Wigfield et al., 2015).

In addition, motivational beliefs in math are shaped by students' varying experiences in their social settings, including interactions with their parents or teachers who are two of the central socializers during adolescence (Eccles & Wigfield, 2020; Wigfield et al., 2015). Parent socialization, such as parents' academic and career guidance, can influence students' motivational belief development (Eccles, 1993; Eccles & Wigfield, 2020). Though adolescence is when students seek more autonomy, parents still serve as central figures of support when they make important academic choices, such as course selection (Harackiewicz et al., 2012), or face obstacles (Zimmerman et al., 2013). Parent socialization may be particularly beneficial for adolescents from marginalized groups in math who are more likely to face social barriers (Suizzo et al., 2012). One common way the negative stereotypes are reinforced is through experiences with their math teacher (Green et al., 2006; McKown, 2013; Roeser et al., 1998). Because adolescence is also a developmental period when students develop an increased awareness of the stereotypes and cultural norms regarding their race/ethnicity (Garcia Coll et al., 1996; Umaña-Taylor et al., 2014; Wang & Degol, 2013), adolescents who are racially/ethnically marginalized in math may perceive higher levels of negative stereotypes and teacher unfairness in math. The quality of adolescents' social interactions with their immediate socializers can strengthen or hinder students' motivational beliefs (Eccles & Wigfield, 2020; Simpkins et al., 2015). Because the social experiences may differ based on students' race/ethnicity, the diverse experiences of these students will need to be explored to better understand the potential variations in adolescents' motivational belief development.

Overarching Theoretical Framework: Situated Expectancy-Value Theory

Situated expectancy-value theory has been used widely by researchers in the fields of motivation and psychology more broadly (Eccles & Wigfield, 2020). Eccles and colleagues' situated expectancy-value theory was developed based on Atkinson's (1957) model, which was influenced by Tolman's (1932) studies on expectancies and Lewin's (1938) work on values. Tolman's (1932) theory suggested that individuals' behaviors are purposive in that they are goal-oriented and guided by one's expectations. Lewin's (1938) work described that the values one have for the task act as a driving force for their engagement or disengagement (Elliot et al., 2017; Wigfield & Eccles, 2020). Incorporating both concepts, Atkinson (1957) developed the expectancy-value theory of achievement motivation, where he explained that one's behavior is influenced by their expectancies of an outcome and how much one values the outcome (Elliot et al., 2017; Wigfield & Eccles, 2020). Eccles and colleagues' situated expectancy-value theory, the theoretical framework for my studies, is based on Atkinson's model but is more elaborate in how expectancies and values are defined and by incorporating various cultural, psychological, and social determinants (Eccles & Wigfield, 2002; Elliot et al., 2017; Wigfield & Eccles, 2020).

According to situated expectancy-value theory, students' academic outcomes, such as their performance or choices, are directly driven by their expectancies for success and subjective task value beliefs (Eccles, 2009; Eccles & Wigfield, 2020). Expectancies for success are defined as one's beliefs about their ability to succeed. Subjective task value beliefs consist of one's interest (i.e., enjoyment of the task), utility value (i.e., perceived usefulness of the task), attainment value (i.e., perceived importance of the task based on one's identity), and cost (i.e., perceived cost of doing the task). Though the various subjective task value beliefs are related, they are unique constructs (Eccles & Wigfield, 2020; Wigfield & Eccles, 2020). For these dissertation studies, only the positive subjective task value beliefs were examined, which are interest, utility value, and attainment value. High expectancies for success and subjective task value beliefs have been associated with positive academic outcomes, such as academic performance and educational choices (e.g., course selection; Simpkins et al., 2006; Wigfield et al., 2015). Likewise, adolescents' motivational beliefs in math have been found to predict students' math achievement, math course-taking in high school as well as STEM college majors and career choices (Guo et al., 2015; Jiang et al., 2020; Seo et al., 2019; Simpkins et al., 2015; Wang et al., 2015).

Situated expectancy-value theory stresses that students' motivational beliefs are shaped by the cultural milieu, such as stereotypes and discrimination, and their social context (Eccles & Wigfield, 2020; Wigfield et al., 2015). That is, adolescents' motivational belief development may follow different trends depending on whether they are privileged or marginalized in math based on their social identities (e.g., race/ethnicity; McGee, 2018). Nevertheless, these societal beliefs are often communicated through socializers (Else-Quest et al., 2013; Nosek & Smyth, 2011). Especially, parents' and teachers' beliefs and behaviors directly influence students' beliefs about what they think they are good at and the tasks to value (Wigfield & Eccles, 2020). For example, parents influence when adolescents make important academic decisions, such as selection into STEM courses (Harackiewicz et al., 2012). Situated expectancy-value theory suggests that students' social identities (e.g., race/ethnicity and gender) and their socio-cultural experiences are important predictors of their motivational belief development.

Math Motivational Belief Development in Adolescence

Across childhood to adolescence, students' academic motivational beliefs in math and other domains have been found to typically decrease (Fredricks & Eccles, 2002; Jacobs et al., 2002; Wigfield et al., 2015). Theories like the stage-environment fit theory suggest that the misfit between the academic environment and adolescents' needs can explain the decreasing patterns (Eccles et al., 1993). That is, in addition to the individual developmental changes that occur during adolescence, adolescents' experiences with academic settings that do not support their increasing need for autonomy can hinder their motivational belief development. In middle and high school, students experience fewer opportunities to engage in their own decision-making (Eccles et al., 1993; Eccles & Roeser, 2009), less positive, personal relationships with their teachers (Eccles et al., 1993), and engage in more social comparison, which could all decrease their expectancies for success and subjective task value beliefs (Wigfield et al., 2004; Wigfield & Cambria, 2010). Thus, various developmental and environmental factors can negatively influence adolescents' motivational belief development.

More recently, however, studies that tested interindividual differences in the developmental trends of youth's motivational beliefs found that there may be multiple unique patterns of motivational belief development underlying the average decreasing trend, where students display qualitatively different developmental trends (Gaspard et al., 2020; Guo et al., 2018; Musu-Gillette et al., 2015). For example, Musu-Gilette and colleagues (2015) found that although the typical decreasing trend was observed, there were multiple unique trajectories including patterns with fast declines, slow declines, and stability for expectancies for success and subjective task value beliefs in math from Grade 4 through college. In other studies, an increasing trajectory was found in math and science subjective task value beliefs from Grades 9 to 11, as well as a stable trajectory in math interest across Grades 1 to 12 (Gaspard et al., 2020; Guo et al., 2018). Gaspard and colleagues (2020) also noted that significantly more male students were represented in the stable math interest trajectory compared to the other two decreasing interest trajectories. These findings hint at important variability across subgroups and that students' individual characteristics can contribute to qualitatively different patterns of motivational belief development (see Wigfield et al., 2015).

Racial/Ethnic Differences

Depending on students' privileged or marginalized status in math, they may display different motivational belief development because they experience different socio-cultural contexts (Martin, 2009; McGee, 2018). For example, Latinx and Black students are more likely to experience negative stereotypes in academic contexts, especially in math, and it may function as a threat to their identity (Steele, 1997; Wang & Degol, 2013; Wigfield & Gladstone, 2019). As adolescents begin to actively form their racial/ethnic identity, their perceptions of negative stereotypes can lead to experiences of higher identity threats, and subsequently to negative academic consequences (Baysu et al., 2016; Ruck et al., 2011; Umaña-Taylor et al., 2014). Adolescents who are racially/ethnically marginalized in math may be more likely to display negative motivational belief development in math since they may be exposed to more academic challenges in math, such as teacher unfairness (Roeser et al., 2000; Roorda et al., 2011).

Though less is known about the math motivational belief development in racial/ethnic minority students, prior cross-sectional studies have found mean-level differences in expectancies for success and subjective task value beliefs by different racial/ethnic groups (e.g., Safavian & Conley, 2016; Seo et al., 2019). Theoretically, students who are members of groups that are negatively stereotyped in math (i.e., Latinx, Black, and female students) may display lower motivational beliefs than those who belong to privileged groups (i.e., White, Asian, and male students; Eccles, 2005; Wong et al., 2003). Nevertheless, the empirical findings have been mixed. In Grade 7, though Latinx students displayed lower expectancies for success, interest, and attainment value, they were as likely to believe in the usefulness of math as non-Latinx students (predominantly Asian Americans; Safavian & Conley, 2016). Else-Quest and colleagues (2013) conducted a study with Grade 10 students from diverse racial/ethnic groups, namely White, Black, Latinx, and Asian Americans, and found Black students reported greater math subjective task value beliefs than White students but no significant differences across expectancies for success or other racial/ethnic group comparisons (Else-Quest et al., 2013). However, higher math competence-related beliefs were reported among Black students compared to White students in another study (Seo et al., 2019). Many of these studies focus on one grade level and are inconsistent in the age group of the participants. To understand the developmental changes in motivational belief across diverse racial/ethnic groups, we need a study that examines the longitudinal development across adolescence.

Additionally, varying patterns emerged for different types of motivational beliefs (e.g., expectancies for success vs interest vs utility value; Petersen & Hyde, 2017). For example, one recent study noted that subjective task value beliefs in math decreased across both middle (Grades 7 to 8) and high school (Grades 9 to 10), whereas expectancies for success increased in high school for a sample comprised of mostly Latinx and Asian students (Umarji et al., 2021). Similarly, subjective task values were found to differentiate, where students displayed high expectancies for success, interest, and utility value, but low attainment value in a racially/ethnically diverse sample (Hsieh et al., 2021). Examining different patterns of development within each racial/ethnic group and separately by motivational beliefs will be critical to document who in each group is succeeding to not reinforce the deficit perspective of minority groups and to not neglect the diversity that exists within each racial/ethnic group (Causadias et al., 2018).

The Intersection of Race/Ethnicity and Gender

Motivational belief development can also be investigated at the intersection of race/ethnicity and gender (e.g., Gaspard et al., 2020; Graham, 2020; Wigfield & Cambria, 2010; Wigfield & Koenka, 2020). In math, gender stereotypes exist where female students are often marginalized (Hsieh et al., 2021; Wang & Degol, 2017). During adolescence, female students can become more likely to perceive discrimination as they become better at understanding stereotypes, the concept of fairness and equity, and making social comparisons with others (Brown & Bigler, 2005). Therefore, adolescents who experience double marginalized status in math (e.g., Black female students) may experience more unfair treatment and display lower participation and performance in math compared to those who are not marginalized or marginalized in only one identity (Joseph et al., 2017; Joseph et al., 2019).

Though less is known about development, prior cross-sectional studies suggest the significance of examining motivational beliefs at the intersection of race/ethnicity and gender. In

Grade 10, gender differences favoring male students emerged for expectancies for success among White and Latinx students but not among Black and Asian students (Seo et al., 2019). Similar patterns favoring male students were found across Grades 9 to 12 among White, Latinx, and Asian students, but not Black students (Rubach et al., 2022). These findings suggest that there may be variations in motivational belief development based on their gender in addition to their racial/ethnic identity. Understanding the development of motivational belief development at the intersection of race/ethnicity and gender will help highlight the role of multiple identities in shaping the diverse experiences of individuals (Causadias et al., 2018) while emphasizing the tenets of the cultural milieu in situated expectancy-value theory (Eccles & Wigfield, 2020; Wigfield & Eccles, 2020).

Socializers as Sources of Challenge and Strength

Situated expectancy-value theory highlights that students' developmental processes occur within their immediate surroundings (Eccles & Wigfield, 2020; Wigfield & Eccles, 2020). Specifically, the theory suggests that parents' and teachers' beliefs and behaviors convey various expectations toward the students and shape their motivational belief development (Wigfield & Eccles, 2020). Understanding the social environments that foster or hinder motivational beliefs is vital to address the existing gaps in STEM (Parker et al., 2020). Therefore, I examined the role of parents and teachers in shaping students' motivational belief development.

Parent Socialization

Parent socialization, parental involvement in providing career guidance or communication about academics, are known to foster students' motivational beliefs (Eccles, 1993). Parental involvement is multi-dimensional and may be categorized as parents' home-based involvement (i.e., parents' involvement in learning activities or schoolwork at home), school-based involvement (i.e., parents visit the school or communicate with school personnel), and academic socialization (i.e., parents communicate their expectations for education and its value, discuss learning strategies, foster and make plans for educational and occupational aspirations; Hill & Tyson, 2009). In a meta-analysis, Hill and Tyson (2009) demonstrated that academic socialization is the most effective parental involvement strategy in adolescence compared to home-based or school-based involvement. In fact, Wang and colleagues (2014) noted that although some parental involvement, such as parent-teacher communication, decreased across adolescence (i.e., Grades 7 to 11), parents' academic socialization increased over time regardless of race/ethnicity. For adolescents, parental involvement that involves advice-giving and communicating about school life or the future may be more beneficial than other types of involvement, such as attending parent-teacher conferences (Hill & Tyson, 2009; Jeynes, 2011). Likewise, discussions about taking math courses and STEM topics may promote adolescents' motivational belief development in math. In fact, adolescents who engaged in more conversations with their parents about their educational plans were found to display higher math expectancies for success during high school (Choi et al., 2016) and smaller decreases in math interest over time (ages 9 to 17; Gottfried et al., 2009).

In addition to parent socialization's role in promoting positive motivational belief development in adolescence (Eccles et al., 1993; Wang et al., 2020), it may serve as a protective factor for adolescents when they encounter challenges (Rutter, 1987; Zimmerman et al., 2013). Aligned with resilience theory, parent socialization may serve as a resource for adolescents to help overcome academic challenges and experience fewer negative consequences (Chen & Gregory, 2009; Zimmerman et al., 2013). Students who are marginalized in math may experience structural barriers in their academic settings (Joseph et al., 2017; Joseph et al., 2019).

Nevertheless, when they experience parental support, it may help them to maintain or even increase in their motivational beliefs despite the challenges. For example, Black college students in STEM majors demonstrated that discussions about educational struggles and future academic success helped them to continue challenging themselves academically (McGee & Spencer, 2015). When parents provide support that disaffirms gender and racial/ethnic stereotypes, students from marginalized groups may be able to develop positive math motivational beliefs and display resilience (Howard et al., 2019; Young & Young, 2018).

Perceived Teacher Unfairness

Social equity theory (see McKown, 2013) stresses the negative effects of perceived differential treatment from teachers on students' academic performance. Specifically, the theory explains that the academic performance of students from racially/ethnically marginalized groups is negatively impacted not only through teachers' explicit differential treatment, but also through students' awareness of signals from teachers that infer negatively stereotyped expectations toward them (McKown, 2013). For example, students can experience a lack of belongingness in the classroom if they perceive their teachers to provide differential treatment to peers who they identify with based on a certain group membership (e.g., racial/ethnic groups). McKown (2013) also posits that such signaling is particularly detrimental to adolescents, because adolescents are better at detecting the signals than younger children. Thus, compared to adolescents who identify as White or Asian, Black and Latinx adolescents may perceive more teacher unfairness in math, an academic domain where they would typically be considered marginalized.

The significance of students' experiences with teachers also aligns with situated expectancy-value theory (Eccles & Wigfield, 2020) and Roeser and colleagues' (1998) school psychological environment model that describe the importance of social environment. According to these models, students' academic performance and their motivational beliefs are influenced by their perceptions of and experiences with their teachers. Specifically, Roeser and colleagues' (1998) conceptual model suggests that the perceived quality of students' relationships with their teachers (i.e., discrimination experiences and teacher supportiveness) can influence their motivational belief development. Perceived quality of relationships with their teachers may be especially critical for the academic experiences of students who are marginalized given the significance of interpersonal processes for marginalized groups (Crosnoe et al., 2004; Umarji et al., 2021). In fact, experiencing teacher unfairness has been associated with lower motivational beliefs and academic performance (Faircloth & Hamm, 2005; Roeser et al., 2000; Wong et al., 2003). Students marginalized in math may display lower motivational beliefs due to perceiving higher teacher unfairness.

As discussed in the social equity theory (McKown, 2013), one mechanism that may explain the link between adolescents' perceptions of teacher unfairness and the decrease in motivational beliefs is students' sense of belongingness. When teachers treat students fairly, students are more likely to feel like they share the same membership as their peers, which in turn will promote their sense of belongingness, and their academic motivational beliefs and performance (Eccles & Roeser, 2011). Students who are more prone to negative stereotypes and teacher unfairness in math, such as Black and Latinx students, may experience more negative self-representations, including a lower sense of belongingness (Master & Meltzoff, 2020). For example, researchers have suggested that traditional beliefs, such as math is a White, male domain, can recreate systematic barriers for Black female students and hinder their ability to develop math identities and perceive higher teacher unfairness in math (Joseph et al., 2019). These experiences of perceiving low support or unfair treatment from their teachers are associated with students' lower motivational beliefs and lower math performance (Lazarides & Ittel, 2012; Lee & Simpkins, 2021; McKellar et al., 2018; Wang & Degol, 2013). Perceived teacher unfairness may remind students that they do not belong in math, which in turn can predict lower motivational beliefs (Master et al., 2016; Master & Meltzoff, 2020). Furthermore, adolescents who do not feel like they belong may continue to experience low academic motivational beliefs because they are less likely to have other support system (Anderman, 2020). Adolescents' experiences of teacher unfairness may lead them to endorse low expectancies for success and subjective task value beliefs in math, which may persist over time.

Overview of the Dissertation Studies

Situated expectancy-value theory describes that students' academic performance and choices are directly influenced by their motivational beliefs, specifically their expectancies for doing well on the task (i.e., expectancies for success) and value of the task (i.e., subjective task values; Eccles, 2009; Eccles & Wigfield, 2020). Across development, however, students' academic motivational beliefs, including in math, have been found to typically decrease (e.g., Fredricks & Eccles, 2002; Jacobs et al., 2002; Wigfield & Cambria, 2010). These decreases, theoretically, should be more pronounced in students from certain racial/ethnic groups who are often marginalized in math (Eccles, 2005; Wong et al., 2003). Nonetheless, more recent studies have noted non-decreasing trends in individuals by testing interindividual differences in motivational belief development (Gaspard et al., 2020; Musu-Gillette et al., 2015). A few recent empirical studies have also highlighted that adolescents whose racial/ethnic and gender groups are marginalized in math do not necessarily display lower motivational beliefs as previously theorized (e.g., Else-Quest et al., 2013; Seo et al., 2019). More studies are needed that examine motivational belief development across adolescence in diverse racial/ethnic groups and at the intersection of race/ethnicity and gender.

In addition, there may be variability in motivational belief development due to adolescents' experiences with their social agents, such as parents and teachers. One of the academic challenges that adolescents might encounter is teacher unfairness (Green et al., 2006; Roeser et al., 1998). Particularly, adolescents who are marginalized in math may experience negative stereotypes and experience teacher unfairness in math (e.g., McKellar et al., 2018). Nevertheless, parent socialization may promote adolescents to endorse positive motivational beliefs (e.g., Simpkins et al., 2015; Wang et al., 2020) or even protect adolescents and help them to display resilience despite encountering academic challenges (Zimmerman et al., 2013). Less research has been conducted to understand the extent to which social influences shape adolescents' motivational belief development. Particularly, more studies that examine the socialization processes in families are in need given the positive role of families in overcoming the potential inequalities experienced by racial/ethnic minority adolescents (Umaña-Taylor & Hill, 2020).

Prior research has often examined motivational belief development in mostly White populations; thus, less is known about motivational belief development in racial/ethnic minority groups. Nonetheless, understanding the motivational belief development across diverse races/ethnicities and various factors that contribute to different developmental patterns are important to identify ways to better support those marginalized in math and address the systematic issues that remain in STEM. Recently, scholars have argued for the need to examine both race/ethnicity and gender in motivation research (Eccles & Wigfield, 2020; Graham, 2020; Wigfield & Koenka, 2020). Likewise, a recent meta-analysis stressed the need for researchers to consider racial/ethnic backgrounds when explaining gender differences in students' STEM motivational belief development and the role of social contexts (Parker et al. 2020). Therefore, my first study focused on charting the motivational belief development at the intersection of race/ethnicity and gender to investigate the interplay between racial/ethnic and gender stereotypes in shaping adolescents' motivational beliefs. In my second study, I address the issue of equity and justice and the consequences of experiencing injustice earlier in life (see Killen et al., 2016). Furthermore, I highlight how parents can benefit the development of racial/ethnic minority adolescents (Umaña-Taylor & Hill, 2020). In summary, my dissertation studies involved testing the variability in the development of adolescents' math motivational beliefs in diverse racial/ethnic groups in general, at the intersection of race/ethnicity and gender, and examining the role of parents and teachers as sources of academic strength and challenge.

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CHAPTER 2

Trajectories of Math Expectancies for Success and Values in Latinx and Asian Students

Abstract

The heterogeneity in the developmental trajectories of math motivational beliefs (i.e., expectancies for success and subjective task value beliefs) was examined among Asian and Latinx male and female students from Southern California across Grades 8 through 10 (N = 2,710; 50% female; 85% Latinx; 15% Asian; M_{age} = 13.77). By conducting growth mixture modelling, two classes of stable trajectories for expectancies for success; five classes of stable, decreasing, or increasing trajectories for interest and utility value; and three classes of stable, decreasing, or increasing trajectories for attainment value were identified. The group comparisons across Asian/Latinx male and female students demonstrated that variability exists in motivational belief development by students' race/ethnicity and gender for some trajectories. One of the notable findings was that though Latina students were more likely to maintain lower expectancies for success compared to Asian male or Latino students, they were also more likely to display smaller decreases in interest compared to Asian female students. The findings from the present study challenge traditional stereotypes in math and highlight positive motivational belief development in students who are marginalized in math (e.g., Latina students).

Public Significance Statement: This study suggests that there are multiple, distinct patterns of math motivational belief development during the transition from middle to high school and that Asian/Latinx male and female students do not always display decreases in their motivational beliefs across adolescence. Our findings show that middle and high school are not too late to apply interventional efforts to foster students' motivational beliefs. Additionally, our findings help guide applied efforts to address the societal and systematic challenges in STEM by displaying the issues of marginalization and privilege based on race/ethnicity and gender.

Keywords: Expectancy-value theory, motivation, math, racial/ethnic differences, gender difference

Trajectories of Math Expectancies for Success and Values in Latinx and Asian Students

Introduction

High school students' math motivational beliefs are important determinants of their subsequent Science, Technology, Engineering and Math (STEM) educational and occupational choices (Seo et al., 2019; Watt et al., 2017). Though scholars have historically found that adolescents' math motivational beliefs typically decrease (e.g., Fredricks & Eccles, 2002; Jacobs et al., 2002; Watt, 2004), recent research suggests that this average trend masks multiple distinct underlying developmental trends, including stability and increases in adolescents' math motivational beliefs (e.g., Gaspard et al., 2020; Guo et al., 2018). However, this research has largely focused on White populations—a group that holds a position of privilege in STEM (Martin, 2009; McGee, 2018). Because the motivational processes found among White populations do not typically generalize to other groups (Hsieh et al., 2021; Starr, Tulagan, & Simpkins, 2022), research charting motivational development for diverse youth in the U.S. is necessary for our society to better support the STEM success of all youth, particularly those who have been historically marginalized.

Race/ethnicity and gender are two social position factors in the U.S. that shape individuals' development in profound ways (Garcia-Coll et al, 1996). Math is no exception; stereotypes and structural barriers based on race/ethnicity and gender privilege some groups in math, including Asian and male students, and marginalize other groups, including Latinx and female students (Hsieh et al., 2021; Wang & Degol, 2017). Though scholars have argued that researchers need to study development at the intersection of race/ethnicity and gender (Crenshaw, 2019), it has received less attention in math. Examining race/ethnicity and gender separately not only keeps some marginalized groups invisible (e.g., Latina students), but fails to address key theoretical questions, such as whether Asian male and female students equally benefit from the model minority stereotype or if Asian female students are still hindered by traditional gender stereotypes (Hsieh et al., 2021; Starr, Gao et al., 2022).

Theoretically, the development of individuals' motivational beliefs should vary based on whether they are members of privileged or marginalized groups in math due to their race/ethnicity, gender, or both (McGee, 2018). In accordance with the current call to examine the intersection of race/ethnicity and gender in motivation research (Eccles & Wigfield, 2020; Graham, 2020; Wigfield & Koenka, 2020), we explored motivational belief development for high school adolescents who had different combinations of privilege or marginalization in math due to their race/ethnicity and gender. We focused on Asian and Latinx male and female adolescents to address theoretical questions on privilege and marginalization based on race/ethnicity and gender, and to contribute to the field's limited understanding of Asian and Latinx youth as more research has focused on White and Black youth to date (Rubach et al., 2022; Starr, Tulagan, & Simpkins, 2022).

Theoretical Frameworks

Situated expectancy-value theory is one of the prominent theories used to examine the development of individuals' motivational beliefs and the correlates of those beliefs. According to this theory, individuals' motivational beliefs—specifically, their expectancies for success and subjective task value beliefs—are the most immediate determinants of individuals' STEM performance and choices (Eccles, 2009; Eccles & Wigfield, 2020). Expectancies for success are defined as individuals' beliefs about their ability to succeed. Subjective task value beliefs include several theoretically and empirically distinct beliefs: interest (i.e., enjoyment of the task), utility value (i.e., perceived usefulness of the task), and attainment value (i.e., perceived importance of the task based on one's identity). These four math motivational beliefs positively predict adolescents' math achievement, math course-taking in high school, STEM college majors, and STEM career choices (Guo et al., 2015; Hsieh et al., 2022; Jiang et al., 2020; Seo et al., 2019; Simpkins et al., 2015a; Wang et al., 2015).

Recently, Eccles and Wigfield renamed the theory to *situated* expectancy-value theory to emphasize that individuals and these motivational processes are situated within a particular cultural milieu and their immediate settings (Eccles & Wigfield, 2020; Wigfield & Eccles, 2020). The cultural milieu includes societal expectations and stereotypes about who is good at certain domains, such as math, and which endeavors are considered appropriate for various groups (e.g., traditional gender roles). Latinx and Black students have been stereotyped to have lower math ability compared to Asian and White students (Else-Quest et al., 2013; Hsieh et al., 2021). Similarly, female students often experience more demotivating treatment than male students given the stereotype that math is a male domain (Lazarides & Ittel, 2012; McKellar et al., 2018). These societal beliefs about race/ethnicity and gender shape the beliefs, behaviors, and messages of socializers in adolescents' lives (e.g., parents, teachers), which influence adolescents' developing motivational beliefs (Else-Quest et al., 2013; Nosek & Smyth, 2011).

Theories suggest adolescents' motivational beliefs should decrease over time. At the individual level, adolescents become better at self-assessing their own ability (Wigfield et al., 2015) and develop a better sense of who they are as well as the social and cultural expectations toward them (Brown & Bigler, 2005; Wang & Degol, 2013). For example, the developmental model of children's perception of discrimination suggests that adolescents can categorize themselves into social groupings and discern the racial and gender stereotypes associated with those social groups (Brown & Bigler, 2005). Adolescents' motivational beliefs can decrease if they internalize society's belief that their racial/ethnic or gender group is less skilled in a domain (Fredricks & Eccles, 2002; Wigfield et al., 2015). At the setting level, the transition to high school (Grades 8 to 10) can cause declines in motivational beliefs due to the increasingly challenging coursework, academic tracking, and stage-environment mismatches (e.g., increasing need for autonomy that is not met by high schools; Eccles et al., 1993; Wigfield et al., 2019). Collectively, these theoretical tenets suggest adolescents' math motivational beliefs should decrease and that the declines may be larger for groups who have been historically marginalized in math.

Several theoretical questions remain on whether race/ethnicity or gender might be more marginalizing and whether there is an additive "double marginalizing" effect. For example, comparisons between Latinx female and male adolescents compared to Asian female and male adolescents can address if gender has a similar effect among racial/ethnic groups whose cultures both espouse traditional gender roles, but also vary in terms of their marginalization or privilege in math. The differences between Latino male and Asian female adolescents can provide insight into whether race/ethnicity or gender might be more marginalizing in math. Further, it is important to know if groups who are marginalized due to both their race/ethnicity and gender, such as Latinas, demonstrate the largest declines or patterns where they remain low and stable across adolescence. Examining the similarities and differences among Latinx and Asian male and female students afford multiple insights into critical theoretical tenets that will help move research forward so that society can support the math success of all youth.

The Complex Changes in Adolescents' Math Motivational Beliefs

Historically, research suggests that students' motivational beliefs in a variety of domains, including math, typically decline from Grades 1 through 12 (Fredricks & Eccles, 2002; Jacobs et al., 2002). However, estimating one average latent trajectory makes other developmental trends invisible, has the potential to perpetuate the assumption of declining trends in math, and overlooks students who are stable or increase in their math motivation over time. In fact, recent research suggests the developmental progression of individuals' math motivational beliefs may be more nuanced and complex during adolescence (Nagy et al., 2010). For example, some researchers found that the math trajectories vary across the four motivational beliefs with decreases in math interest and utility value, but stability in math expectancies for success from Grades 7 to 12 making it important to test the developmental trends of the four motivational beliefs separately (Petersen & Hyde, 2017). Others suggest that there is important variability across individuals where the developmental trends qualitatively vary across subgroups (Archambault & Eccles, 2010; Gaspard et al., 2020; Guo et al., 2018; Musu-Gillette et al., 2015). Guo and colleagues (2018), for example, found that, although most students displayed decreases in their math and science subjective task value beliefs across Grades 9 through 11, some students displayed increases. Similarly, Gaspard and colleagues (2020) found three distinct developmental patterns in students' math interest across Grades 1 through 12 including trajectories showing strong decreases, moderate decreases, and moderate stability. In both studies, male students were more likely to display a stable or increasing trajectory than female students, who were more likely to display decreasing patterns. These studies that utilized person-centered approaches highlight that subgroups of individuals display qualitatively different developmental trends in their math motivational beliefs. Thus, in this study, we utilized a person-centered approach (i.e., growth mixture models) to chart the development of Latinx and Asian adolescents' math motivational beliefs.

Motivational Belief Development of Latinx and Asian Adolescents

In this study, we focused on understanding math motivational belief development for Latinx and Asian students. Even though they are the two largest minority groups in the U.S. (NSF, 2019), only a few studies have focused on math motivational beliefs among these populations (Rubach et al., 2022; Starr, Tulagan, & Simpkins, 2022). In addition, even though Latinxs and Asians share their racial/ethnic minority status in the U.S., these two groups differ in terms of math stereotypes—with Latinx students being more likely to experience negative stereotypes about their math abilities and the opposite for Asian students (Else-Quest et al., 2013). As a result, these groups may experience different socio-cultural contexts when it comes to their math learning (Martin, 2009). For example, they may vary in their math coursework (i.e., course tracking) and their experiences in those courses (Simpkins et al., 2006; Wang, 2012), which have been linked to students' math motivational beliefs (Frenzel et al., 2010). Those who are racially/ethnically marginalized in math are more likely to experience negative stereotypes in their math abilities and academic environments that hinder their math motivational beliefs compared to those who are not marginalized in math (Alfaro et al., 2009; Rosenbloom & Way, 2004).

Though less research has been conducted to test the trajectories in math motivational beliefs by race/ethnicity, a few cross-sectional studies have noted racial/ethnic differences. For example, Latinx students displayed lower math expectancies for success, interest, and attainment value, but not utility value, compared to Asian and White students in middle school (Safavian & Conley, 2016; Umarji et al., 2021). In high school, some studies suggested similar patterns of lower math expectancies for success for Latinx students compared to non-Latinx students (Grades 9 & 10; Umarji et al., 2021), whereas other studies showed that Latinx students had similar math expectancies for success and subjective task values as Asian students (Grade 10;

Else-Quest et al., 2013). Not only is there limited research on these populations, but the findings from the prior studies are mixed. Given that these studies involved students at varying grade levels, it is unclear if there are developmental changes in these racial/ethnic differences; we need studies that chart math motivational belief development across adolescence for Latinx and Asian youth.

Additionally, one recent meta-analytic study showed a substantial degree of heterogeneity in the effects across gender for math expectancies for success, interest, utility value, and attainment value, highlighting the potential role of other factors, such as race/ethnicity, in shaping adolescents' motivational beliefs (Parker et al., 2020). Relatedly, the findings on gender differences in motivational belief development have been mixed where some researchers have found female students to display more negative math motivational belief trajectories than male students (Gaspard et al.,2020; Watt, 2004) whereas others have noted minimal gender differences (Fredricks & Eccles, 2002; Jacobs et al., 2002; Nagy et al., 2010). Some scholars have argued that the variability within each gender is larger than between genders (e.g., Hyde & Mertz, 2009). Guo and colleagues (2018), for instance, found through a pattern-centered approach that some male students' motivational beliefs were low and increasing over time (66%; n = 280) whereas other male students' motivational beliefs displayed the opposite pattern of starting high and decreasing over time (51%, n = 408). The variability within each gender suggests other processes in addition to gender-related ones also shape students' motivational beliefs and calls for studies that consider the intersectionality of gender and other factors, such as race/ethnicity.

There is a need to jointly examine gender and racial/ethnic differences in motivational belief development (e.g., Gaspard et al., 2020; Graham, 2020; Wigfield & Cambria, 2010;

Wigfield & Koenka, 2020). Prior cross-sectional studies have suggested differences at the intersection of race/ethnicity and gender. For example, Seo and colleagues (2019) tested gender differences within race/ethnicity in Grade 10 students and found no gender differences in math expectancies for success among Asians, but lower math expectancies for success in Latina students compared to Latino students (Seo et al., 2019). In one recent study, male students displayed higher math competence-related beliefs than female students among Asian students and among Latinx students across all grade levels in high school (Rubach et al., 2022). Hsieh and colleagues (2021) found that whereas Asian female students were more likely to be overrepresented in high motivational belief group than other patterns, Latina students were underrepresented in the high motivational belief group. Though findings from these studies demonstrate the importance of studying differences at the intersection of race/ethnicity and gender, these studies were conducted at one-time point and do not provide information on motivational belief development. Accounting for both race/ethnicity and gender is critical to understanding the diverse experiences of individuals that are influenced by their multiple social identities (Causadias et al., 2018). Thus, we tested differences in the development of adolescents' math motivational beliefs at the intersection of race/ethnicity and gender to address theoretical tenets of the cultural milieu in shaping motivational beliefs as specified in situated expectancy-value theory (Eccles & Wigfield, 2020; Wigfield & Eccles, 2020). If racial/ethnic and gender differences exist, our study will demonstrate a need to address the societal and systematic issues to close the gaps in math motivational belief development.

The Current Study

Though prior studies have shown average decreasing trends in students' motivational belief development across childhood to adolescence, less has been empirically tested across the transition period from middle to high school and in racially/ethnically minority groups. In one prior study, Umarji and colleagues (2021) utilized the same data as this study and modeled growth curves using hierarchical linear modeling. They found that subjective task value beliefs in math decreased across both middle (Grades 7 – 8) and high school (Grades 9 – 10), whereas math expectancies for success increased in high school. Though Umarji and colleagues (2021) examined the development of students' math motivational beliefs using the same data, they did not examine if subgroups of adolescents displayed qualitatively different trends as suggested by other research. In addition, they tested whether race/ethnicity and gender each separately predicted differences in the initial levels of adolescents' motivational beliefs; they did not test whether the change over time varied across groups nor intersectionality. We extended the prior work by estimating growth mixture modeling to identify the unique developmental trends present among subgroups within the Latinx and Asian students. Testing intersectionality in the current paper extends the prior work by addressing key theoretical questions and focusing on potentially vulnerable groups (e.g., Latinas) who are invisible when they are tested separately.

Our investigation in motivational belief development at the intersection of race/ethnicity and gender may demonstrate that adolescents display multiple, qualitatively unique trajectories (Eccles & Wigfield, 2020; Musu-Gilette et al., 2015; Wigfield et al., 2015). Given the exploratory approach, specific numbers of trajectories were not hypothesized a priori. Based on prior literature, however, we expected adolescents to display stability, decreases, as well as increases over time in their motivational beliefs across Grades 8 to 10.

By comparing the four groups, we expected Asian male students to display the most positive growth trajectories (e.g., high initial levels that are stable), Asian female and Latino students to display patterns in-between, and Latina students to display the most negative growth trajectories (e.g., strong decreases or low initial levels that are stable). Nevertheless, we expected gender differences among Asians to be minimal given the strong model minority stereotype that Asians experience in math which may counter the gender stereotypes in math (Hsieh et al., 2021; Trytten et al., 2012). In our analyses, we controlled for relevant background variables that may influence students' motivational beliefs, such as parents' education level, math course, performance, and cohort (Else-Quest et al., 2013; Simpkins et al., 2015a).

Method

Participants

Data were drawn from the California Achievement Motivation Project (CAMP), a cross-sequential study on the relations between students' motivational beliefs and their academic outcomes. The study involved four school districts in Southern California where students were predominantly Latinx and Asian. Students were surveyed on their motivational beliefs at four time points in October and May of the 2004 – 2005 and 2005 – 2006 school years. We focused on 3,343 students (M_{age} = 13.76) from two cohorts, who were between Grades 8 to 10 (i.e., Cohort 1 = Grades 8 – 9; Cohort 2 = Grades 9 – 10), because we were particularly interested in examining adolescents' motivational belief development during their transition to high school. The sample was 50% female, 39% low-income, 65% English as Second Language students, 69% Latinx, 12% Asian, <1% American Indian or Alaskan Native, 1% Pacific Islander, 14% White, and 2% Black. Racial/ethnic percentages of the sample were representative of the districts. We excluded participants who selected race/ethnicity other than Asian and Latinx due to our focus on understanding the motivational belief development in these two largest growing racial/ethnic minority groups in the U.S. The final analytic sample consisted of 2,710 students (M_{age} = 13.77) who were 50% female, 43% low-income, 78% English as Second Language students, 85%

Latinx, and 15% Asian. The use of human participants was approved for this project at the participating institutions.

A comparison of the analytic sample and the excluded sample is provided in the supplemental material (Table 1.S1). Of the 29 comparisons, only two demonstrated a small effect or larger; compared to the excluded sample, students in the analytic sample reported higher math utility value in the Fall of Grade 9 ($d = .29$) and were more likely to have parents with lower education levels ($d = .69$).

Measures

Students' motivational beliefs (i.e., expectancies for success, interest, utility value, and attainment value) were assessed using a survey administered by trained research assistants in math class to students who gave assent and had parental consent. The items used to measure students' motivational beliefs have demonstrated high validity and reliability in previous studies (e.g., Conley, 2012; Safavian, 2019; Safavian & Conley, 2016; Umarji et al., 2021). We conducted measurement invariance tests and confirmed that the constructs have similar measurement properties (a) across grade levels (i.e., Grades 8 – 10) and (b) across the four racial/ethnic and gender groups (i.e., Asian and Latinx male and female students; Table 1.S2).

Expectancies for Success

Students' expectancies for success are their perceptions of their ability to do well in math (Eccles, 2009; Wigfield et al., 2015). Students reported their expectancies for success using four items on a 5-point scale ($\alpha = .78 - .84$): (a) "How certain are you that you can learn everything taught in math?" (b) "How sure are you that you can do even the most difficult homework problems in math?" (c) "How confident are you that you can do all the work in math class, if you don't give up?" and (d) "How confident are you that you can do even the hardest work in your math class?" (1 = *Not at all certain/sure/confident*, 5 = *Very certain/sure/confident*).

Subjective Task Value Beliefs

Subjective task value beliefs are about the value students attach to a task (Eccles, 2009; Wigfield et al., 2015). The three subjective task values were interest, utility value, and attainment value. Though interest, utility value, and attainment value are all values, they are theoretically unique constructs (Eccles & Wigfield, 2020; Wigfield & Eccles, 2020), which has been supported by empirical work (e.g., Guo et al., 2016). The development of these three subjective task values has been shown to vary, such as high math interest but low math attainment values (Hsieh et al., 2021; Parker et al., 2020; Safavian & Conley, 2016). Particularly relevant to these analyses, some work suggests the changes in students' math and science motivational beliefs also vary across these three value beliefs (Hsieh et al., 2022; Parker et al., 2020). Therefore, we examined each of the three subjective task values separately in this study.

Interest derives from the enjoyment gained by engaging in a task (Eccles, 2009; Eccles & Wigfield, 2020). Interest value was measured using six items on a 5-point scale (α = .94 - .95): (a) "I enjoy the subject of math," (b) "I like math," (c) "I am fascinated by math," (d) "I enjoy doing math," (e) "Math is exciting to me," and (f) "How much do you like doing math?" (1 = *Not at all true for me/Not at all,* 5 = *Very true for me/Very much*).

Utility value is value given to a task because it is found to be useful for fulfilling individuals' current or future plans (Eccles, 2009; Eccles & Wigfield, 2020). Utility value was measured using seven items on a 5-point scale (α = .86 - .90): (a) "In general, how useful is what you learn in math?" (b) "Being good at math will be important when I get a job or go to college," (c) "How useful is learning math for what you want to do after you graduate and go to work?" (d) "Compared to most of your other school subjects, how useful is what you learn in math?" (e)

"Math helps me in my daily life outside of school," (f) "Math concepts are valuable because they will help me in the future," and (g) "Math will be useful for me later in life" (1 = *Not at all true for me/Not at all useful,* 5 = *Very true for me/Very useful*).

Attainment value captures the importance of a task as it relates to one's personal and collective identities (Eccles, 2009; Eccles & Wigfield, 2020). Attainment value was measured using seven items on a 5-point scale (α = .88 - .91): (a) "Thinking mathematically is an important part of who I am," (b) "It is important to me to be a person who reasons mathematically," (c) "I feel that, to me, being good at solving problems which involve math or reasoning mathematically is," (d) "It is important for me to be someone who is good at solving problems that involve math," (e) "Being someone who is good at math is important to me," (f) "Being good at math is an important part of who I am," and (g) "Compared to most of your other school subjects, how important is it for you to be good at math" (1 = *Not at all true for me/Not at all important,* 5 = *Very true for me/Very important*).

Gender and Race/Ethnicity

Students' gender (0 = *Male*, 1 = *Female*) and race/ethnicity were obtained from the school district data. Primary race/ethnicity was indicated as Hispanic or Latino, Black or Black (not of Hispanic origin), White (not of Hispanic origin), Asian (e.g., Vietnamese, Chinese, etc.), Pacific Islander (e.g., Samoan, Native Hawaiian, etc.), or American Indian or Alaskan Native. In this study, we included participants who identified as either Hispanic/Latino or Asian.

Background Variables

Demographic variables, specifically parents' education level (1= *Not a high school graduate,* 5 = *Graduate school/post-graduate training*), students' prior achievement at the first time of the survey in Grade 8 or Grade 9 (students' math performance on California Standards

Test; 1 = *Far below basic*, 5 = *Advanced*), cohort (0 = Cohort 2 [i.e., Grades 9 – 10], 1 = Cohort 1 [i.e., Grades 8 – 9]), and the level of students' math course at the first time of survey in Grade 8 or 9 (a course which the California Standards Test was administered on; 1 = *General math,* 7 = *Algebra II*) were added as background variables in the analyses. This demographic information was obtained from the school district data.

Plan of Analysis

Descriptive statistics were obtained using Stata 15 and all other analyses were conducted using M*plus*8 (Muthén & Muthén, 2017). Missing data were handled using the Full-Information-Maximum-Likelihood (FIML) method (Kline, 2015). In both cohorts, most of the missingness in the analytic sample was due to missing one or more motivational beliefs at later time points. All students in the analytic sample had information on their motivational beliefs at one or more time points across the four possible time points. When students in the analytic sample with complete data (Cohort 1: n = 303; Cohort 2: n = 505) were compared with students in the analytic sample who had at least one piece of missing data (Cohort 1: n = 931; Cohort 2: n = 973), only one out of the 42 comparisons demonstrated a small effect or larger; in cohort 2, students with complete data were more likely to be enrolled in more advanced math courses than students with some missing data (d = .27; Table 1.S3).

Growth Mixture Modelling (i.e., GMM) was used to describe the within-person changes over time and the between-person differences in these changes (Grimm et al., 2017). GMM is a method that can be used to identify groups (or classes) of individuals who display unique trajectories and determine class membership of the individuals based on the observed trajectory post-hoc (Grimm et al., 2017; Ram & Grimm, 2009). We decided to use GMM over other conventional methods, such as latent growth curves, because prior research suggested subgroups of individuals demonstrated qualitatively unique developmental trends, such as decreases, increases, or stability (Jung & Wickrama, 2008). Our aim was to describe the fundamental differences in individuals' motivational belief development. By conducting a person-centered approach, we were able to identify the unique developmental trends without making assumptions about the number of trends and what those trends looked like (Frankfurt et al., 2016).

Following the steps of GMM estimation (Ram & Grimm, 2009), we first identified the optimal baseline shape of the average trajectories for each of the four math motivational beliefs on the full sample (Grimm et al., 2017). The intercept was centered at the spring of Grade 9 because we expected greater individual differences once students encounter changes in school environments by transitioning to high school (Grimm et al., 2017). Subsequently, we identified the unique trajectories for each of the four math motivational beliefs across Grades 8 to 10 using the default growth mixture model suggested by experts, which specifies that the means are free to vary, and variances are fixed to be equal across classes (Frankfurt et al., 2016; Grimm et al., 2017; Muthén & Muthén, 2017).

We determined the optimal GMM solution using multiple indicators as suggested by statistical experts (Ram & Grimm, 2009) along with the theoretical alignment. Lower Bayesian information criterion (BIC), Akaike information criterion (AIC), and Adjusted BIC values are considered indicators of a better-fitting model (Ram & Grimm, 2009). Statistically significant *p*-values on the Vuong-Lo-Mendell-Rubin likelihood ratio test (VLMR), Lo-Mendell-Rubin likelihood ratio test (LMR), and Bootstrap likelihood ratio test (BLRT) suggest that the model with a greater number of classes demonstrates an increase in model fit and should be selected over the model with fewer classes (Grimm et al., 2017). Entropy was examined but not used as a criterion for model selection because scholars have posited that though entropy close to 1 may imply more accurate distinction of classes, class assignment can still contain a high degree of error by chance for models with a greater number of latent classes (Masyn, 2013). We increased the number of classes until the information criteria displayed worse model fit, convergence problems were encountered, or until the number of individuals in one of the classes was too small ($n < 30$; Ferguson et al., 2019; Grimm et al., 2017).

Given that GMM is an exploratory analysis, one concern is whether the findings (i.e., the number of classes) are in fact a true representation of the data (Grimm et al., 2017; Ram & Grimm, 2009). For cross-validation, we tested whether the trajectories replicated across two random subsamples of the data as suggested by the experts and found similar shapes of trajectories (Figures 1.S1 – 1.S4; Ram & Grimm, 2009).

Subsequently, we examined racial/ethnic and gender differences in students' math motivational belief trajectories by including three dichotomized indicators that represent three of the four groups of this study defined by race/ethnicity and gender (i.e., Asian/Latinx male/female students) as predictors of the latent class membership in the GMM (Masyn, 2013). For example, dichotomized indicators for Asian female adolescents, Latino adolescents, and Latina adolescents were added as predictors to determine their likelihood of belonging to one trajectory compared to Asian male adolescents. The models were re-estimated with different reference groups so all comparisons across the four groups were considered. In line with the recent recommendation on adding predictors while avoiding the error of misclassification (Asparouhov & Muthén, 2014; Nylund-Gibson et al., 2014), a three-step specification was implemented using the R3STEP command on Mplus (Asparouhov & Muthén, 2014). The 3-step procedure involves estimating an unconditional model, assigning individuals to the most likely class assignments using the latent class posterior distribution, and re-estimating a mixture model with parameters fixed to the values from the prior step and predictors being added as auxiliary variables (Asparouhov & Muthén, 2014). The models were estimated with a host of covariates, including parents' education level, students' prior achievement, the level of students' math course, and cohort; they were added at this stage to not interfere with the process of class determination (Grimm et al., 2017). To avoid listwise deletion of the observations missing on the covariates, the 3-step procedure was implemented manually, and the variances of the covariates were estimated. As a robustness check, these models were also estimated without covariates.

For this study, the models were estimated with the TYPE = MIXTURE command to indicate that it is a mixture model and with varying numbers of classes (Grimm et al., 2017). The models were estimated with the %OVERALL% statement where all model parameters were specified (i.e., slope, intercept, covariances, and residual variances). Subsequently, class-specific model statements were added where we respecified the model parameters.

Results

Descriptive statistics and the correlations among the key variables are shown in Tables 1.1 and 1.2. Generally, students displayed declines in the mean levels of their motivational beliefs across the four groups (i.e., Asian/Latinx male/female students). As expected, students' motivational beliefs were positively correlated with each other (r = .15 – .75, p < .001). Though minimal, being female was often negatively correlated with students' expectancies for success (r = -.08 – -.10, p < .001) and taking higher math courses (r = .12, p < .001). Also, being Asian was often positively correlated with students' motivational beliefs, prior achievement, math course, and higher parent education (r = .07 – .33, p < .001). When correlations were examined within the four groups, similar positive associations among motivational beliefs were mostly observed (Tables 1.S4 – 1.S5).

Students' Math Motivational Belief Trajectories

In order to test whether adolescents in our study display various trajectories of motivational beliefs over time (i.e., stability, decreases, and increases), we, first, identified the optimal shape of the average trajectory for each math motivational belief on the full sample. We found that linear trajectories displayed a better fit than the no growth trajectories for the four motivational beliefs, namely expectancies for success, interest, utility value, and attainment value (Table 1.S6). Quadratic trajectories were also tested, but the quadratic and linear models fit the data equally well and the quadratic slopes were not statistically significant. Thus, linear trajectories were selected for the GMMs.

Second, we sought to identify the distinct underlying trajectories for each motivational belief. The fit indices of the GMM models as well as our final decision on the number of classes are reported in Table 1.3. The unique trajectories for the four motivational beliefs are reported in Figure 1.1 and Table 1.S7. The two-class model was always a better fit than the one-class model, which suggested that there were at least two qualitatively different trends in the development.

For students' math expectancies for success, the two-class model was selected over the three-class model for several reasons. First, the three-class model displayed statistically significant *pVLMR* and *pLMR* values, but also had higher BIC and ABIC values compared to the two-class model (Table 1.3). Second, one of the classes in the three-class model only included five adolescents, which did not meet the criterion of having at least 30 individuals in each class (Ferguson et al., 2019). The models with four or more classes had higher BIC and ABIC values as well as non-significant *pVLMR* and *pLMR* values, indicating that solutions with four or more classes did not improve the fit of the model. The unique trajectories for students' math expectancies for success included *High and Stable* and *Moderate and Stable* trajectories (Figure

1.1). The *High and Stable* trajectory started with a comparatively higher mean level of expectancies for success than the *Moderate and Stable* trajectory and displayed no significant changes over time (*n* = 1,161; $M[SE]_{\text{intercept}}$ = 3.58 [.10], $p < .001$, $M[SE]_{\text{slope}}$ = -.10 [.07], ns). The *Moderate and Stable* trajectory started with a moderate mean level of expectancies for success and displayed no significant changes over time (*n* = 1,549; $M[SE]_{\text{intercept}}$ = 2.79 [.07], $p < .001$, $M[SE]_{\text{slope}}$ = .08 [.10], ns).

For students' math interest, the five-class model was chosen as the final model. For the four- and five-class models, we set the variance to .001 to handle model convergence issues as recommended by the experts (Jung & Wickrama, 2008; Ramm & Grimm, 2009). By comparing the model fit, we noticed that the fit continued to improve up to the five-class model, indicated by smaller AIC, BIC, and ABIC values, as well as statistically significant *pVLMR, pLMR,* and *pBLRT* values (Table 1.3). The *pVLMR* and *pLMR* values were no longer statistically significant for the six-class model, which indicated that the six-class model was not a significant improvement over the more parsimonious five-class model. The unique trajectories for interest included *Low and Stable, Moderate and Stable, Moderate with Large Decreases, High with Small Decreases,* and *Moderate with Increases* trajectories (Figure 1.1). The *Low and Stable* trajectory started with a lower mean level of interest compared to the *Moderate and Stable* trajectory and maintained a similar low average level over time (*n* = 1,089; $M[SE]_{\text{intercept}}$ = 1.74 [.04], $p < .001$, $M[SE]_{\text{slope}}$ = -.05 [.03], ns). The *Moderate and Stable* trajectory started with an average mean level of interest and maintained a similar moderate level (*n* = 864; $M[SE]_{\text{intercept}}$ = 2.92 [.05], $p < .001$, $M[SE]_{\text{slope}}$ = -.11 [.06], ns). For the *High with Small Decreases* trajectory, the group had the highest mean level of interest but displayed small decreases over time (*n* = 342; $M[SE]_{\text{intercept}}$ = 4.17 [.17], $p < .001$, $M[SE]_{\text{slope}}$ = -.17 [.06], $p < .01$). The *Moderate with*

Large Decreases trajectory started with a lower mean level of interest than the *High with Small Decreases* trajectory but displayed comparatively larger decreases than the *High with Small Decreases* trajectory (n = 283; $M[SE]_{intercept}$ = 2.62 [.15], $p < .001$, $M[SE]_{slope}$ = -.98 [.07], $p < .001$). A small group of individuals were found to start with an average mean level of interest but increased in their interest over time (n = 132; $M[SE]_{intercept}$ = 3.04 [.28], $p < .001$, $M[SE]_{slope}$ = 1.07 [.19], $p < .001$). We called this group *Moderate with Increases* trajectory.

For students' math utility value, the five-class model was selected as the final model. After handling convergence issues for the three- to five-class models by fixing the variance to .001, we compared the model fit. The model fit was worse for the three- and four-class models compared to the two-class model as demonstrated by larger AIC, BIC, and ABIC values as well as non-significant *pVLMR* and *pLMR* values for the three- and four-class models (Table 1.3). However, the five-class model had significant *pVLMR* and *pLMR* values and lower AIC, BIC, and ABIC values compared to the other models, including the two-class model, indicating a significant improvement in the model. We selected the five-class model instead of the six-class model because the six-class model had non-significant *pVLMR, pLMR,* and *pBLRT* values. The five trajectories included *High with Moderate Decreases, High with Small Decreases, Moderate and Stable, High with Increases, and Moderate with Large Decreases* trajectories (Figure 1.1). The *High with Moderate Decreases* trajectory started with an average mean level of utility value but displayed moderate decreases over time (n = 1,064; $M[SE]_{intercept}$ = 3.46 [.05], $p < .001$, $M[SE]_{slope}$ = -.48 [.03], $p < .001$). The *High with Small Decreases* trajectory started with a high mean level of utility value and displayed comparatively smaller decreases than the *High with Moderate Decreases* trajectory (n = 1,007; $M[SE]_{intercept}$ = 4.31 [.04], $p < .001$, $M[SE]_{slope}$ = -.08 [.02], $p < .001$). The *Moderate and Stable* trajectory started with an average mean level of utility value and maintained a similar level over time (n = 232; $M[SE]_{\text{intercept}}$ = 2.61 [.08], $p < .001$, $M[SE]_{\text{slope}}$ = -.10 [.15], ns). The *High with Increases* trajectory started with an above-average mean level of utility value and increased over time (n = 223; $M[SE]_{\text{intercept}}$ = 3.66 [.07], $p < .001$, $M[SE]_{\text{slope}}$ = .41 [.13], $p < .01$). The *Moderate with Large Decreases* trajectory started with an average mean level of utility value and showed larger decreases than the *High with Moderate Decreases* and the *High with Small Decreases* trajectory (n = 184; $M[SE]_{\text{intercept}}$ = 2.33 [.19], $p < .001$, $M[SE]_{\text{slope}}$ = -.95 [.19], $p < .001$).

For students' math attainment value, the three-class model was chosen as the final model. The model fit continued to improve up to the three-class model, which was indicated by smaller AIC, BIC, and ABIC values, as well as statistically significant *pVLMR, pLMR,* and *pBLRT* values (Table 1.3). The *pVLMR and pLMR* values were no longer statistically significant for the four-class model, suggesting that the four-class model was not a significant improvement over the three-class model. The three-classes were *Moderate with Decreases* (n = 1,732; $M[SE]_{\text{intercept}}$ = 2.56 [.05], $p < .001$, $M[SE]_{\text{slope}}$ = -.37 [.03], $p < .001$), *High and Stable* (n = 915; $M[SE]_{\text{intercept}}$ = 3.57 [.06], $p < .001$, $M[SE]_{\text{slope}}$ = -.10 [.06], ns), and *Moderate with Increases* (n = 63; $M[SE]_{\text{intercept}}$ = 3.38 [.16], $p < .001$, $M[SE]_{\text{slope}}$ = 1.05 [.13], $p < .001$) trajectories (Figure 1.1).

Overall, we found two classes of stable trajectories for expectancies for success. We also found that students were relatively equally split in their belongingness to these two classes. For interest, utility value, and attainment value, varying numbers of classes of stable, decreasing, and increasing trajectories were identified. For interest, five classes were identified with the largest group of students belonging to the *Low and Stable* trajectory. Of the five classes for utility value, most of the students belonged to the *High with Small Decreases* or *High with Moderate Decreases* trajectory. Across the three classes for attainment value, the largest group of students displayed a *Moderate with Decreases* trajectory.

Gender and Racial/Ethnic Differences

We hypothesized that adolescents' motivational belief trajectories would differ by their racial/ethnic and gender membership. We hypothesized that Asian male students would display the most positive motivational beliefs, followed by Asian female and Latino students, then Latina students. We also hypothesized that the differences between Asian male and female students may be small given the strong model minority stereotype in math for Asians (Hsieh et al., 2021; Trytten et al., 2012). The differences were tested while controlling for parents' education level, as well as students' prior achievement, math course, and cohort.

For students' math expectancies for success (Table 1.4), significant differences were found between Latina adolescents compared to both groups of male adolescents. Latina students had a lower likelihood of belonging to the *High and Stable* group than the *Moderate and Stable* group compared to Asian male (β = -1.73 [.74], $p < .05$) and Latino (β = -.97 [.23], $p < .001$) students. That is, Latina students, on average, were more likely to maintain average expectancies for success over time compared to Asian male or Latino students who were more likely to maintain higher math expectancies for success over time. No other significant group differences were found.

For students' math interest (Table 1.5), we found racial/ethnic differences within each gender group for the *High with Small Decreases* group and significant differences between all groups and Asian male adolescents for the *Moderate with Increases* group. Latina adolescents had a higher likelihood of belonging to the *High with Small Decreases* group than the *Moderate with Large Decreases* group compared to Asian female adolescents (β = 2.09 [.95], $p < .05$). In addition, Latino (β = 22.93 [7.31], $p < .01$), Asian female (β = 24.11 [2.95], $p < .001$), and Latina

($\beta = 24.91$ [1.23], $p < .001$) students were more likely to belong to the *Moderate with Increases* group than the *Moderate with Large Decreases* group compared to Asian male students. No group differences were found for the two stable trajectories (i.e., *Low and Stable* & *Moderate and Stable*) with *Moderate with Large Decreases* trajectory as the reference group.

For students' math utility value (Table 1.6), we found gender differences among Latinx and among Asians as well as a racial/ethnic difference among female students. Latina students were less likely to belong to the *High with Small Decreases* group than the *High with Moderate Decreases* group compared to Latino students ($\beta = .41$ [18], $p < .05$). In addition, Asian male ($\beta = 11.06$ [.58], $p < .001$), Latino ($\beta = 10.42$ [.57], $p < .001$), and Latina ($\beta = 10.20$ [.82], $p < .001$) students had a higher likelihood of belonging to the *High with Increases* group than the *High with Moderate Decreases* group compared to Asian female students. No group differences were found in the *Moderate and Stable* or *Moderate with Large Decreases* trajectories with *High with Moderate Decreases* trajectory as the reference group.

For students' math attainment value (Table 1.7), we found a gender difference among Asians, and a racial/ethnic difference among male students. Asian female ($\beta = 5.71$ [2.71], $p < .05$), Latino ($\beta = 7.44$ [.52], $p < .001$), and Latina ($\beta = 7.40$ [.56], $p < .001$) students were more likely to be in the *Moderate with Increases* group than the *Moderate with Decreases* group compared to Asian male students. No other significant group differences were found with *Moderate with Decreases* trajectory as the reference group.

Results Without Controlling the Background Variables

As a robustness check, we tested racial/ethnic and gender differences without controlling for parents' education level, students' prior achievement, students' math course, and their cohort (Tables 1.S8 – 1.S11). Though the findings discussed largely replicated in the robustness check, there were three main differences. The first key difference from the main findings was that both Latino and Latina students were more likely to display more negative math expectancies for success and interest development than Asian students, which did not emerge in the main analyses. That is, whereas we found that only Latina students were less likely to belong to the *High and Stable* group than the *Moderate and Stable* group for math expectancies for success compared to Asian male students, Latino students also displayed the same pattern as Latina students in the robustness check (β = -1.44 [.42], $p < .01$). Similarly, both Latino and Latina students were more likely to be in the *Low and Stable* group than the *Moderate with Large Decreases* group for math interest compared to Asian female students (β = 1.40 [.46], $p < .01$ for Latinos; β = 1.61 [.47], $p < .01$ for Latinas). This pattern was not found in the main analyses. Second, Asian female students were less likely to belong to the *High with Small Decreases* group than the *Moderate with Large Decreases* group compared to Asian male students for interest (β = -1.82 [.85], $p < .05$), which was a pattern that did not emerge in the main analyses. Lastly, whereas we found Latino/a students were more likely to belong to the increasing groups than the decreasing groups compared to Asian students for both interest and utility value, these patterns did not emerge in the robustness check.

Discussion

Despite Asian and Latinx groups being the two largest racial/ethnic minority groups in the U.S., little is known about their motivational belief development (Rubach et al., 2022; Starr, Tulagan, & Simpkins, 2022). In this study, we described the developmental trends of Asian and Latinx adolescents' math motivational beliefs and tested differences at the intersection of race/ethnicity and gender to highlight the development of students who have often been invisible in prior research (e.g., Latinas and Asian females). One of the central contributions of this study is that Asian and Latinx adolescents' math motivational beliefs did not always demonstrate decreases, which historically have been highlighted in research (e.g., Jacob et al., 2002); in fact, we found two stable trajectories for expectancies for success as well as varying patterns of decreases, increases, and stability for each of the three subjective task values. A second central contribution is that certain groups defined by the intersection of race/ethnicity and gender displayed different developmental trends, which went undetected in prior work examining race/ethnicity and gender separately (e.g., Umarji et al., 2021). We discuss the theoretical and applied implications of our findings in more detail below.

Adolescents' Math Expectancies for Success

Though theories, like stage-environment fit theory (Eccles et al., 1993), and prior empirical evidence suggest students' math expectancies for success decrease from childhood through adolescence (e.g., Jacobs et al., 2002), findings from recent research focused specifically on adolescence, including the current study, demonstrated that adolescents' expectancies for success may be stable during middle and high school (e.g., Petersen & Hyde, 2017). These conflicting findings concerning developmental declines versus stability could be the result of historical timing as the studies noting stability are more recent or developmental timing as the trajectories illustrating stability only span adolescence. Decreases emerged when researchers estimated one growth function from childhood through adolescence. During adolescence, both setting- and individual-level processes may promote stability in students' math expectancy beliefs (e.g., Wigfield et al., 2015). Course tracking based on students' math ability often starts in middle school and continues throughout high school. Simultaneously, individuals' views of their abilities shift from more optimistic views during childhood to more realistic views that are tied to their actual performance and ability over time (Fredricks & Eccles, 2002). Continuity in students' math track placement could inform adolescents' stronger sense of their math competency. These results suggest that scholars examining the changes in youth's math expectancy beliefs over longer periods of time might consider quadratic or cubic terms that allow growth to accelerate (or decelerate) over time or spline models that can accommodate different growth functions for separate developmental periods.

The differences at the intersection of race/ethnicity and gender among the two stable trajectories for adolescents' expectancies for success have several important implications. Specifically, Latina students were more likely to maintain lower expectancies for success compared to Latino and Asian male students. In contrast, Asian female students did not differ from Asian or Latino students. These differences across the groups highlight the importance of an intersectional lens. Prior work based on the same data found gender differences but no racial/ethnic differences (Umarji et al., 2021). Based on that work, we would have expected similarities between Asian female and Latina students and differences between Asian female and the male students—both of which did not emerge. Our approach helped uncover that Latina students may be particularly vulnerable for lower math expectancies for success due to experiencing double marginalization in math by both race/ethnicity and gender (Else-Quest et al., 2013; Hsieh et al., 2021). The model minority stereotype that Asians are good in math might have buffered Asian female students' expectancies for success (Hsieh et al., 2021; McGee, 2018); similarly, the notion that math is a male domain might have buffered Latino students' expectancies for success even though Latinxs are marginalized in math due to their ethnicity (Lazarides & Ittel, 2012; McKellar et al., 2018). Given that we observed these patterns above and beyond several background variables (e.g., prior math achievement, math course difficulty), Latina students' experiences of double marginalization in math may be strongly related to their expectancies for success development. Latinas, a group that is invisible when gender and race/ethnicity are examined separately, might be a group that would benefit from applied efforts to bolster structural supports.

Because social position factors, including gender and race/ethnicity, are associated with numerous contextual factors, such as experiences and access to resources in the U.S. (Garcia-Coll et al., 1996), it is important to consider group differences based on these social position factors with and without controls (e.g., parent education, math course difficulty). As expected, more significant differences emerged without covariates. In the case of math expectancies for success, there were racial/ethnic differences within each gender where Latino students displayed more negative beliefs compared to Asian male students with parallel differences among Latina and Asian female students. Adolescents' math achievement and the rigor of their math courses were significant predictors of their expectancies for success in the analyses with covariates. The development of Latinx students' expectancies for success may be strongly related to their placement in lower math course tracks or lower math performance compared to Asian students (NSF, 2019). The pattern of findings with and without controls suggest that negative social and academic experiences of Latinxs, including lower course placement or achievement gaps, may affirm negative societal stereotypes in math. Structural barriers in math, stigma associated with lower course tracking, or varying class quality are some of the issues that may need to be addressed to close the racial/ethnic gaps in expectancies for success development in math (Crisp et al., 2015; Murphy & Zirkel, 2015).

Adolescents' Math Interest, Utility Value, and Attainment Value

For all three subjective task value beliefs, we found subgroups of adolescents who demonstrated stable (72% for interest; 9% for utility value; 34% for attainment value), decreasing (23% for interest; 83% for utility value; 64% for attainment value), or increasing (5% for interest; 8% for utility value; 2% for attainment value) trajectories. Similar trajectories have emerged in other studies on students' math interest (Gaspard et al., 2020; Musu-Gilette et al., 2015), utility value (Musu-Gilette et al., 2015), and overall subjective task values (Guo et al., 2018) among White U.S. students in the 1980s and 1990s (Gaspard et al., 2020; Musu-Gilette et al., 2015) and Finnish students in 2004 (Guo et al., 2018). For example, Guo and colleagues (2018) found a decreasing as well as an increasing trajectory across high school in adolescents' overall math subjective task values, which combined their math interest, importance, and usefulness. The current findings extend this work by demonstrating that Asian and Latinx U.S. adolescents displayed similar patterns for each of the three subjective task values.

Testing the three subjective task value belief separately in this study also extends prior findings by highlighting differences across the three beliefs. For example, the largest group of students varied by belief with the *Decreasing* groups being the largest for utility value (76%) and attainment value (64%) whereas the two *Stable* groups were the largest for interest (72%). The characteristics of math courses, including when it is required, may contribute to these different prevalent patterns. Adolescents may perceive math to be useful or important to them as it is a required part of the core curriculum in middle and the beginning of high school; additionally, they may display moderate or high initial levels of utility and attainment value because their socializers, such as their parents also demonstrate high values in math (Simpkins et al., 2015b). However, adolescents' value of math may wane as they are introduced to more diverse topics during high school. As they explore their options and start making more concrete decisions about their future, they may find math to be less central to how they see themselves or useful for what they want to do. Their interest in math, however, may not change as much during this period because it has already become individualized and relatively enduring given that adolescents have already taken math for many years (Hidi & Renninger, 2006). Though learning environment can facilitate developmental changes in interest, the classes in middle and high school are likely to continue to be less interesting, involving less teacher-student interaction and less personalized learning experiences, leading to relatively stable patterns of interest development during this developmental stage (Eccles et al., 1993). Overall, our findings suggest interventional efforts to increase interest or prevent utility value and attainment value from decreasing may be particularly helpful in addressing some of the disparities we see in motivational belief development in math.

Analyzing the data with a person-centered approach in this study highlighted groups that are often overlooked in variable-centered analyses; one example from the current study is a group of individuals whose subjective task values increased over time. Documenting these increases contributes to motivation theory and calls in question the leaky STEM pipeline metaphor that assumes people who leave STEM do not return and that no one moves from non-STEM into STEM fields. The findings from this study and others (e.g., Hsieh & Simpkins, 2022; Starr, Carranza, & Simpkins, 2022) suggest that the pathways in and out of STEM are more fluid with some students moving toward STEM during high school. It also suggests that middle and high school are not too late to spark students' math motivational beliefs. Adolescents' exposure to positive socio-cultural environments may strengthen their motivational beliefs (Lee et al., 2023). For example, many Latinx students in this study and in other datasets displayed a high probability of transitioning from low to high motivational beliefs than maintaining low motivational beliefs across high school, and parent socialization was found to help maintain their high motivational beliefs (Lee et al., 2023). Positive social interactions with their teachers, peers, or parents may strengthen students' motivational beliefs (Eccles & Wigfield, 2020; Simpkins et al., 2020). More studies are needed to explore what may spark, increase, and maintain positive motivational beliefs.

In contrast to the findings for expectancies for success in math, Latina students did not display the most negative growth trajectories for subjective task values compared to the other groups. It may be that the double marginalization in math is less related to Latina students' subjective task value development compared to their expectancies for success. For example, one study indicated that Latina students were more likely to belong to a profile with low identity and expectancies for success but relatively high interest and utility values (Hsieh et al., 2021). In addition, both Latino and Latina students were found to display an above-average level of subjective task values in Grade 10 (Else-Quest et al., 2013). Studies show that Latinx students have robust family support systems that foster strong academic values (Alfaro et al., 2006). Latina students' choice to not pursue STEM may be more associated with their expectancies for success than their subjective task values.

Asian students in this study were more likely to endorse high levels of subjective task values as they entered high school and display decreasing trajectories than increasing trajectories. Asian students may display declines because even though the model minority stereotype might help them to perform better in math, the pressure to conform to the stereotype could also lead to more negative academic attitudes, such as their interest (McGee, 2018). Future studies could involve testing the trajectories across a longer time span or exploring underlying mechanisms that may lead to varying developmental trajectories.

One notable difference found in our analyses with and without covariates is that, without covariates, Latinx students were no longer more likely to belong to the increasing trajectories compared to Asian students for interest and utility value. Similar to race/ethnicity, the experiences students have based on their racial/ethnic backgrounds can also be socially constructed because students from different racial/ethnic backgrounds experience different quality in classes or access to resources (Martin, 2009). Our findings suggest that when the effects from these structural barriers are controlled for (e.g., math course-taking, achievement, and parents' education level), Latinx students displayed positive development in their subjective task values. Based on these findings, our next steps may entail exploring ways to target the systematic and structural issues that exist in academic and social experiences of marginalized groups.

Though we focused on discussing the variability that exists in motivational belief development due to students' race/ethnicity and gender, many of the group differences were not statistically significant. Based on the traditional stereotypes, we speculated that Latinx adolescents (and Latinas specifically), who are marginalized in math, would evidence the most negative developmental trends (e.g., low and stable or decreasing beliefs) and that Asians (and Asian male adolescents specifically) would display the most positive developmental trends (Else-Quest et al., 2013; McGee, 2018). However, our findings debunk many of these long-held assumptions by displaying not only that some marginalized adolescents (e.g., Latina students) displayed more positive developmental trajectories than the other groups, but also that racial/ethnic and gender differences in the trajectories of the motivational beliefs for Asian/Latinx male/female students were often not statistically significant. These findings suggest the need to explore beyond the average trends within certain group memberships and to test heterogeneity within groups (e.g., gender differences within race/ethnicity). By doing so, we will be able to highlight the complexity in the development of individuals that are shaped by their multiple social identities and roles (e.g., Causadias et al., 2018).

Limitations and Future Directions

Despite the significant contributions of this study, it is not without limitations. Our study involved charting the motivational belief development between Grades 8 to 10, and thus cannot address trends at other developmental ages. Also, our data was collected in Southern California where there are large Latinx and Asian populations, which may limit its generalization to other areas. Though the sample consisted of more Latinx than Asian students and the results might be biased due to the high representation of Latinx population, the sample was representative of the school districts from which students were recruited. With GMM, experts posit that the identification of subgroups accounts for many factors, including but not limited to relative group sizes (Ram & Grimm, 2009). Therefore, we believe that our findings are meaningful despite the differences in the sample composition, but future studies could involve testing whether the results replicate among samples with a larger number of Asian students.

Replicating these patterns across historical time, developmental period, and groups will be critical. Though recent work suggests the racial/ethnic and gender differences in adolescents' math motivational beliefs have not changed since the 1980s (Rubach et al., 2022), the developmental changes might differ by historical time. Additionally, researchers can test if the developmental trends in youth's motivational beliefs are the same when one growth function is estimated from childhood through adolescence versus models where more dynamic growth functions are estimated. Finally, our work and other studies on racially/ethnically diverse populations suggest some adolescents' math motivational beliefs increase or are stable (e.g., Hsieh & Simpkins, 2022). Though we examined developmental patterns at the intersection of race/ethnicity and gender, future research could explore other ways to examine diversity within groups (e.g., racial/ethnic differences within gender, gender within race/ethnicity, etc.).

In some of the models for interest and utility value, we had to fix the variance of the slopes to .001 to aid with model convergence. Even though experts recommend fixing the variance of the growth factors to handle model convergence issues in GMM (Jung & Wickrama, 2008; Ramm & Grimm, 2009), models with fixed variances should be interpreted with caution given that overextraction can be more common when the variances are constrained to be homogeneous (Infurna & Grimm, 2017). Thus, even though we followed the procedures recommended by statistical experts and selected our final models based on multiple indicators, theoretical alignment, and after cross-validating our findings among subsamples, we note the concern (Ram & Grimm, 2009).

Conclusion

This study highlights the unique patterns of math motivational belief development during the transition from middle to high school. Our findings also add to the limited literature on Asian and Latinx students and help guide applied efforts to address the gaps that exist across students of diverse backgrounds by displaying the issues of marginalization and privilege at the intersection of race/ethnicity and gender. One critical implication of our findings is that researchers might utilize various analytic strategies to examine the potential multiple trajectories that underlie the average trends. By using a person-centered approach, we were able to identify patterns that challenge the long-held stereotypes concerning the leaky STEM pipeline, declines in math motivational beliefs, and that marginalized adolescents display larger decreases in their motivational beliefs than adolescents privileged in math. This study suggests that motivation researchers can move forward to explore diversity that exists within racial/ethnic and gender groups to document not only those who are falling behind but also those who are succeeding. By doing so, we will be able to highlight the strengths of marginalized groups, provide more targeted support, and help identify specific ways to address the societal and systematic issues that exist in STEM, such as in math, to create a more equitable learning environment for all youth.

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Tables and Figures

Table 1.1
Descriptive Statistics

Indicator	Analytic sample		Asian male adolescents		Asian female adolescents		Latino adolescents		Latina adolescents	
	n	*M* (*SD*)	*n*	*M* (*SD*)	*n*	*M* (*SD*)	*n*	*M* (*SD*)	*n*	*M* (*SD*)
Expectancies for success										
Grade 8 Fall	1,014	3.30(0.87)	90	3.47(0.78)	95	3.48(0.78)	439	3.34(0.89)	390	3.17(0.89)
Grade 8 Spring	1,051	3.27(0.88)	84	3.59(0.85)	89	3.51(0.76)	451	3.28(0.88)	427	3.15(0.88)
Grade 9 Fall	2,004	3.24(0.87)	142	3.49(0.75)	136	3.35(0.76)	841	3.28(0.90)	885	3.14(0.87)
Grade 9 Spring	1,935	3.27(0.92)	145	3.55(0.84)	130	3.36(0.81)	815	3.33(0.95)	845	3.15(0.91)
Grade 10 Fall	1,008	3.16(0.86)	75	3.36(0.82)	72	3.14(0.75)	404	3.22(0.90)	457	3.08(0.84)
Grade 10 Spring	947	3.28(0.91)	66	3.44(0.91)	68	3.27(0.73)	383	3.37(0.95)	430	3.19(0.89)
Interest										
Grade 8 Fall	1,014	2.75(1.19)	90	3.12(1.15)	95	3.15(1.07)	439	2.67(1.18)	390	2.65(1.22)
Grade 8 Spring	1,051	2.52(1.11)	84	2.69(1.05)	89	2.88(0.96)	451	2.46(1.09)	427	2.47(1.15)
Grade 9 Fall	2,004	2.67(1.15)	142	3.00(1.07)	136	2.76(1.11)	841	2.65(1.13)	885	2.63(1.18)
Grade 9 Spring	1,932	2.59(1.11)	144	2.86(1.15)	130	2.71(1.01)	813	2.56(1.08)	845	2.54(1.14)
Grade 10 Fall	1,006	2.49(1.07)	75	2.59(1.14)	72	2.56(0.92)	402	2.52(1.09)	457	2.43(1.07)
Grade 10 Spring	942	2.55(1.09)	66	2.69(0.99)	67	2.51(0.91)	381	2.52(1.09)	428	2.55(1.14)
Utility value										
Grade 8 Fall	1,014	4.01(0.74)	90	3.91(0.83)	95	4.07(0.69)	439	3.99(0.75)	390	4.06(0.71)
Grade 8 Spring	1,051	3.82(0.81)	84	3.80(0.85)	89	4.07(0.67)	451	3.78(0.85)	427	3.81(0.77)
Grade 9 Fall	2,004	3.83(0.81)	142	3.83(0.78)	136	3.83(0.81)	841	3.77(0.82)	885	3.88(0.81)
Grade 9 Spring	1,932	3.63(0.88)	145	3.68(0.83)	130	3.71(0.86)	813	3.59(0.88)	844	3.65(0.89)
Grade 10 Fall	1,006	3.52(0.89)	75	3.37(0.90)	72	3.48(0.78)	402	3.46(0.87)	457	3.61(0.91)
Grade 10 Spring	943	3.51(0.91)	66	3.35(0.97)	67	3.52(0.76)	381	3.48(0.86)	429	3.54(0.95)
Attainment value										
Grade 8 Fall	1,015	3.28(0.86)	91	3.35(0.78)	95	3.39(0.74)	439	3.24(0.88)	390	3.27(0.90)
Grade 8 Spring	1,051	2.98(0.89)	84	3.03(0.87)	89	3.26(0.77)	451	2.93(0.89)	427	2.96(0.92)
Grade 9 Fall	2,006	3.09(0.92)	142	3.25(0.88)	136	3.17(0.85)	842	3.05(0.91)	886	3.09(0.94)
Grade 9 Spring	1,935	2.91(0.93)	145	3.04(0.98)	130	3.07(0.85)	815	2.88(0.92)	845	2.87(0.93)
Grade 10 Fall	1,008	2.82(0.91)	75	2.88(0.83)	72	2.94(0.83)	404	2.82(0.92)	457	2.80(0.92)
Grade 10 Spring	948	2.83(0.96)	66	2.91(0.94)	68	3.01(0.88)	383	2.83(0.93)	431	2.79(1.01)
Demographics										
Math achievement	2,532	2.81(1.01)	203	3.53(0.99)	194	3.63(0.85)	1,046	2.68(0.97)	1,090	2.64(0.95)
Math course	2,525	2.38(1.32)	201	2.81(1.47)	194	3.27(1.69)	1,041	2.11(1.15)	1,089	2.41(1.28)
Parents' education level	1,995	1.98(1.09)	147	2.75(1.22)	157	2.85(1.19)	801	1.86(1.02)	890	1.81(0.98)

Table 1.2
Bivariate Correlations for the Analytic Sample

Indicator	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Expectancies for success																													
1. Gr.8 Fall	--																												
2. Gr.8 Spring	.54*	--																											
3. Gr.9 Fall	.48*	.63*	--																										
4. Gr.9 Spring	.34*	.46*	.59*	--																									
5. Gr.10 Fall	--	--	.46*	.60*	--																								
6. Gr.10 Spring	--	--	.44*	.51*	.62*	--																							
Interest																													
7. Gr.8 Fall	.57*	.40*	.38*	.31*	--	--	--																						
8. Gr.8 Spring	.37*	.53*	.46*	.37*	--	--	.66*	--																					
9. Gr.9 Fall	.38*	.41*	.56*	.40*	.29*	.34*	.63*	.75*	--																				
10. Gr.9 Spring	.31*	.37*	.37*	.57*	.35*	.33*	.52*	.66*	.66*	--																			
11. Gr.10 Fall	--	--	.33*	.39*	.53*	.44*	--	--	.53*	.65*	--																		
12. Gr.10 Spring	--	--	.33*	.36*	.40*	.56*	--	--	.49*	.59*	.68*	--																	
Utility value																													
13. Gr.8 Fall	.41*	.25*	.18*	.15*	--	--	.44*	.30*	.23*	.18*	--	--	--																
14. Gr.8 Spring	.21*	.40*	.28*	.20*	--	--	.34*	.49*	.36*	.33*	--	--	.50*	--															
15. Gr.9 Fall	.20*	.28*	.41*	.24*	.24*	.19*	.29*	.37*	.50*	.32*	.30*	.27*	.41*	.62*	--														
16. Gr.9 Spring	.18*	.22*	.28*	.42*	.29*	.23*	.27*	.33*	.38*	.51*	.37*	.34*	.35*	.49*	.58*	--													
17. Gr.10 Fall	--	--	.20*	.29*	.43*	.30*	--	--	.30*	.38*	.51*	.38*	--	--	.50*	.65*	--												
18. Gr.10 Spring	--	--	.22*	.27*	.32*	.45*	--	--	.30*	.38*	.39*	.52*	--	--	.43*	.56*	.65*	--											
Attainment value																													
19. Gr.8 Fall	.56*	.36*	.31*	.23*	--	--	.62*	.44*	.39*	.30*	--	--	.67*	.40*	.34*	.33*	--	--	--										
20. Gr.8 Spring	.31*	.49*	.37*	.31*	--	--	.43*	.62*	.48*	.43*	--	--	.41*	.66*	.48*	.41*	--	--	.56*	--									
21. Gr.9 Fall	.34*	.41*	.51*	.34*	.25*	.28*	.42*	.52*	.64*	.42*	.38*	.37*	.35*	.49*	.68*	.44*	.39*	.37*	.50*	.67*	--								
22. Gr.9 Spring	.22*	.31*	.35*	.52*	.32*	.28*	.34*	.43*	.47*	.65*	.47*	.43*	.25*	.41*	.42*	.67*	.50*	.43*	.40*	.59*	.59*	--							
23. Gr.10 Fall	--	--	.27*	.35*	.43*	.34*	--	--	.34*	.45*	.63*	.47*	--	--	.37*	.48*	.69*	.46*	--	--	.51*	.67*	--						
24. Gr.10 Spring	--	--	.29*	.34*	.35*	.49*	--	--	.37*	.47*	.49*	.68*	--	--	.32*	.42*	.50*	.67*	--	--	.48*	.59*	.65*	--					
Background variables																													
25. Female	-.07	-.07	-.08*	-.10*	-.09	-.10	.00	.02	-.02	-.02	-.04	.00	.06	.05	.06	.03	.09	.04	.02	.03	.02	.00	.00	-.01	--				
26. Asian	.09	.14*	.09*	.08*	.04	.03	.15*	.11*	.07	.07*	.03	.02	-.02	.07	.00	.03	-.05	-.03	.05	.09	.05	.07	.04	.06	-.01	--			
27. Achievement	.29*	.34*	.28*	.26*	.20*	.19*	.20*	.15*	.13*	.16*	.10	.12*	.05	.04	.01	.05	.03	.05	.12*	.05	.04	.09*	.05	.11*	-.01	.33*	--		
28. Math course	.15*	.07	.12*	.10*	.11*	.09	.17*	.09	.13*	.12*	.07	.05	.02	.00	.03	.02	.00	.04	.09	.03	.10*	.09*	.04	.08	.12*	.21*	.14*	--	
29. Parents' education	.05	.13*	.07	.03	.05	.03	.00	.03	.01	-.03	-.04	-.01	-.01	.00	-.02	-.07	-.06	-.08	.05	.05	.01	-.03	-.04	.02	.-.02	.32*	.16*	.13*	--

Note. The correlations between Grades 8 to 10 motivational beliefs are missing due to the cross-cohort design of the dataset. *$p < .001$.

Table 1.3

Fit Indices From the GMM Models for Each Motivational Belief

Number of classes	AIC	BIC	ABIC	*pVLMR*	*pLMR*	*pBLRT*	Class *N*s
			Expectancies for success				
1	18606.131	18641.559	18622.495				2710
2	**18559.376**	**18612.518**	**18583.922**	**.045**	**.050**	**< .001**	**1549, 1161**
3	18556.907	18627.763	18589.636	.012	.014	.120	1173, 5, 1532
4	18553.614	18642.185	18594.525	.835	.839	.500	1301, 133, 614, 662
5	18549.074	18655.359	18598.167	.645	.657	.429	560, 733, 9, 33, 1375
			Interest				
1	21316.910	21352.998	21333.274				2710
2	21192.426	21245.568	21216.972	< .001	< .001	< .001	983, 1727
3	21121.914	21192.770	21154.642	< .01	< .05	< .001	1106, 547, 1057
4	21124.758	21201.519	21160.214	<.05	<.05	<.001	359, 1068, 373, 910
5	**21090.510**	**21184.985**	**21134.148**	**<.05**	**<.05**	**<.001**	**1089, 864, 283, 132, 342**
6	21065.637	21177.826	21117.457	.06	.06	<.001	315, 108, 300, 758, 256, 973
			Utility value				
1	17547.202	17582.631	17563.567				2710
2	17426.305	17479.447	17450.851	< .05	< .05	< .001	614, 2096
3	17450.229	17509.276	17477.503	.34	.35	<.001	1301, 1001, 408
4	17386.869	17463.630	17422.325	.23	.23	<.001	219, 1038, 321, 1131
5	**17358.152**	**17452.627**	**17401.790**	**<.05**	**<.05**	**<.001**	**232, 223, 1007, 1064, 184**
6	17331.055	17443.245	17382.876	.30	.31	<.001	455, 120, 851, 128, 275, 881
			Attainment value				
1	18714.362	18749.790	18730.726				2710
2	18694.404	18747.547	18718.951	< .01	< .01	< .001	932, 1778
3	**18678.372**	**18749.229**	**18711.101**	**< .001**	**< .001**	**< .001**	**1732, 915, 63**
4	18665.419	18753.989	18706.330	.13	.14	<.001	57, 449, 1336, 867
5	18658.405	18764.690	18707.498	.19	.20	.01	302, 795, 1010, 557, 46

Note. Bold indicates the selected model. The best model was selected based on AIC, BIC, and ABIC; *p*-values on the VLMR, LMR, and BLRT; as well as the number of class proportions.

Table 1.4

Logistic Regression Results Predicting Trajectories of Expectancies for Success by Race/Ethnicity and Gender

	Reference group = Moderate and Stable High and Stable
Predictors	β (*SE*)
Compared to Asian male adolescents	
Asian female adolescents	-1.51 (.85)
Latino adolescents	-.76 (.72)
Latina adolescents	**-1.73 (.74)***
Compared to Asian female adolescents	
Asian male adolescents	1.51 (.85)
Latino adolescents	.75 (.47)
Latina adolescents	-.22 (.46)
Compared to Latino adolescents	
Asian male adolescents	.76 (.72)
Asian female adolescents	-.75 (.47)
Latina adolescents	**-.97 (.23)*****
Background variables	
Parents' education level	-.01 (.11)
Math Achievement	**1.22 (.15)*****
Math course	**.30 (.12)****
Cohort	-.12 (.65)

Note. $^*p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Table 1.5

Logistic Regression Results Predicting Trajectories of Interest by Race/Ethnicity and Gender

	Reference group = Moderate with Large Decreases			
	Low and Stable	Moderate and Stable	High with Small Decreases	Moderate with Increases
Predictors	β (*SE*)	β (*SE*)	β (*SE*)	β (*SE*)
Compared to Asian male adolescents				
Asian female adolescents	-1.22 (1.20)	-1.39 (1.36)	-2.02 (1.22)	**24.11 (2.95)*** **
Latino adolescents	-.32 (1.07)	-.72 (1.17)	-.55 (1.05)	**22.93 (7.31)** **
Latina adolescents	-.11 (1.13)	-.79 (1.23)	.07 (1.04)	**24.91 (1.23)*** **
Compared to Asian female adolescents				
Asian male adolescents	1.22 (1.20)	1.39 (1.36)	2.02 (1.22)	**-24.18 (1.36)*** **
Latino adolescents	.91 (.61)	.67 (.75)	1.47 (.99)	-1.18 (8.65)
Latina adolescents	1.11 (.61)	.60 (.76)	**2.09 (.95)* **	.80 (3.04)
Compared to Latino adolescents				
Asian male adolescents	.32 (1.07)	.72 (1.17)	.55 (1.05)	**-22.77 (1.17)*** **
Asian female adolescents	-.91 (.61)	-.67 (.75)	-1.47 (.99)	1.18 (8.65)
Latina adolescents	.21 (.43)	-.07 (.50)	.62 (.49)	1.98 (6.69)
Background variables				
Parents' education level	-.11 (.20)	-.24 (.26)	-.28 (.25)	.39 (.69)
Math Achievement	-.41 (.39)	-.27 (.53)	.65 (.37)	-.37 (3.23)
Math course	-.19 (.12)	.01 (.14)	-.05 (.16)	-.51 (.55)
Cohort	-.22 (.62)	-.28 (.79)	-.94 (.56)	-2.31 (10.85)

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

Table 1.6

Logistic Regression Results Predicting Trajectories of Utility Value by Race/Ethnicity and Gender

	Reference group = High with Moderate Decreases			
	High with Small Decreases	Moderate and Stable	High with Increases	Moderate with Large Decreases
Predictors	β (*SE*)	β (*SE*)	β (*SE*)	β (*SE*)
Compared to Asian male adolescents				
Asian female adolescents	.29 (.39)	-.20 (.69)	**-11.06 (.58)*** **	-1.00 (1.73)
Latino adolescents	.07 (.33)	.18 (.64)	-.64 (.75)	.43 (.85)
Latina adolescents	.48 (.33)	.40 (.65)	-.85 (.98)	.69 (.90)
Compared to Asian female adolescents				
Asian male adolescents	-.29 (.39)	.20 (.69)	**11.06 (.58)*** **	1.00 (1.73)
Latino adolescents	-.22 (.31)	.38 (.58)	**10.42 (.57)*** **	1.43 (1.74)
Latina adolescents	.19 (.31)	.60 (.60)	**10.20 (.82)*** **	1.69 (1.79)
Compared to Latino adolescents				
Asian male adolescents	-.07 (.33)	-.18 (.64)	.64 (.75)	-.43 (.85)
Asian female adolescents	.22 (.31)	-.38 (.58)	**-10.42 (.57)*** **	-1.43 (1.74)
Latina adolescents	**.41 (.18)* **	.22 (.31)	-.21 (.53)	.26 (.36)
Background variables				
Parents' education level	.07 (.10)	.08 (.19)	.08 (.33)	**.43 (.18)* **
Math Achievement	.10 (.09)	.05 (.22)	-.35 (.23)	-.28 (.23)
Math course	-.06 (.08)	.18 (.21)	.12 (.19)	-.20 (.28)
Cohort	-.29 (.21)	.56 (.45)	**2.00 (.73)** **	.06 (.53)

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

Table 1.7

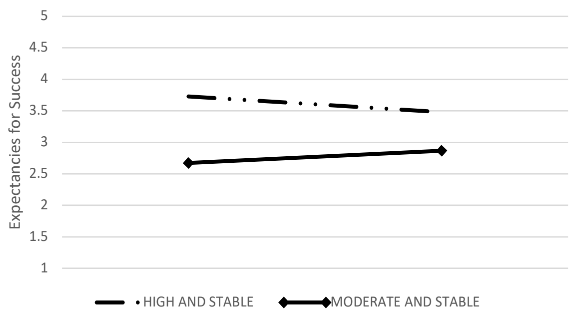
Logistic Regression Results Predicting Trajectories of Attainment Value by Race/Ethnicity and Gender

	Reference group = Moderate with Decreases	
	Moderate with Increases	High and Stable
Predictors	β (*SE*)	β (*SE*)
Compared to Asian male adolescents		
Asian female adolescents	**5.71 (2.71)***	.06 (.43)
Latino adolescents	**7.44 (.52)*****	-.36 (.35)
Latina adolescents	**7.40 (.56)*****	-.24 (.34)
Compared to Asian female adolescents		
Asian male adolescents	**-.5.71 (2.71)***	-.06 (.43)
Latino adolescents	1.74 (2.77)	-.42 (.36)
Latina adolescents	1.69 (2.91)	-.31 (.35)
Compared to Latino adolescents		
Asian male adolescents	**-7.44 (.51)*****	.36 (.35)
Asian female adolescents	-1.74 (2.77)	.42 (.36)
Latina adolescents	-.05 (.62)	.12 (.19)
Background variables		
Parents' education level	.16 (.33)	-.05 (.10)
Math Achievement	-.10 (.31)	**.36 (.11)****
Math course	.33 (.19)	-.07 (.08)
Cohort	-.09 (.55)	**-1.56 (.25)*****

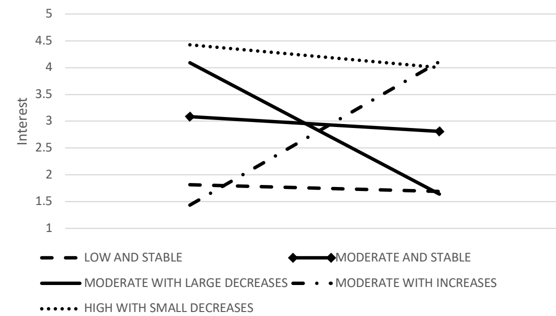
Note. *p < .05. **p < .01. ***p < .001.

Figure 1.1

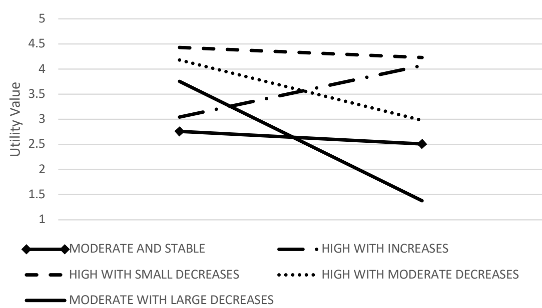
Unique Trajectories of the Final GMM Models for Each Motivational Belief



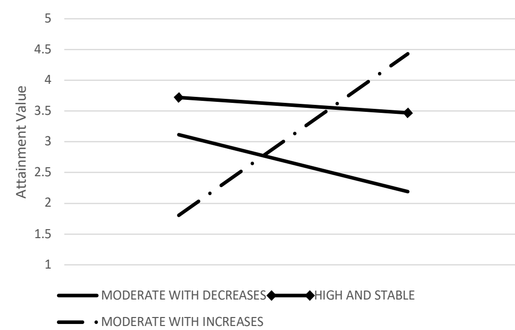
	High and Stable (n = 1,549) Mean (*S.E*)	Moderate and Stable (n = 1,161) Mean (*S.E*)
Intercept	3.58 (.10) ***	2.79 (.07) ***
Slope	- .10 (.07)	.08 (.10)



	Low and Stable (n = 1,089) Mean (*S.E*)	Moderate and Stable (n = 864) Mean (*S.E*)	Moderate with Large Decreases (n = 283) Mean (*S.E*)	Moderate with Increases (n = 132) Mean (*S.E*)	High with Small Decreases (n = 342) Mean (*S.E*)
Intercept	1.74 (.04)***	2.92 (.05)***	2.62 (.15)***	3.04 (.28)***	4.17 (.07)***
Slope	-.05 (.03)	-.11 (.06)	-.98 (.07)***	1.07 (.19)***	-.17 (.06)**



	Moderate and Stable (n = 232) Mean (*S.E*)	High with Increases (n = 223) Mean (*S.E*)	High with Small Decreases (n = 1,007) Mean (*S.E*)	High with Moderate Decreases (n = 1,064) Mean (*S.E*)	Moderate with Large Decreases (n = 184) Mean (*S.E*)
Intercept	2.61 (.08)***	3.66 (.07)***	4.31 (.04)***	3.46 (.05)***	2.33 (.19)***
Slope	-.10 (.15)	.41 (.13)**	-.08 (.02)***	-.48 (.03)***	-.95 (.19)***



	Moderate with Decreases (n = 1,732) Mean (*S.E*)	High and Stable (n = 915) Mean (*S.E*)	Moderate with Increases (n = 63) Mean (*S.E*)
Intercept	2.56 (.05)***	3.57 (.06)***	3.38 (.16)***
Slope	-.37 (.03)***	-.10 (.06)	1.05 (.13)***

Note. Intercept at Spring of Grade 9.

Supplemental Material

Table 1.S1

Comparisons Between Analytic and Excluded Samples

	Analytic sample		Excluded sample		
	n	*M* (*SD*)	*n*	*M* (*SD*)	Effect size
Grade 8 motivational beliefs					
Time 1: Fall					
Expectancies for success	1014	3.30 (0.88)	247	3.33 (0.93)	.03[a]
Interest	1014	2.75 (1.20)	247	2.65 (1.24)	.08[a]
Utility value	1014	4.02 (0.74)	247	3.92 (0.76)	.13[a]
Attainment value	1015	3.28 (0.87)	247	3.19 (0.85)	.10[a]
Time 2: Spring					
Expectancies for success	1050	3.27 (0.88)	234	3.24 (1.00)	.03[a]
Interest	1050	2.52 (1.11)	233	2.46 (1.16)	.05[a]
Utility value	1050	3.82 (0.81)	234	3.68 (0.83)	.17[a]
Attainment value	1050	2.98 (0.90)	233	2.85 (0.88)	.15[a]
Grade 9 motivational beliefs					
Time 1: Fall					
Expectancies for success	2004	3.24 (0.88)	443	3.26 (0.97)	.02[a]
Interest	2004	2.68 (1.15)	443	2.58 (1.16)	.09[a]
Utility value	2004	3.83 (0.82)	443	3.58 (0.88)	.29[a]
Attainment value	2006	3.09 (0.92)	443	2.91 (0.94)	.19[a]
Time 2: Spring					
Expectancies for success	1935	3.27 (0.93)	423	3.17 (1.00)	.10[a]
Interest	1932	2.59 (1.11)	422	2.46 (1.12)	.12[a]
Utility value	1932	3.63 (0.88)	424	3.49 (0.95)	.15[a]
Attainment value	1935	2.91 (0.93)	423	2.82 (0.97)	.09[a]
Grade 10 motivational beliefs					
Time 1: Fall					
Expectancies for success	1008	3.17 (0.86)	217	3.22 (0.94)	.06[a]
Interest	1006	2.49 (1.08)	217	2.48 (1.08)	.01[a]
Utility value	1006	3.53 (0.89)	217	3.39 (0.89)	.16[a]
Attainment value	1008	2.83 (0.91)	217	2.82 (0.95)	.01[a]
Time 2: Spring					
Expectancies for success	947	3.29 (0.91)	201	3.43 (0.92)	.15[a]
Interest	942	2.55 (1.10)	200	2.57 (1.11)	.02[a]
Utility value	943	3.51 (0.91)	200	3.41 (0.83)	.11[a]
Attainment value	948	2.83 (0.97)	201	2.82 (0.96)	.01[a]
Demographics					
Female	2710	0.50 (0.50)	619	0.52 (0.50)	.02[b]
Math achievement	2532	2.81 (1.02)	602	2.86 (0.96)	.05[a]
Math course	2525	2.39 (1.32)	602	2.43 (1.25)	.03[a]
Parents' education level	1994	1.99 (1.09)	521	2.73 (1.04)	.69[a]

Note. *SD* = Standard deviation. Convention for [a]Cohen's *d*: small = .2, medium = .5, large = .8. [b]Phi coefficient: small = .1, medium = .3, large = .5.

Table 1.S2

Measurement Invariance Tests by Time and Race/Ethnicity and Gender

Model	χ^2	*df*	*p*	RMSEA	90% CI	CFI	ΔCFI	TLI	SRMR
				Time invariance					
Expectancies for success									
Configural	716.54	98	<.001	.048	.045-.052	.955	—	.945	.037
Weak	736.46	107	<.001	.047	.043-.050	.954	<.01	.949	.040
Strong	813.34	116	<.001	.047	.044-.050	.949	<.01	.948	.042
Interest									
Configural	2098.72	246	<.001	.053	.051-.055	.962	—	.957	.026
Weak	2110.10	261	<.001	.051	.049-.053	.962	< .001	.960	.027
Strong	2130.39	276	<.001	.050	.048-.052	.962	< .001	.962	.027
Utility value									
Configural	3158.921	343	<.001	.055	.023-.057	.907	—	.898	.047
Weak	3307.383	361	<.001	.055	.053-.057	.903	<.01	.898	.057
Strong	3450.747	379	<.001	.055	.053-.056	.899	<.01	.899	.062
Attainment value									
Configural	2681.73	344	<.001	.050	.048-.052	.926	—	.919	.035
Weak	2719.11	362	<.001	.049	.047-.051	.925	<.01	.922	.037
Strong	2804.12	380	<.001	.049	.047-.050	.923	<.01	.924	.038
				Racial/ethnic and gender invariance					
Expectancies for success									
Configural	24.78	8	<.001	.072	.041-.106	.994	—	.981	.015
Weak	49.51	20	<.001	.061	.040-.082	.989	<.01	.987	.087
Strong	131.48	31	<.001	.090	.074-.106	.962	.027[a]	.971	.114
Interest									
Configural	109.07	31	<.001	.079	.064-.096	.991	—	.982	.015
Weak	131.14	49	<.001	.065	.052-.078	.990	<.01	.988	.071
Strong	169.15	67	<.001	.062	.050-.073	.988	<.01	.989	.083
Utility value									
Configural	171.79	49	<.001	.079	.066-.092	.979	—	.965	.028
Weak	188.71	70	<.001	.065	.054-.076	.980	<.01	.976	.060
Strong	224.95	91	<.001	.061	.051-.071	.978	<.01	.979	.066
Attainment value									
Configural	146.87	50	<.001	.069	.057-.083	.985	—	.975	.023
Weak	166.72	71	<.001	.058	.047-.069	.985	<.001	.982	.049
Strong	226.03	92	<.001	.060	.050-.070	.979	<.01	.981	.065

Note. Race/ethnicity and gender invariance was tested across the four groups, which were Asian males, Asian females, Latinos, and Latinas. [a]Partial measurement invariance was tested.

Table 1.S3

Comparisons Between Participants in the Analytic Sample: Participants With Complete Data and Participants With Some Missing Data

	Sample with complete data		Sample with some missing data		
	n	*M* (*SD*)	*n*	*M* (*SD*)	Effect size
Cohort 1: Grades 8 – 9					
Grade 8 Time 1: Fall					
Expectancies for success	303	3.32 (0.87)	711	3.30 (0.88)	.02[a]
Interest	303	2.74 (1.22)	711	2.76 (1.19)	.02[a]
Utility value	303	4.04 (0.70)	711	4.01 (0.76)	.04[a]
Attainment value	303	3.30 (0.85)	712	3.28 (0.88)	.02[a]
Grade 8 Time 2: Spring					
Expectancies for success	303	3.37 (0.85)	748	3.23 (0.89)	.16[a]
Interest	303	2.63 (1.19)	748	2.48 (1.08)	.13[a]
Utility value	303	3.91 (0.76)	748	3.79 (0.83)	.15[a]
Attainment value	303	3.01 (0.92)	748	2.97 (0.89)	.04[a]
Grade 9 Time 1: Fall					
Expectancies for success	303	3.31 (0.86)	418	3.20 (0.91)	.12[a]
Interest	303	2.56 (1.14)	418	2.56 (1.16)	.00[a]
Utility value	303	3.78 (0.83)	418	3.75 (0.89)	.03[a]
Attainment value	303	2.94 (0.93)	420	2.95 (0.96)	.01[a]
Grade 9 Time 2: Spring					
Expectancies for success	303	3.27 (0.96)	349	3.23 (0.94)	.04[a]
Interest	303	2.51 (1.10)	347	2.52 (1.10)	.01[a]
Utility value	303	3.63 (0.90)	347	3.59 (0.91)	.04[a]
Attainment value	303	2.83 (0.96)	349	2.81 (0.94)	.02[a]
Demographics					
Female	303	0.50 (0.50)	931	0.49 (0.50)	.01[b]
Asian	303	0.14 (0.35)	931	0.18 (0.39)	.05[b]
Math achievement	303	3.11 (0.91)	847	3.03 (1.03)	.08[a]
Math course	303	1.66 (1.00)	838	1.55 (0.93)	.11[a]
Parents' education	303	1.86 (1.02)	578	2.02 (1.08)	.15[a]
Cohort 2: Grades 9 – 10					
Grade 9 Time 1: Fall					
Expectancies for success	505	3.29 (0.88)	778	3.21 (0.86)	.09[a]
Interest	505	2.76 (1.13)	778	2.74 (1.16)	.02[a]
Utility value	505	3.91 (0.76)	778	3.84 (0.80)	.09[a]
Attainment value	505	3.17 (0.88)	778	3.18 (0.91)	.01[a]
Grade 9 Time 2: Spring					
Expectancies for success	505	3.31 (0.89)	778	3.26 (0.93)	.05[a]
Interest	505	2.60 (1.07)	777	2.65 (1.14)	.05[a]
Utility value	505	3.66 (0.85)	777	3.64 (0.89)	.02[a]
Attainment value	505	2.92 (0.88)	778	2.97 (0.94)	.05[a]
Grade 10 Time 1: Fall					
Expectancies for success	505	3.18 (0.88)	503	3.16 (0.84)	.02[a]
Interest	505	2.49 (1.06)	501	2.49 (1.10)	.00[a]
Utility value	505	3.49 (0.87)	501	3.56 (0.92)	.08[a]
Attainment value	505	2.80 (0.88)	503	2.85 (0.94)	.05[a]
Grade 10 Time 2: Spring					
Expectancies for success	505	3.31 (0.92)	442	3.26 (0.90)	.05[a]
Interest	505	2.53 (1.07)	437	2.58 (1.13)	.05[a]
Utility value	505	3.45 (0.90)	438	3.57 (0.91)	.13[a]
Attainment value	505	2.80 (0.95)	443	2.87 (0.99)	.07[a]
Demographics					
Female	505	0.55 (0.50)	973	0.50 (0.50)	.05[b]
Asian	505	0.16 (0.37)	973	0.12 (0.32)	.06[b]
Math achievement	505	2.65 (0.98)	879	2.58 (0.98)	.07[a]
Math course	505	3.26 (1.15)	880	2.94 (1.23)	.27[a]
Parents' education level	505	2.00 (1.12)	610	2.00 (1.12)	.00[a]

Note. *SD* = Standard deviation. Convention for [a]Cohen's *d*: small = .2, medium = .5, large = .8. [b]Phi coefficient: small = .1, medium = .3, large = .5.

Table 1.S4

Bivariate Correlations for the Asian Male (Below the Diagonal) & Female (Above the Diagonal) Groups

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Expectancies for success																											
1. Gr.8 Fl	--	.38[b]	.41[a]	.14	--	--	.62[b]	.37[b]	.24	.24	--	--	.37[b]	.01	-.06	.07	--	--	.65[b]	.20	.16	-.12	--	--	.39[b]	.34[b]	.09
2. Gr.8 Spr	.58[b]	--	.73[b]	.46[a]	--	--	.28[a]	.53[b]	.32[a]	.13	--	--	.13	.12	-.18	-.10	--	--	.40[b]	.51[b]	.27	-.02	--	--	.45[b]	.13	.31[a]
3. Gr.9 Fl	.40[a]	.69[b]	--	.60[b]	.42[b]	.36[a]	.20	.40[a]	.39[b]	.18[a]	.13	.10	.00	.03	.20[a]	.17	.11	.11	.22	.28	.35[b]	.13	.09	.03	.17	-.01	.02
4. Gr.9 Spr	.32[a]	.51[b]	.61[b]	--	.61[b]	.44[b]	.07	.22	.41[b]	.45[b]	.28[a]	.21	-.16	.01	.27[a]	.34[b]	.24[a]	.22	-.11	.08	.35[b]	.40[b]	.37[a]	.30[a]	.09	-.13	-.06
5. Gr.10 Fl	--	--	.40[b]	.58[b]	--	.62[b]	--	--	.16	.20	.41[b]	.32[a]	--	--	.14	.34[a]	.29[a]	.25	--	--	.10	.29[a]	.40[b]	.26[a]	.15	.00	.06
6. Gr.10 Spr	--	--	.36[a]	.39[a]	.25	--	--	--	.11	.04	.10	.37[a]	--	--	.05	.20	.07	.24[a]	--	--	.05	.04	.05	.20	.20	.07	-.01
Interest																											
7. Gr.8 Fl	.38[b]	.22	.37[a]	.46[a]	--	--	--	.60[b]	.61[b]	.42[a]	--	--	.30[a]	.02	.01	-.01	--	--	.56[b]	.16	.13	-.10	--	--	.33[a]	.31[a]	-.05
8. Gr.8 Spr	.10	.34[a]	.54[b]	.44[a]	--	--	.63[b]	--	.68[b]	.65[b]	--	--	.16	.30[a]	.07	.15	--	--	.36[a]	.44[b]	.29	.04	--	--	.31[a]	-.01	.03
9. Gr.9 Fl	.16	.34[a]	.48[b]	.32[b]	.08	.25	.65[b]	.77[b]	--	.70[b]	.48[b]	.47[b]	.15	.19	.44[b]	.41[b]	.23	.29[a]	.37[a]	.22	.56[b]	.46[b]	.21	.31[a]	-.04	-.01	-.15
10. Gr.9 Spr	.03	.31[a]	.39[b]	.60[b]	.44[b]	.26[a]	.58[b]	.63[b]	.59[b]	--	.69[b]	.54[b]	.06	.06	.28[a]	.49[b]	.29[a]	.32[a]	.15	-.02	.33[b]	.55[b]	.31[a]	.35[a]	.07	-.06	-.22[a]
11. Gr.10 Fl	--	--	.21	.36[a]	.50[b]	.40[a]	--	--	.48[b]	.64[b]	--	.77[b]	--	--	.24	.39[b]	.44[b]	.33[a]	--	--	.29[a]	.54[b]	.57[b]	.52[b]	.01	-.03	-.03
12. Gr.10 Spr	--	--	.31[a]	.33[a]	.30[a]	.42[b]	--	--	.53[b]	.59[b]	.55[b]	--	--	--	.19	.35[a]	.33[a]	.45[b]	--	--	.25	.41[b]	.39[a]	.58[b]	.22	.15	-.06
Utility value																											
13. Gr.8 Fl	.12	.00	.29	.39[a]	--	--	.51[b]	.48[b]	.31[a]	.25	--	--	--	.41[b]	.41[a]	.34	--	--	.61[b]	.13	.19	.00	--	--	.03	.08	-.06
14. Gr.8 Spr	-.03	.25[a]	.48[b]	.44[a]	--	--	.37[a]	.56[b]	.47[b]	.46[a]	--	--	.57[b]	--	.64[b]	.56[b]	--	--	.16	.60[b]	.45[a]	.17	--	--	-.09	-.12	.01
15. Gr.9 Fl	.22	.35[a]	.39[b]	.35[b]	.10	.39[a]	.44[a]	.53[b]	.56[b]	.44[b]	.28[a]	.42[a]	.65[b]	.72[b]	--	.70[b]	.60[b]	.52[b]	.29	.23	.72[b]	.54[b]	.35[a]	.38[a]	-.17	-.09	-.10
16. Gr.9 Spr	.23	.31[a]	.37[b]	.52[b]	.27[a]	.36[a]	.33[a]	.38[a]	.39[b]	.64[b]	.42[b]	.49[b]	.45[a]	.41[a]	.65[b]	--	.74[b]	.61[b]	.44[a]	.21	.54[b]	.72[b]	.54[b]	.50[b]	.01	-.19[a]	-.18
17. Gr.10 Fl	--	--	.32[a]	.30[a]	.40[b]	.28[a]	--	--	.41[b]	.46[b]	.55[b]	.41[a]	--	--	.63[b]	.72[b]	--	.72[b]	--	--	.51[b]	.63[b]	.73[b]	.61[b]	-.04	-.13	-.01
18. Gr.10 Spr	--	--	.33[a]	.33[a]	.31[a]	.43[b]	--	--	.41[a]	.50[b]	.35[a]	.55[b]	--	--	.60[b]	.63[b]	.64[b]	--	--	--	.43[b]	.53[b]	.63[b]	.73[b]	.12	.05	-.19
Attainment value																											
19. Gr.8 Fl	.39[b]	.25[a]	.35[a]	.39[a]	--	--	.53[b]	.34[a]	.39[a]	.27	--	--	.67[b]	.41[b]	.43[a]	.45[a]	--	--	--	.41[b]	.44[a]	.20	--	--	.29[a]	.20	.05
20. Gr.8 Spr	.14	.28[a]	.37[a]	.45[a]	--	--	.31[a]	.50[b]	.38[a]	.43[a]	--	--	.48[b]	.64[b]	.67[b]	.56[b]	--	--	.56[b]	--	.42[a]	.26	--	--	.20	.02	.13
21. Gr.9 Fl	.23	.25	.45[b]	.40[b]	.17	.42[a]	.35[a]	.41[a]	.64[b]	.49[b]	.38[a]	.56[b]	.45[a]	.59[b]	.71[b]	.50[b]	.37[a]	.45[b]	.46[a]	.71[b]	--	.61[b]	.45[b]	.46[b]	-.06	.05	-.10
22. Gr.9 Spr	-.02	.10	.41[b]	.57[b]	.26[a]	.35[a]	.33[a]	.30	.42[b]	.73[b]	.45[b]	.54[b]	.37[a]	.47[a]	.45[b]	.69[b]	.46[b]	.41[b]	.49[a]	.56[b]	.59[b]	--	.67[b]	.66[b]	.10	.01	-.19
23. Gr.10 Fl	--	--	.43[b]	.40[b]	.42[b]	.44[b]	--	--	.47[b]	.61[b]	.72[b]	.55[b]	--	--	.45[b]	.60[b]	.75[b]	.49[b]	--	--	.58[b]	.71[b]	--	.76[b]	.05	.01	-.17
24. Gr.10 Spr	--	--	.40[a]	.52[b]	.38[a]	.48[b]	--	--	.53[b]	.65[b]	.45[b]	.70[b]	--	--	.56[b]	.63[b]	.50[b]	.74[b]	--	--	.69[b]	.55[b]	.57[b]	--	.19	.10	-.17
Background variables																											
25. Math Ach	.26[a]	.32[a]	.15	.25[a]	.20	-.06	-.11	-.05	.03	.18[a]	.06	.07	-.15	-.07	.06	.16	.15	-.02	.03	.05	-.01	.11	.04	.09	--	.12	.00
26. Math Crs	.19	.15	.08	.13	.07	.04	.07	.08	.16	.09	.11	.08	-.06	-.06	-.08	-.13	-.08	-.09	.16	.15	.10	-.02	.01	.12	.13	--	.09
27. Parent Ed	.11	.13	.21[a]	.15	.22	.18	.04	.04	.31[a]	.22[a]	.09	.14	.00	.05	.22[a]	.20[a]	.17	.18	.13	.27[a]	.26[a]	.25[a]	.19	.25	.08	.11	--

Note. Fl = Fall, Spr = Spring, Math ach = Math prior achievement, Math Crs = Math Course, Parent Ed = Parent's education level. Correlations for female sample are presented above the diagonal, and correlations for male sample are presented below the diagonal. The correlations between Grade 8 and Grade 10 motivational beliefs are missing due to the cross-cohort design of the dataset.
a = $p < .05$. b = $p < .001$.

Table 1.S5

Bivariate Correlations for the Latinx Male (Below the Diagonal) & Female (Above the Diagonal) Groups

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Expectancies for success																											
1. Gr.8 Fl	--	.58[b]	.48[b]	.43[b]	--	--	.62[b]	.48[b]	.44[b]	.42[b]	--	--	.41[b]	.27[b]	.18[a]	.15[a]	--	--	.57[b]	.38[b]	.35[b]	.28[b]	--	--	.20[b]	.12[a]	.00
2. Gr.8 Spr	.50[b]	--	.60[b]	.48[b]	--	--	.46[b]	.59[b]	.48[b]	.41[b]	--	--	.29[b]	.43[b]	.31[b]	.23[b]	--	--	.38[b]	.51[b]	.45[b]	.35[b]	--	--	.25[b]	.03	.00
3. Gr.9 Fl	.48[b]	.63[b]	--	.62[b]	.46[b]	.48[b]	.44[b]	.53[b]	.59[b]	.42[b]	.35[b]	.33[b]	.22[b]	.22[b]	.38[b]	.28[b]	.20[b]	.25[b]	.36[b]	.41[b]	.53[b]	.40[b]	.28[b]	.31[b]	.24[b]	.17[b]	.00
4. Gr.9 Spr	.28[b]	.42[b]	.54[b]	--	.57[b]	.55[b]	.37[b]	.41[b]	.43[b]	.60[b]	.43[b]	.40[b]	.21[a]	.17[a]	.25[b]	.43[b]	.30[b]	.34[b]	.31[b]	.34[b]	.36[b]	.52[b]	.31[b]	.36[b]	.25[b]	.15[b]	-.03
5. Gr.10 Fl	--	--	.47[b]	.62[b]	--	.64[b]	--	--	.32[b]	.36[b]	.57[b]	.44[b]	--	--	.29[b]	.30[b]	.44[b]	.34[b]	--	--	.27[b]	.31[b]	.43[b]	.34[b]	.20[b]	.14[a]	.05
6. Gr.10 Spr	--	--	.41[b]	.48[b]	.64[b]	--	--	--	.41[b]	.38[b]	.50[b]	.66[b]	--	--	.24[b]	.26[b]	.36[b]	.49[b]	--	--	.34[b]	.29[b]	.39[b]	.53[b]	.28[b]	.10	.03
Interest																											
7. Gr.8 Fl	.55[b]	.37[b]	.35[b]	.26[b]	--	--	--	.73[b]	.63[b]	.53[b]	--	--	.43[b]	.37[b]	.30[b]	.30[b]	--	--	.63[b]	.50[b]	.45[b]	.38[b]	--	--	.19[b]	.13[a]	-.11
8. Gr.8 Spr	.31[b]	.49[b]	.40[b]	.32[b]	--	--	.61[b]	--	.79[b]	.68[b]	--	--	.27[b]	.46[b]	.37[b]	.34[b]	--	--	.46[b]	.64[b]	.54[b]	.43[b]	--	--	.12[a]	.04	-.09
9. Gr.9 Fl	.36[b]	.35[b]	.56[b]	.37[b]	.30[b]	.30[b]	.62[b]	.72[b]	--	.69[b]	.53[b]	.49[b]	.23[b]	.38[b]	.49[b]	.37[b]	.24[b]	.30[b]	.40[b]	.52[b]	.63[b]	.48[b]	.33[b]	.39[b]	.16[b]	.14[b]	-.07
10. Gr.9 Spr	.24[b]	.34[b]	.34[b]	.55[b]	.36[b]	.33[b]	.49[b]	.63[b]	.63[b]	--	.67[b]	.59[b]	.17[a]	.33[b]	.35[b]	.52[b]	.36[b]	.41[b]	.36[b]	.45[b]	.45[b]	.64[b]	.41[b]	.49[b]	.16[b]	.14[b]	.13[b]
11. Gr.10 Fl	--	--	.35[b]	.37[b]	.50[b]	.42[b]	--	--	.56[b]	.64[b]	--	.66[b]	--	--	.33[b]	.37[b]	.51[b]	.42[b]	--	--	.38[b]	.44[b]	.60[b]	.50[b]	.14[a]	.09	-.06
12. Gr.10 Spr	--	--	.36[b]	.34[b]	.38[b]	.51[b]	--	--	.50[b]	.59[b]	.71[b]	--	--	--	.28[b]	.33[b]	.36[b]	.52[b]	--	--	.36[b]	.43[b]	.45[b]	.69[b]	.17[b]	.02	.00
Utility value																											
13. Gr.8 Fl	.48[b]	.32[b]	.18[a]	.13	--	--	.49[b]	.33[b]	.23[b]	.21[a]	--	--	--	.56[b]	.40[b]	.30[b]	--	--	.66[b]	.43[b]	.37[b]	.25[b]	--	--	.07	.03	.01
14. Gr.8 Spr	.22[b]	.45[b]	.32[b]	.19[a]	--	--	.34[b]	.52[b]	.35[b]	.32[b]	--	--	.46[b]	--	.68[b]	.52[b]	--	--	.46[b]	.66[b]	.49[b]	.41[b]	--	--	.00	-.05	-.09
15. Gr.9 Fl	.24[b]	.29[b]	.48[b]	.23[b]	.24[b]	.15[a]	.30[b]	.37[b]	.52[b]	.28[b]	.30[b]	.25[b]	.37[b]	.56[b]	--	.59[b]	.52[b]	.45[b]	.31[b]	.48[b]	.65[b]	.42[b]	.43[b]	.33[b]	.02	.03	-.06
16. Gr.9 Spr	.20[a]	.22[b]	.29[b]	.42[b]	.29[b]	.21[b]	.24[b]	.31[b]	.39[b]	.49[b]	.37[b]	.34[b]	.38[b]	.46[b]	.54[b]	--	.66[b]	.59[b]	.29[b]	.40[b]	.42[b]	.65[b]	.48[b]	.41[b]	.01	.03	-.16[b]
17. Gr.10 Fl	--	--	.23[b]	.33[b]	.47[b]	.32[b]	--	--	.37[b]	.41[b]	.52[b]	.40[b]	--	--	.42[b]	.60[b]	--	.66[b]	--	--	.40[b]	.49[b]	.70[b]	.49[b]	.02	-.03	-.10[a]
18. Gr.10 Spr	--	--	.22[b]	.21[b]	.33[b]	.46[b]	--	--	.30[b]	.34[b]	.37[b]	.53[b]	--	--	.35[b]	.49[b]	.62[b]	--	--	--	.38[b]	.46[b]	.50[b]	.65[b]	.10[a]	.03	-.11[a]
Attainment value																											
19. Gr.8 Fl	.56[b]	.36[b]	.29[b]	.19[a]	--	--	.64[b]	.44[b]	.38[b]	.26[b]	--	--	.70[b]	.39[b]	.37[b]	.33[b]	--	--	--	.60[b]	.51[b]	.44[b]	--	--	.09	.05	-.01
20. Gr.8 Spr	.28[b]	.49[b]	.36[b]	.28[b]	--	--	.41[b]	.64[b]	.47[b]	.44[b]	--	--	.43[b]	.67[b]	.49[b]	.41[b]	--	--	.55[b]	--	.68[b]	.60[b]	--	--	-.05	-.03	-.10
21. Gr.9 Fl	.36[b]	.41[b]	.53[b]	.30[b]	.27[b]	.24[b]	.41[b]	.52[b]	.65[b]	.38[b]	.39[b]	.37[b]	.34[b]	.48[b]	.70[b]	.43[b]	.37[b]	.33[b]	.49[b]	.68[b]	--	.63[b]	.56[b]	.51[b]	.03	.08[a]	-.08[a]
22. Gr.9 Spr	.22[b]	.33[b]	.32[b]	.52[b]	.34[b]	.29[b]	.34[b]	.47[b]	.46[b]	.66[b]	.50[b]	.43[b]	.26[b]	.42[b]	.41[b]	.68[b]	.50[b]	.39[b]	.37[b]	.61[b]	.55[b]	--	.68[b]	.63[b]	.08[a]	-.11[a]	-.15[b]
23. Gr.10 Fl	--	--	.25[b]	.39[b]	.44[b]	.31[b]	--	--	.36[b]	.49[b]	.66[b]	.50[b]	--	--	.31[b]	.47[b]	.69[b]	.41[b]	--	--	.45[b]	.66[b]	--	.69[b]	.05	.01	-.06
24. Gr.10 Spr	--	--	.30[b]	.30[b]	.37[b]	.50[b]	--	--	.33[b]	.41[b]	.49[b]	.69[b]	--	--	.27[b]	.39[b]	.51[b]	.68[b]	--	--	.43[b]	.55[b]	.59[b]	--	-.11[a]	.04	-.02
Background variables																											
25. Math Ach	.32[b]	.34[b]	.31[b]	.27[b]	.20[b]	.16[a]	.15[a]	.12[a]	-.11[a]	.13[b]	.06	.07	-.11[a]	.06	.02	.05	.05	.00	.12[a]	.06	.05	.05	.03	.08	--	.08[a]	.03
26. Math Crs	.10[a]	.01	.09[a]	.09[a]	.15[a]	.15[a]	-.11[a]	.08	.12[a]	.10[a]	.08	.06	.02	.03	.05	.06	.10	.10	.06	-.01	.10[a]	.06	.05	.09	.05	--	. 08[a]
27. Parent Ed	-.01	.11	.05	.01	-.02	-.03	-.02	.04	.01	.00	-.07	-.08	.01	.02	.00	-.03	-.03	-.07	.05	.07	.05	-.01	-.08	.00	.10[a]	. 03	--

Note. Fl = Fall, Spr = Spring, Math ach = Math prior achievement, Math Crs = Math Course, Parent Ed = Parent's education level. Correlations for female sample are presented above the diagonal, and correlations for male sample are presented below the diagonal. The correlations between Grade 8 and Grade 10 motivational beliefs are missing due to the cross-cohort design of the dataset.
a = $p < .05$. b = $p < .001$.

Table 1.S6

Fit Indices of the Linear Trajectory for Each Motivational Belief

Model	χ^2	*df*	*p*	RMSEA	90% CI	CFI	TLI
Expectancies for success							
No growth	231.77	20	< .001	.063	.055-.070	.909	.950
Linear	**179.69**	**17**	**< .001**	**.059**	**.052-.067**	**.930**	**.955**
Interest							
No growth	345.51	20	< .001	.077	.070-.085	.900	.945
Linear	**137.45**	**17**	**< .001**	**.051**	**.043-.059**	**.963**	**.976**
Utility value							
No growth	778.85	20	< .001	.118	.111-.126	.684	.826
Linear	**139.61**	**17**	**< .001**	**.052**	**.044-.060**	**.949**	**.967**
Attainment value							
No growth	666.66	20	< .001	.109	.102-.116	.763	.869
Linear	**199.09**	**17**	**< .001**	**.063**	**.055-.071**	**.933**	**.957**

Note. Bold indicates the selected model.

Table 1.S7

Intercept and Slope of Classes From the Final GMM Model for Each Motivational Belief

	M (*S.E*)	*M* (*S.E*)	*M* (*S.E*)	*M* (*S.E*)	*M* (*S.E*)
Expectancies for success					
	High and Stable (n = 1,549)	Moderate and Stable (n = 1,161)			
Intercept[a]	3.58 (.10)***	2.79 (.07)***			
Slope[b]	-.10 (.07)	.08 (.10)			
Interest					
	Low and Stable (n = 1,089)	Moderate and Stable (n = 864)	High with Small Decreases (n = 342)	Moderate with Large Decreases (n = 283)	Moderate with Increases (n = 132)
Intercept[c]	1.74 (.04)***	2.92 (.05)***	4.17 (.07)***	2.62 (.15)***	3.04 (.28)***
Slope[†]	-.05 (.03)	-.11 (.06)	-.17 (.06)**	-.98 (.07)***	1.07 (.19)***
Utility Value					
	High with Moderate Decreases (n = 1,064)	High with Small Decreases (n = 1,007)	Moderate and Stable (n = 232)	High with Increases (n = 223)	Moderate with Large Decreases (n = 184)
Intercept[d]	3.46 (.05)***	4.31 (.04)***	2.61 (.08)***	3.66 (.07)***	2.33 (.19)***
Slope[†]	-.48 (.03)***	-.08 (.02)***	-.10 (.15)	.41 (.13)**	-.95 (.19)***
Attainment Value					
	Moderate with Decreases (n = 1,732)	High and Stable (n = 915)	Moderate with Increases (n = 63)		
Intercept[e]	2.56 (.05)***	3.57 (.06)***	3.38 (.16)***		
Slope[f]	-.37 (.03)***	-.10 (.06)	1.05 (.13)***		

Note. Intercept at Spring of Grade 9. Variance was constrained to be equal across classes. [†]Variance was set to .001 for model convergence. [a]Variance = .29, $p < .001$. [b]Variance = .10, $p < .001$. [c]Variance = .12, $p < .001$. [d]Variance = .06, $p < .001$. [e]Variance = .28, $p < .001$. [f]Variance = .03, $p < .10$.
*$p < .05$. **$p < .01$. ***$p < .001$.

Table 1.S8

Logistic Regression Results Predicting Trajectories of Expectancies for Success by Race/Ethnicity and Gender Without Covariates

	Reference group = Moderate and Stable High and Stable
Predictors	β (SE)
Compared to Asian male adolescents	
Asian female adolescents	.88 (.61)
Latino adolescents	**-1.44 (.42)****
Latina adolescents	**-2.05 (.52)*****
Compared to Asian female adolescents	
Asian male adolescents	-.88 (.61)
Latino adolescents	-.56 (.35)
Latina adolescents	**-1.17 (.35)****
Compared to Latino adolescents	
Asian male adolescents	**1.44 (.52)****
Asian female adolescents	.56 (.35)
Latina adolescents	**-.61 (.17)*****

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

Table 1.S9

Logistic Regression Results Predicting Trajectories of Interest by Race/Ethnicity and Gender Without Covariates

	Reference group = Moderate with Large Decreases			
	Low and Stable	Moderate and Stable	High with Small Decreases	Moderate with Increases
Predictors	β (SE)	β (SE)	β (SE)	β (SE)
Compared to Asian male adolescents				
Asian female adolescents	-1.19 (.77)	-1.12 (.85)	**-1.82 (.85)***	-.41 (1.46)
Latino adolescents	.20 (.70)	-.42 (.77)	-.81 (.73)	.43 (1.29)
Latina adolescents	.42 (.71)	-.47 (.78)	-.39 (.73)	.78 (1.29)
Compared to Asian female adolescents				
Asian male adolescents	1.19 (.77)	1.12 (.85)	**1.82 (.85)***	.41 (1.46)
Latino adolescents	**1.40 (.46)****	.71 (.53)	1.02 (.59)	.84 (.84)
Latina adolescents	**1.61 (.47)****	.65 (.55)	**1.44 (.59)***	1.19 (.83)
Compared to Latino adolescents				
Asian male adolescents	-.20 (.70)	.42 (.77)	.81 (.73)	-.43 (1.29)
Asian female adolescents	**-1.40 (.46)****	-.71 (.53)	-1.02 (.59)	-.84 (.84)
Latina adolescents	.22 (.34)	-.06 (.41)	.42 (.39)	.35 (.50)

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

Table 1.S10

Logistic Regression Results Predicting Trajectories of Utility Value by Race/Ethnicity and Gender Without Covariates

	Reference group = High with Moderate Decreases			
	High with Small Decreases	Moderate and Stable	High with Increases	Moderate with Large Decreases
Predictors	β (SE)	β (SE)	β (SE)	β (SE)
Compared to Asian male adolescents				
Asian female adolescents	.27 (.39)	-.21 (.73)	-4.17 (16.50)	-.43 (1.21)
Latino adolescents	-.01 (.32)	-.03 (.56)	-.34 (.61)	.39 (.80)
Latina adolescents	.38 (.32)	.18 (.56)	-.47 (.63)	.59 (.80)
Compared to Asian female adolescents				
Asian male adolescents	-.27 (.39)	.21 (.73)	4.17 (16.50)	.43 (1.21)
Latino adolescents	-.27 (.28)	.18 (.56)	3.83 (16.49)	.82 (.98)
Latina adolescents	.11 (.28)	.39 (.56)	3.70 (16.49)	1.02 (.98)
Compared to Latino adolescents				
Asian male adolescents	.01 (.32)	.03 (.56)	.34 (.61)	-.39 (.80)
Asian female adolescents	.27 (.28)	-.18 (.56)	-3.83 (16.49)	-.82 (.98)
Latina adolescents	**.38 (.17)***	.21 (.31)	-.14 (.43)	.20 (.35)

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

Table 1.S11

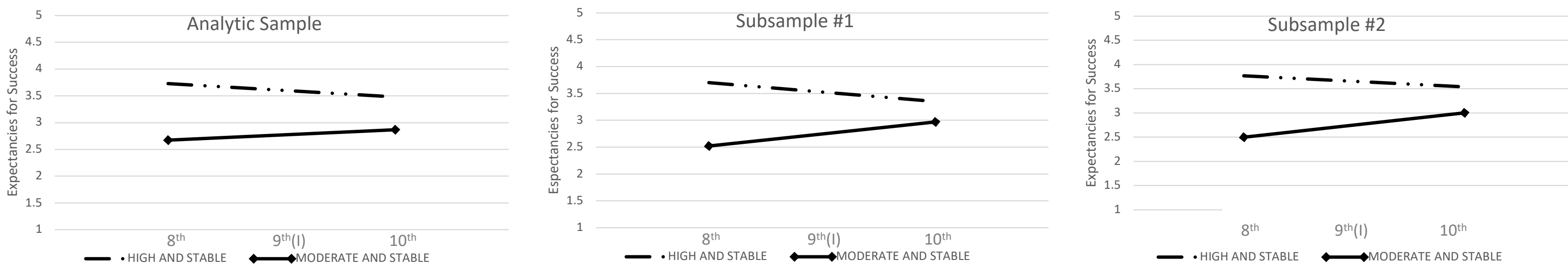
Logistic Regression Results Predicting Trajectories of Attainment Value by Race/Ethnicity and Gender Without Covariates

	Reference group = Moderate with Decreases	
	Moderate with Increases	High and Stable
Predictors	β (SE)	β (SE)
Compared to Asian male adolescents		
Asian female adolescents	**16.38 (2.87)*** **	-.03 (.38)
Latino adolescents	**17.73 (.63)*** **	-.46 (.29)
Latina adolescents	**17.83 (.29)*** **	-.33 (.29)
Compared to Asian female adolescents		
Asian male adolescents	**-16.38 (2.84)*** **	.03 (.38)
Latino adolescents	1.35 (2.86)	-.42 (.30)
Latina adolescents	1.45 (2.86)	-.30 (.30)
Compared to Latino adolescents		
Asian male adolescents	**-17.73 (.42)*** **	.46 (.29)
Asian female adolescents	-1.35 (2.86)	.42 (.30)
Latina adolescents	.10 (.55)	.12 (.17)

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

Figure 1.S1

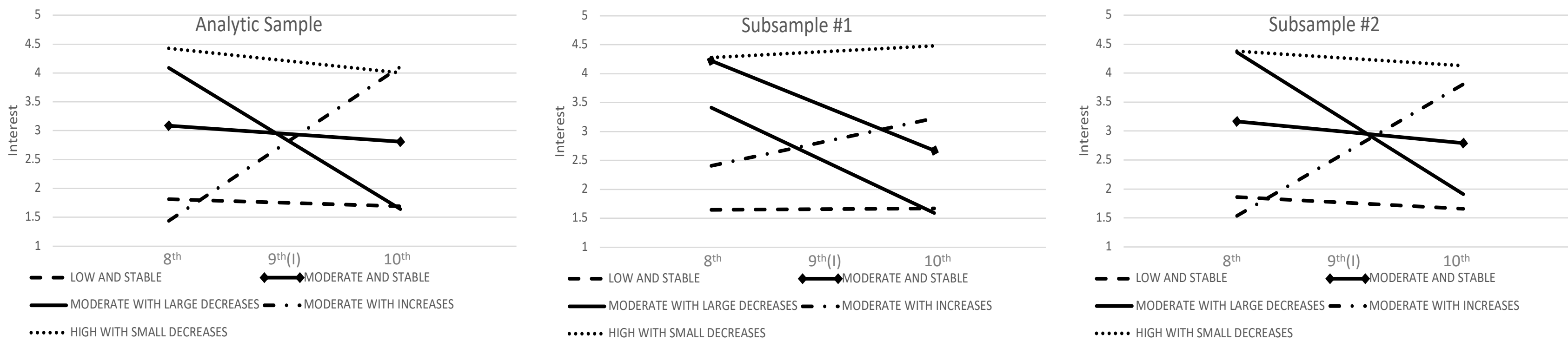
Comparison With Two Random Subsamples for Expectancies for Success



Note. I = Intercept at Spring of Grade 9.

Figure 1.S2

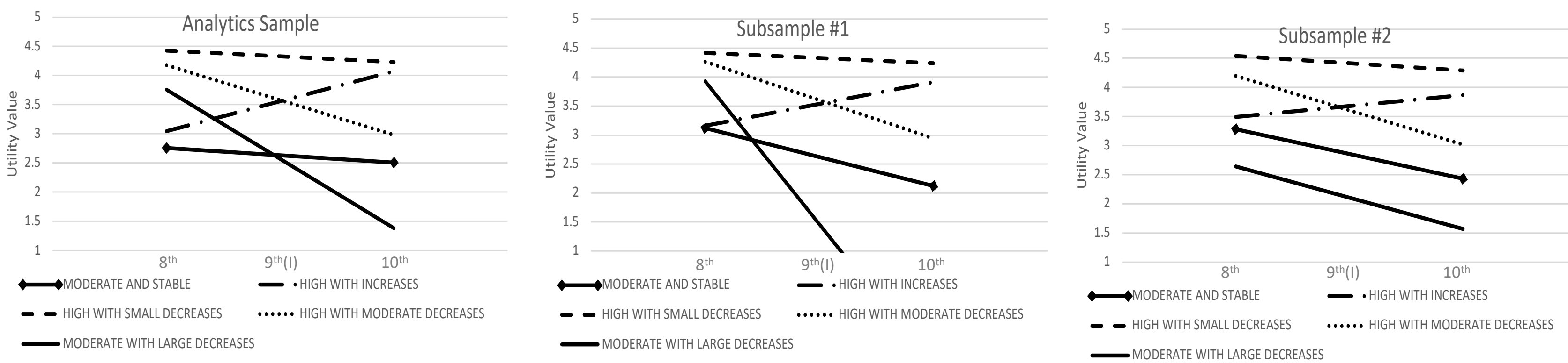
Comparison With Two Random Subsamples for Interest



Note. I = Intercept at Spring of Grade 9.

Figure 1.S3

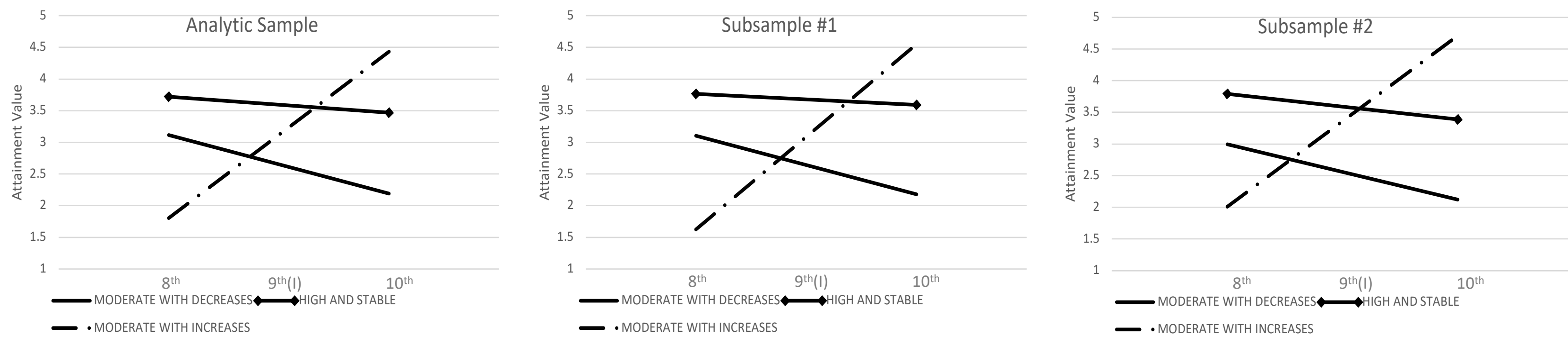
Comparison With Two Random Subsamples for Utility Value



Note. I = Intercept at Spring of Grade 9.

Figure 1.S4

Comparison With Two Random Subsamples for Attainment Value



Note. I = Intercept at Spring of Grade 9.

CHAPTER 3

The Changes in Math Motivational Beliefs Across High School by Race/Ethnicity: The Role of Teachers and Parents

Abstract

The changes in adolescents' math motivational beliefs (i.e., expectancies for success, interest, and utility value) across Grades 9 to 11 and the associations between these changes and adolescents' experiences with socializers (i.e., perceived teacher unfairness and parent socialization) were examined in four racial/ethnic groups (*N* = 19,010; 50% female; 62% White; 9% Asian; 18% Latinx; 11% Black; M_{age} = 14.53 in Grade 9). Latent transition analyses suggested that the changes varied across adolescents' motivational beliefs in all racial/ethnic groups. For expectancies for success, many students either maintained their high or low expectancies across Grades 9 to 11. For interest, many students maintained their high or low interest or switched from high to low interest by Grade 11. For utility value, many students maintained their high values or switched from low to high values by Grade 11. Parent socialization predicted positive changes among Latinx and Asian students whereas perceived teacher unfairness predicted negative changes among Black students. The findings from the present study highlight the diverse patterns of changes in adolescents' motivational beliefs and the potential role of socializers as sources of strength or challenge.

Keywords: Expectancy-value theory, motivation, math, race/ethnicity, parents, teachers

The Changes in Math Motivational Beliefs Across High School by Race/Ethnicity: The Role of Teachers and Parents

Introduction

Latinx and Black individuals continue to be underrepresented relative to White and Asian individuals in most math-intensive Science, Technology, Engineering, and Math (STEM) fields, including college majors and occupations (NSF, 2019). Even in high school, Latinx and Black students, on average, typically perform 10% lower on standardized tests in math compared to White and Asian students (NCES, 2015). Given that math motivational beliefs in high school are directly associated with their subsequent math performance and STEM outcomes, such as STEM course-taking, college majors, or career choices, examining math motivational belief processes in diverse racial/ethnic groups during high school is important to address some of the racial/ethnic gaps that persist in STEM (Hsieh et al., 2022; Seo et al., 2019).

Prior literature has frequently concentrated on comparisons across race/ethnicity, which often reinforce the challenges faced by marginalized groups and position Black and Latinx students from a deficit perspective (Causadias et al., 2018). However, a few recent studies that focused on each racial/ethnic group separately highlight variability in adolescents' motivational belief development and that not all marginalized students have low motivational beliefs in STEM, including math (e.g., Hsieh et al., 2022; Puente et al., 2021). For example, varying trends, such as decreasing and stable trends, were identified in motivational beliefs among racial/ethnic minority students (Hsieh et al., 2021; Starr, Carranza, Simpkins, 2022; Umarji et al., 2021). Identifying variability in students' math motivational belief development within racial/ethnic identities is important to describe the strengths experienced by marginalized groups.

Students' motivational beliefs are shaped by their immediate environment, including their interactions with socializers, such as teachers and parents (Eccles & Wigfield, 2020). For example, students who are racially/ethnically marginalized in math may encounter more structural barriers, such as more unfair treatment from their teachers, and, as a result, decrease in their motivational beliefs (Roeser et al., 2000; Wong et al., 2003). Conversely, STEM-related support from parents may help students maintain or increase their motivational beliefs and persist in STEM (Choi et al., 2015; McGee & Spencer, 2015; Starr, Ramos, & Simpkins, 2022). However, individuals who identify with the same racial/ethnic group may also vary dramatically in terms of their experiences with their socializers which can lead to varying changes in their motivational beliefs (e.g., Causadias et al., 2018; Simpkins et al., 2015a). By examining the associations between adolescents' experiences and their motivational beliefs within race/ethnicity, we will be able to identify the potential role of socializers as sources of strength or challenge for adolescents.

There is a need to explore how social contexts influence students' motivational belief development by race/ethnicity (e.g., Parker et al., 2020). Particularly, more studies are needed to understand the promotive role of families because families can be important agents that help racial/ethnic minority students overcome inequity experiences (Umaña-Taylor & Hill, 2020). In addition, examining the social contexts that challenge or reaffirm negative stereotypes will help address the need to increase awareness of the consequences of unjust experiences in adolescence among psychologists and practitioners (Killen et al., 2016). Therefore, this study was conducted to examine the changes in adolescents' motivational beliefs during high school in four different racial/ethnic groups (i.e., Asian, Latinx, Black, White), and investigate the potential hindering role of experiencing injustice in academic settings (i.e., perceived teacher unfairness) and the promotive role of parental support (i.e., parent socialization) on students' math motivational belief development.

Theoretical Framework

Situated expectancy-value theory posits that students' academic performance and choices are directly influenced by their motivational beliefs, specifically their expectancies for success, and subjective task values, such as interest (i.e., enjoyment of the task), and utility value (i.e., perceived usefulness of the task; Eccles, 2009; Eccles & Wigfield, 2020). During adolescence, when students mature and become more conscious of their identity and skillsets, their motivational beliefs are likely to change (Eccles & Wigfield, 2020). Not only do these beliefs become more concrete, but they also change as students work to align their identities and goals with the societal roles or expectations toward them. Subsequently, adolescents' beliefs about their ability to do well in math or math-related values in high school are associated with their later STEM outcomes, such as math course-taking and achievement in high school as well as selection into STEM college majors or occupations (Guo et al., 2015; Hsieh et al., 2022; Jiang et al., 2020; Seo et al., 2019; Simpkins et al., 2015a; Wang et al., 2015).

According to situated expectancy-value theory, students' motivational beliefs are shaped by their immediate settings and the broader cultural milieu, which includes societal stereotypes and beliefs (Eccles & Wigfield, 2020; Wigfield & Eccles, 2020). The societal expectations of the cultural milieu are communicated to students through their interactions with central socializers, including parents and teachers. Though adolescence is often characterized as a time when parents play a minimal role in their development, adolescents have been found to seek adults, such as parents, when they make important academic decisions (Harackiewicz et al., 2012; Hill & Tyson, 2009). Even among those who have been marginalized in math due to their race/ethnicity, parent and teacher supports positively predict adolescents' STEM motivational beliefs (Starr, Ramos, & Simpkins, 2022; Starr, Tulagan, & Simpkins, 2022). Receiving positive messages about their ability in math likely promotes students' motivational beliefs whereas the messages that doubt their ability should have the opposite effect. Thus, adolescents' math motivational beliefs could change in positive or negative ways depending on their interactions with socializers (Starr, Ramos, & Simpkins, 2022).

Historically, societal stereotypes about math suggest it is a White, Asian, masculine domain and that Latinx, Black, and female students display lower math performance compared to White, Asian, and male students (Else-Quest et al., 2013; Joseph et al., 2019). These stereotypes are likely to result in students who are racially/ethnically marginalized in math to encounter more negative social experiences that convey these negative stereotypes, which may result in negative math outcomes (e.g., Wang & Degol, 2017). For example, teachers' explicit and implicit differential treatment has been negatively associated with students' academic performance (McKown, 2013). That is, the signals from teachers that infer negatively stereotyped expectations (e.g., differential treatment of other students that share the same racial/ethnic identity) can negatively influence students' performance by triggering their lack of belongingness in the classroom. Roeser and colleagues' (1998) school psychological environment model demonstrates that students' perceived quality of relationships (i.e., discrimination experiences and teacher supportiveness) influences their motivational belief development. For example, students who perceived their teachers to treat them unfairly or disrespectfully due to their gender or race/ethnicity were found to endorse lower academic values (Roeser et al., 2000). Thus, adolescents who are racially/ethnically marginalized in math may be more likely to display negative than positive motivational belief development due to perceiving their teachers to be more unfair toward them compared to others.

However, adolescents who receive appropriate support may be able to overcome such challenges and display positive motivational belief development in math (McGee & Spencer, 2015). Eccles' (1993) parent socialization model describes that parents' specific behaviors, such as career guidance and communication about their expectations for their children, foster students' motivational beliefs. Similarly, resilience theory suggests that parental involvement can function as a resource that promotes positive development in students (Fergus & Zimmerman, 2005; Zimmerman et al., 2013). The theory also stresses that parental involvement can function as a protective factor when adolescents encounter academic challenges (Rutter, 1987; Zimmerman et al., 2013). In other words, parent socialization could be a resource adolescents draw on to overcome the structural barriers and experience fewer negative consequences (Chen & Gregory, 2009; Zimmerman et al., 2013). Likewise, receiving STEM socialization may promote positive math motivational belief development as well (Starr, Ramos, & Simpkins, 2022). Adolescents who experience parent socialization in STEM may be more likely to display positive motivational belief development (e.g., high stability) despite encountering structural barriers.

Developmental Changes in Motivational Beliefs

Historically, the research suggests that students' motivational beliefs tend to decrease from childhood to adolescence (Fredricks & Eccles, 2002; Jacobs et al., 2002; Watt, 2004). The recent work focused on adolescence, however, suggests the trends may vary across students. Some studies continue to find a decreasing trend (e.g., Nagy et al., 2010) whereas other studies suggest adolescents' math motivational beliefs may be stable during adolescence (e.g., Petersen

& Hyde, 2017). Additionally, studies that tested whether qualitatively different patterns emerged in students' motivational belief development suggest some adolescents' beliefs decrease whereas others' beliefs increase or are stable (e.g., Gaspard et al., 2020; Guo et al., 2018; Lee et al., 2023). Scholars have found that the trends not only differ across students, but also may differ across various motivational beliefs (i.e., expectancies for success, interest, or utility value; Petersen & Hyde, 2017; Safavian & Conley, 2016). For example, whereas interest was found to decrease over time, the level of expectancies for success did not change much (Petersen & Hyde, 2017). Most prior studies on motivational belief development involved White populations and are limited in explaining the processes in more diverse populations (e.g., Fredricks & Eccles, 2002; Jacobs et al., 2002; Watt, 2004). One study that tested the development among predominantly Latinx and Asian students found similar decreasing patterns for subjective task values but a slight increase in expectancies for success across adolescence (Umarji et al., 2021). There is a need for more studies that examine the developmental trends in each of the motivational beliefs among racial/ethnic minority groups.

Theoretically, students who are historically privileged in math (i.e., Asian and White students) should be more likely to display positive motivational belief development (e.g., maintaining high motivation) compared to students marginalized in math (i.e., Black and Latinx students) who are likely to display negative motivational belief development (e.g., switching from high to low motivation). These varying patterns may be observed during adolescence as students begin to develop a better awareness of the stereotypes and the cultural norms that exist toward their race/ethnicity (Brown & Bigler, 2005; Garcia Coll et al., 1996; Wang & Degol, 2013). For those marginalized in math, their more concrete perceptions of the negative stereotypes may lead to experiences of higher identity threats and to negative academic consequences (Baysu et al., 2016; Ruck et al., 2011).

Not all students may decrease in their motivational beliefs; a few studies have noted increasing or stable patterns among mostly White participants (e.g., Gaspard et al., 2020; Guo et al., 2018; Petersen & Hyde, 2017). These more positive motivational belief developmental patterns, however, have been seldom discussed in the literature let alone the factors that may contribute to the varying patterns of development. Though less research has been conducted to test math motivational belief development among marginalized groups, one recent study found that many students across racial/ethnic groups maintained overall high motivational beliefs over time rather than decrease (Hsieh & Simpkins, 2022). Similarly, some adolescents from diverse racial/ethnic backgrounds were found to not only maintain STEM career expectations, but also switch from Non-STEM to STEM career expectations across Grades 9 to 11 (Starr, Ramos, & Simpkins, 2022). The same study also noted that parent and teacher supports helped students maintain STEM expectations. In this study, we extended these prior studies by testing whether there are varying patterns of motivational belief development in diverse racial/ethnic groups to highlight the potential variations in these processes within each race/ethnicity and the academic experiences that may hinder or foster students' motivational beliefs.

Perceived Teacher Unfairness

The negative consequences of perceived teacher unfairness have been noted in studies across race/ethnicity (Lee & Simpkins, 2021; Wong et al., 2003). Using the same dataset as this study, studies have displayed the negative influence of perceived teacher unfairness on students' math motivational beliefs and performance (Lee & Simpkins, 2021; Shifrer et al., 2023). Particularly, Shifrer and colleagues (2023) found that students' perceived equitable treatment from their teachers in Grade 9 was positively associated with their concurrent math motivational beliefs regardless of students' race and gender. This study not only demonstrates the importance of understanding the role of perceived teacher unfairness but also the potential negative impacts of unfair treatment that do not necessarily involve explicit discrimination based on race/ethnicity or gender. Nevertheless, this study combined all motivational beliefs into one construct and only tested the associations cross-sectionally at Grade 9. We extended this work by testing whether perceived teacher unfairness predicted concurrent as well as changes in students' motivational beliefs in math (i.e., expectancies for success, interest, and utility value) across high school.

Social equity theory suggests that the social processes in school, such as negative relations with their teachers experienced by marginalized groups, contribute to racial-ethnic gaps (McKown, 2013). Black adolescents' experiences of teacher unfairness in school were found to predict lower expectancies for success and subjective task value beliefs in academics in Grade 8 students (Wong et al., 2003). Also, experiencing unfairness from others, including from their teachers, was associated with lower academic performance in Latinx and Black high school students (Faircloth & Hamm, 2005). In order to address the racial/ethnic gaps that remain in STEM (NSF, 2019), it will be important to understand students' experiences with their teachers among those who are marginalized in math (i.e., Black and Latinx adolescents), because theoretically, they may perceive more teacher unfairness and display lower or decreases in their math motivational beliefs.

Parent Socialization

Parent socialization is another important predictor of students' academic functioning, including their motivational belief development (Eccles, 1993; Eccles & Wigfield, 2020). Adolescents' conversations with their parents about their academic plans, such as selecting courses, were found to increase students' expectancies for success in math, which in turn led to higher math performance in racially/ethnically diverse students in Grade 10 (Choi et al., 2015). In one longitudinal study with predominantly White youth ages 9 to 17, parents' expectations and communication with their children about academics predicted higher math interest concurrently at age nine as well as smaller decreases in adolescents' math interest over time (Gottfried et al., 2009).

Given the strong associations between parent socialization and students' motivational beliefs, parent socialization may function as a source of resilience and protect marginalized adolescents when facing structural barriers (Chen & Gregory, 2009; Zimmerman et al., 2013). For example, parental support was protective for adolescents with low perceived competence when they encountered teacher unfairness in math (Lee & Simpkins, 2021). Additionally, there is strong evidence that parents' STEM support is associated with fostering students' motivational beliefs in math (i.e., Latinx and Black students; Starr, Tulagan, & Simpkins, 2022). One qualitative study involving high-achieving Black students in STEM college majors demonstrated that students' discussions with parents about educational struggles and future academic success helped them to continue challenging themselves academically (McGee & Spencer, 2015). Also, parent socialization was found to positively predict Latinx adolescents' motivational beliefs, and their determination to persevere through challenges (Kuperminc et al., 2008; Suizzo et al., 2012). Given the strong positive associations between parent socialization and the motivational belief development of students marginalized in math, these adolescents may display less negative motivation development if they talk to their parents about their academic experiences in math. Parent socialization may be a resource that helps adolescents to maintain high motivational beliefs or increase in their motivational beliefs.

The Current Study

According to situated expectancy-value theory, students' motivational beliefs are shaped by their developmental processes and socio-cultural environmental influences (Eccles & Wigfield, 2020). Adolescents may display diverse changes in their motivational beliefs and these developmental changes should be related to their interactions with socializers, especially parents and teachers (Wigfield & Eccles, 2020). Those who fit positive stereotypes in math, such as Asian and White students, may be more likely to display higher stable motivational beliefs or experience increases over time than negative motivational belief development. Those who fit negative stereotypes in math, such as Latinx and Black students, may be more likely to display lower stable motivational beliefs or experience decreases over time than high motivational beliefs. Additionally, negative math motivational belief development may be related to adolescents' negative academic experiences in math, such as teacher unfairness (McKown, 2013; Roeser et al., 1998). Nevertheless, students who receive parental support may be more likely to maintain their math motivational beliefs or switch from low to high beliefs despite encountering structural barriers (Chen & Gregory, 2009; Zimmerman et al., 2013).

In this study, we examined the motivational belief processes and their relations with the socializers within each of the four racial/ethnic groups in the U.S.: White, Asian, Latinx, and Black groups. By doing so, we aimed to highlight diverse patterns of changes that may exist even within marginalized or privileged groups and avoid deficit-based approaches that emphasize the negative development in marginalized groups (e.g., Causadias et al., 2018). We included students' perceived teacher unfairness in Grade 9 as the predictor of adolescents' motivational belief development from Grades 9 to 11 because the experiences adolescents have during Grade 9 may be especially critical in shaping their subsequent motivational beliefs during high school (e.g., Roybal et al., 2014). For example, the experiences students have in Grade 9 may predict students' ability to handle new demands and challenges as well as hardships they encounter in high school (Cohen & Smerdon, 2009; Mizelle & Irvine, 2000; Roybal et al., 2014).

First, we expected a higher likelihood of maintaining high motivational beliefs than switching from high to low motivational beliefs and a higher likelihood of switching from low to high motivational beliefs than maintaining low motivational beliefs among students who are privileged in math (i.e., Asian and White groups) across Grades 9 to 11. Also, we expected a higher likelihood of switching from high to low motivational beliefs than maintaining high motivational beliefs and a higher likelihood of maintaining low motivational beliefs than switching from low to high motivational beliefs among students who are marginalized in math (i.e., Latinx and Black groups) across Grades 9 to 11. However, we also expected variability in adolescents' motivational belief development. That is, though we expected these patterns based on traditional stereotypes, we also expected students to display patterns that contradict the traditional stereotypes in all racial/ethnic groups.

Second, we expected students' perceptions of teacher unfairness in Grade 9 to negatively predict their motivational beliefs in math in Grade 9 (i.e., high than low motivation), especially among those who are marginalized in math (i.e., Latinx and Black groups). Conversely, we expected parent socialization to positively predict adolescents' motivational beliefs in math in Grade 9 (i.e., low than high motivation).

Third, we expected students' perceptions of teacher unfairness in Grade 9 to predict higher likelihoods of maintaining low motivational beliefs or switching from high to low motivational beliefs than the other patterns across Grades 9 to 11, especially among students who are marginalized in math (i.e., Latinx and Black groups). Conversely, we expected parent socialization to predict higher likelihoods of maintaining high motivational beliefs or switching from low to high motivational beliefs than the other patterns across Grades 9 to 11 in all racial/ethnic groups.

Method

Participants

Data were drawn from the High School Longitudinal Study (HSLS). HSLS is a longitudinal study that involves a nationally representative sample of high school students in the U.S. The study was designed and conducted by the National Center for Education Statistics (NCES) to study high school students' educational and vocational trajectories in STEM (Ingels et al., 2011). The HSLS dataset was collected through a two-stage stratified sampling design with schools as the primary sampling units. In the first stage, 944 high schools from 10 states were randomly selected. In the second stage, students in each school were randomly sampled within strata defined by race/ethnicity, resulting in a total of 25,210 participants in the base-year study. The current study used the data from the first two waves when students were in Grade 9 (base-year, collected in Fall 2009) and Grade 11 (first follow-up, collected in Spring 2012).

Of the 25,210 participants, we sequentially excluded students who had missing information on their gender or race/ethnicity or were not White, Latinx, Black, or Asian (n = 2,150), then students missing information on motivational beliefs (i.e., expectancies for success, interest, utility value, attainment value) in both Grades 9 and 11 (n = 2,470), or on perceived teacher unfairness and parent socialization (n = 1,570). The analytic sample consisted of 19,010 participants (M_{age} = 14.53 in Grade 9; 50% female). They were 62% White (non-Latinx), 9% Asian (non-Latinx), 18% Latinx, and 11% Black/African-American (non-Latinx).

A comparison of the analytic sample and the excluded sample is provided in Table 2.S1. Of the 15 comparisons, three demonstrated at least a small effect; compared to the excluded sample, students in the analytic sample were more likely to identify as White ($\varphi = .39$), and report higher family socioeconomic status ($d = .25$) and higher math achievement ($d = .23$).

Measures

Students' math motivational beliefs were measured using the student survey administered in the Fall of Grade 9 and in the Spring of Grade 11. Students' perceived teacher unfairness and parent socialization were measured using the student survey in Grade 9.

Motivational beliefs

Aligned with situated expectancy-value theory (Eccles, 2009; Eccles & Wigfield, 2020), we measured students' expectancies for success, interest, and utility value as indicators of students' motivational beliefs. Given that each motivational belief is a unique construct that can be empirically distinguished (Guo et al., 2016; Eccles & Wigfield, 2002), and the trends may vary depending on the motivational belief construct (e.g., Petersen & Hyde, 2017), we tested the development of each motivational construct separately. The items used to measure motivational beliefs have demonstrated high validity and reliability in previous studies (e.g., Eccles & Wigfield, 1995; Simpkins et al., 2015a).

Originally, the survey items were measured using a four-point Likert scale (1 = *Strongly agree,* 4 = *Strongly disagree*). For all motivational beliefs, we averaged and dichotomized the scale at a meaningful cut-off to indicate low or high motivational beliefs (0 = *Low motivational beliefs*, 1 = *High motivational beliefs*). In other words, students who agreed with statements were considered to have high motivational beliefs whereas students who disagreed with statements were considered to have low motivational beliefs. By doing so, we could test whether students maintained low motivational beliefs, maintained high motivational beliefs, switched from low to high motivational beliefs, or switched from high to low motivational beliefs between Grades 9 and 11. Prior studies have utilized the same strategy to create a meaningful cut-off that distinguished adolescents with high or low motivational beliefs (e.g., Hsieh et al., 2022)

Expectancies for Success. Students' expectancies for success are their perceptions of their ability to do well in math. Students reported their math expectancies for success using 4 items on a 4-point scale (α = .89 & .90): (a) "9^{th}/11^{th} grader is confident he/she can do excellent job on fall 2009/spring 2012 math tests," (b) "9^{th}/11^{th} grader is certain he/she can understand fall 2009/spring 2012 math textbook," (c) "9^{th}/11^{th} grader is certain he/she can master skills in fall 2009/spring 2012 math course," and (d) "9^{th}/11^{th} grader is confident he/she can do excellent job on fall 2009/spring 2012 math assignments" (0 = *Low expectancies for success*, 1 = *High expectancies for success*).

Interest. Students' interest derives from the enjoyment gained by engaging in a task. Interest was measured using 3 items on a 4-point scale (α = .78 & .78): "How much do you agree or disagree with the following statements about your [fall 2009/spring 2012] math course?": (a) "You are enjoying this class very much," (b) "You think this class is a waste of your time," and (c) "You think this class is boring" (0 = *Low interest,* 1 = *High interest*).

Utility Value. Utility value is a value given to a task because it is found to be useful for fulfilling individuals' current or future plans. Utility value was measured using 3 items on a 4-point scale (α = .78 & .82): "How much do you agree or disagree with the following statements about the usefulness of your [fall 2009/spring 2012] math course? What students learn in this course": (a) "is useful for everyday life," (b) "will be useful for college," (c) "will be useful for a future career" (0 = *Low utility value,* 1 = *High utility value*).

Perceived Teacher Unfairness

Aligned with social equity theory (McKown, 2013) and Roeser and colleagues' (1998) school psychological environment model, we measured students' perceptions of teacher unfairness and disrespect in Grade 9 using the following 3 items on a 4-point scale ($\alpha = .80$): (a) "9^{th} grade math teacher treats students with respect," (b) "9^{th} grade math teacher treats every student fairly," and (c) "9^{th} grade math teacher treats some kids better than others" (1 = *Strongly agree*, 4 = *Strongly disagree*). For one item, (i.e., "9^{th} grade math teacher treats some kids better than others"), the scale was reverse-coded so that high scores signified higher perceived teacher unfairness (1 = *Strongly disagree*, 4 = *Strongly agree*). Previous studies examining unfair treatment by teachers have used similar items where participants responded to whether they perceived their teacher to treat students unfairly and disrespectfully (e.g., Gini et al.,2018; Lenzi et al., 2014).

Parent Socialization

The items for parent socialization aligned with Eccles' (1993) parent socialization model and Hill and Tyson's (2009) definition in that they measured parents' discussion with their adolescents about academic plans and STEM. Students' perceived parent socialization in 9^{th} grade was measured using 7 items: (a) 9^{th} grader talked to [mother/father] about math courses to take in 2009-2010," (b) "9^{th} grader talked to [mother/father] about going to college," (c) "9^{th} grader talked to [mother/father] about adult jobs/careers," and (d) "Parents discussed STEM program or article with 9^{th} grader in last year" (0 = *No*, 1 = *Yes*). Previous studies examining parent socialization have used similar items (e.g., Fan & Williams, 2010; Starr, Ramos & Simpkins, 2022).

Race/Ethnicity

Students provided information on their race/ethnicity (White [non-Latinx], Asian [non-Latinx], Latinx, Black/African-American [non-Latinx], Native Hawaiian/Pacific Islander [non-Latinx], American Indian/Alaska Native [non-Latinx], More than one race [non-Latinx]). In this study, we included participants who identified as White, Asian, Latinx, or Black/African American.

Background Variables

Background variables included gender (0 = *Male*, 1 = *Female*), indicators of family socioeconomic status (i.e., a composite measure of parents' education, occupation, and family income), and Grade 9 achievement (i.e., a criterion-referenced measure of achievement on algebraic reasoning assessment; Ingels et al., 2011). The achievement score was based on an achievement test that was developed and administered by HSLS which tested students on six algebraic content domains, such as students' understanding of the language of algebra or equations, and four algebraic processes, such as solving algebraic problems. The IRT-estimated reliability was 0.92 for the items. The unidimensionality of the test items was tested through a confirmatory factor analysis (Ingels et al., 2011).

We controlled for gender, family socioeconomic status, and students' prior achievement. Gender was added as a background variable because math is a domain where stereotypes have historically persisted towards gender as well as race/ethnicity (Else-Quest et al., 2013; Nosek & Smyth, 2011). Male and female adolescents from each racial/ethnic group may have different experiences in math and display varying motivation development (Brown & Leaper, 2010; Wang & Degol, 2017). Additionally, students' family socioeconomic status and their prior performance can influence their motivation development (Eccles & Wigfield, 2020). Given that racial/ethnic disparities have often been found in students' math performance (e.g., NSF, 2019) and family income (e.g., Perry et al., 2012), we controlled for these factors in our analyses.

Plan of Analysis

Descriptive statistics and logistic regression analyses were conducted using Stata 15. The latent transition analyses were conducted using M*plus*. From the entire analytic sample, 14,320 participants had complete data whereas 4,690 participants were missing some data (Table 2.S2). Of the 15 comparisons, three demonstrated at least a small effect. Compared to the sample with some missing data, the sample with complete data reported more parent socialization (d = .22), higher family socioeconomic status (d = .32), and higher math achievement (d = .46). Missing data were handled using the Full-Information-Maximum-Likelihood (FIML) method (Kline, 2015).

Our first research question was to examine the developmental changes of expectancies for success, interest, and utility value in math across Grades 9 to 11 in four racial/ethnic groups (i.e., White, Asian, Latinx, Black). Separate latent transition models were estimated for each motivational belief. In M*plus*, the models were estimated with TYPE = MIXTURE COMPLEX command in order to include the sampling weights to account for the nonresponse rate in the sampling process, and strata and primary sampling unit to correct the standard errors from the stratified design of the dataset. Also, maximum likelihood estimation with robust standard errors (i.e., MLR estimator) was used to account for the non-normality in the data and to accompany the TYPE command (Muthén & Muthén, 2017).

Our second research question was to examine the associations between perceived teacher unfairness and parent socialization with adolescents' motivational beliefs in Grade 9. Logistic regression models were estimated with perceived teacher unfairness, parent socialization, and background variables (i.e., prior achievement, family socioeconomic status, and gender) with students' Grade 9 motivational beliefs as the outcome for each racial/ethnic group.

Our third research question was to examine the associations between perceived teacher unfairness and parent socialization with the changes across Grades 9 to 11. Again, logistic regression models were estimated with perceived teacher unfairness, parent socialization, and background variables (i.e., prior achievement, family socioeconomic status, and gender) for each racial/ethnic group. With Grade 11 motivational beliefs as the outcome, two models were estimated in each racial/ethnic group: (a) among students with high motivational beliefs in Grade 9 and (b) among students with low motivational beliefs in Grade 9. By doing so, we tested whether students maintained high motivational beliefs or switched from high to low motivational beliefs from Grades 9 to 11 and whether students maintained low motivational beliefs or switched from low to high motivational beliefs from Grades 9 to 11.

Results

Table 2.1 shows the descriptive statistics and Tables 2.2 & 2.3 display the correlations among the key variables for White, Asian, Latinx, and Black students. In all races/ethnicities, more than 50% of the students reported high expectancies for success, interest, and utility value in Grade 9. In Grade 11, more than 50% of Asians and Blacks reported high expectancies for success whereas 47% of White and 48% of Latinx reported high expectancies for success. Only in the Asian group, more than half (56%) reported high interest. 41% of White, 47% of Latinx, and 46% of Black students displayed high interest in Grade 11. For utility value, however, more than 80% of the students had high utility value in Grade 11 in all racial/ethnic groups. In all races/ethnicities, motivational beliefs were often positively correlated with each other (r = .07

– .43, $p < .01$). Mostly, perceived teacher unfairness was negatively ($r = -.06 – -.36$, $p < .01$) and parent socialization was positively ($r = .05 – .15$, $p < .01$) correlated with motivational beliefs.

Developmental Changes in Motivational Beliefs

We examined the developmental changes of expectancies for success, interest, and utility value in math across Grades 9 to 11 within each racial/ethnic group (i.e., Asian, Latinx, Black, White; Figures 2.1 – 2.3). Below, we describe the frequencies of stability and change in students' motivational beliefs by race/ethnicity.

Expectancies for Success

The change patterns in expectancies for success are displayed in Figure 2.1. In Grade 9, we found that more than 50% of the students in the White and Latinx groups and more than 60% of students in the Asian and Black groups had high expectancies for success. In Grade 11, more than 50% of students in the Asian and Black groups had high expectancies for success, but the pattern reversed for the White and Latinx groups, where less than 50% (47% for White & 45% for Latinx students) had high expectancies for success.

For White students ($n = 11{,}770$), 57% reported high expectancies for success and 43% reported low expectancies for success in Grade 9. Of those with high expectancies for success, 58% maintained a high level whereas 42% switched from high to low beliefs. Of those with low expectancies for success in Grade 9, 32% switched from low to high beliefs whereas 68% maintained their low expectancies for success. For Asian students ($n = 1{,}660$), 66% reported high expectancies for success and 34% reported low expectancies for success in Grade 9. Of those with high expectancies for success, 61% maintained a high level whereas 39% switched from high to low beliefs. Of those with low expectancies for success, 39% switched from low to high beliefs whereas 61% maintained their low expectancies for success. For Latinx students ($n =$

3,430), 54% reported high expectancies for success and 46% reported low expectancies for success. Of those with high expectancies for success, 56% maintained a high level whereas 44% switched from high to low beliefs. Of those with low expectancies for success, 31% switched from low to high beliefs whereas 69% maintained their low expectancies for success. For Black students (n = 2,160), 61% reported high expectancies for success and 39% reported low expectancies for success. Of those with high expectancies for success, 62% maintained a high level whereas 38% switched from high to low beliefs. Of those with low expectancies for success, 38% switched from low to high beliefs whereas 62% maintained their low expectancies for success.

In summary, though there were more students with high expectancies for success than low expectancies for success in Grade 9 in each racial/ethnic group, the reverse was true for White and Latinx groups in Grade 11. For the White and Latinx groups, the majority of students with low expectancies for success in Grade 9 maintained their low level than switch to high expectancies for success in Grade 11 (68% for White, 69% for Latinx), and almost half of the students with high expectancies for success in Grade 9 displayed decreases (42% for White, 44% for Latinx) from Grade 9 to Grade 11. For the Asian and Black groups, however, the majority of students maintained their high expectancies for success across Grades 9 to 11 (61% for Asian, 62% for Black).

Interest

The change patterns in interest are displayed in Figure 2.2. Similar to expectancies for success, close to 50% of White and Latinx students and close to 60% of Asian and Black students had high interest in Grade 9. By Grade 11, however, the pattern reversed for White, Latinx, and Black students where less than 50% of the students had high interest.

For White students (*n* = 11,770), 53% reported high interest and 47% reported low interest in Grade 9. Of those with high interest, 50% maintained a high level whereas 50% switched from high to low beliefs. Of those with low interest, 29% switched from low to high beliefs whereas 71% maintained their low interest. For Asian students (*n* = 1,660), 63% reported high interest and 37% reported low interest in Grade 9. Of those with high interest, 63% maintained a high level whereas 37% switched from high to low beliefs. Of those with low interest, 35% switched from low to high beliefs whereas 65% maintained their low interest. For Latinx students (*n* = 3,430), 55% reported high interest and 45% reported low interest in Grade 9. Of those with high interest, 53% maintained a high level whereas 47% switched from high to low beliefs. Of those with low interest, 34% switched from low to high beliefs whereas 66% maintained their low interest. For Black students (*n* = 2,160), 59% reported high interest and 41% reported low interest in Grade 9. Of those with high interest, 56% maintained a high level whereas 44% switched from high to low beliefs. Of those with low interest, 35% switched from low to high beliefs whereas 65% maintained their low interest. Overall, though more than 50% of the students had high interest in Grade 9 in all racial/ethnic groups, the pattern was reversed by Grade 11 for the White, Latinx, and Black groups.

In summary, most of the students with low interest in Grade 9 maintained their low level than switch to high interest in Grade 11 in each racial/ethnic group (i.e., 65 – 71%). For the White, Latinx, and Black groups, almost half of the students who started with high interest in Grade 9 switched to low interest by Grade 11 (i.e., 44% – 50%). For the Asian group, however, the majority of students with high interest in Grade 9 (63%) maintained their high level in Grade 11.

Utility Value

The change patterns in utility value are displayed in Figure 2.3. Unlike expectancies for success and interest, the majority of students in each race/ethnicity held high utility value in Grade 9 (> 70%). The high proportion was also found in Grade 11 for all racial/ethnic groups (> 80%).

For White students (*n* = 11,770), 71% reported high utility value and 29% reported low utility value in Grade 9. Of those with high utility value, 86% maintained a high level whereas 14% switched from high to low beliefs. Of those with low utility value, 70% switched from low to high beliefs whereas 30% maintained their low utility value. For Asian students (*n* = 1,660), 76% reported high utility value and 24% reported low utility value in Grade 9. Of those with high utility value, 90% maintained a high level whereas 10% switched from high to low beliefs. Of those with low utility value, 66% switched from low to high beliefs whereas 34% maintained their low utility value. For Latinx students (*n* = 3,430), 78% reported high utility value and 22% reported low utility value in Grade 9. Of those with high utility value, 86% maintained a high level whereas 14% switched from high to low beliefs. Of those with low utility value, 72% switched from low to high beliefs whereas 28% maintained their low utility value. For Black students (*n* = 2,160), 84% reported high utility value and 16% reported low utility value in Grade 9. Of those with high utility value, 91% maintained a high level whereas 9% switched from high to low beliefs. Of those with low utility value, 76% switched from low to high beliefs whereas 24% maintained their low utility value.

In summary, most of the students with high utility value in Grade 9 maintained their high level than switch to low utility value by Grade 11 in each race/ethnicity (i.e., 86 – 91%). Even for students who held low utility value in Grade 9, the majority of them switched to high utility value by Grade 11 (i.e., 66% – 76%).

Grade 9 Motivational Beliefs and Their Associations with Perceived Teacher Unfairness and Parent Socialization

Subsequently, we examined the extent to which perceived teacher unfairness and parent socialization predicted adolescents' motivational beliefs in Grade 9 controlling for prior achievement, family socioeconomic status, and gender (Table 2.4). In each race/ethnicity, perceived teacher unfairness predicted lower odds of displaying high motivational beliefs in Grade 9 (OR: .56, $p < .001$ – .69, $p < .05$ for expectancies for success; .28, $p < .001$ – .34, $p < .01$ for interest; .46, $p < .001$ – .79, $p < .05$ for utility value). Parent socialization significantly predicted higher odds of displaying high motivational beliefs in Grade 9 for the White group (OR: 1.58, $p < .001$ for expectancies for success; 2.23, $p < .001$ for interest; 2.04, $p < .001$ for utility value) and Latinx group (OR: 2.42, $p < .01$ for expectancies for success; 2.25, $p < .01$ for interest; 2.58, $p < .001$ for utility value), but not the Asian and Black groups (p = ns). We also tested the models without the background variables and found similar results (Table 2.S3).

Changes in Motivational Beliefs and Their Associations with Perceived Teacher Unfairness and Parent Socialization

In addition, we examined the extent to which perceived teacher unfairness and parent socialization predicted the changes in adolescents' motivational beliefs from Grades 9 to 11 in each race/ethnicity controlling for prior achievement, family socioeconomic status, and gender (Tables 2.5 – 2.7). When we tested the associations without the background variables, the main results were consistent (Tables 2.S4 – 2.S6).

Expectancies for Success

Perceived teacher unfairness was not associated with changes in students' expectancies for success for all races/ethnicities (Table 2.5). Parent socialization was not associated with any changes in expectancies for success for White and Black students. However, we found that parent socialization was associated with higher odds of switching from low to high expectancies for success than maintaining low expectancies for success for Asian students with low expectancies for success in Grade 9 (OR: 4.07, $p < .01$). In addition, parent socialization was associated with higher odds of maintaining high expectancies for success than switching from high to low expectancies for success for Latinx students with high expectancies for success in Grade 9 (OR: 3.00, $p < .05$).

Interest

Perceived teacher unfairness was not associated with any changes in interest for most groups (Table 2.6). However, we found that perceived teacher unfairness was associated with lower odds of maintaining high interest than switching from high to low interest for Black students with high interest in Grade 9 (OR: .75, $p < .05$). Parent socialization was associated with changes in interest only for White students (OR: 1.30, $p < .05$ for maintaining high interest & 1.34, $p < .05$ for switching from low to high interest).

Utility Value

Perceived teacher unfairness and parent socialization were not associated with changes in students' utility value in most groups, except one time (Table 2.7). Perceived teacher unfairness was associated with lower odds of maintaining high utility value than switching from high to low utility value for White students with high utility value in Grade 9 (OR: .75, $p < .001$).

Discussion

In this study, we examined motivational belief development across high school (i.e., Grades 9 to 11) in four racial/ethnic groups (i.e., White, Asian, Latinx, and Black) and the extent to which perceived teacher unfairness and parent socialization were associated with adolescents' motivational belief development. We found varying patterns of changes in each racial/ethnic group. Perceived teacher unfairness and parent socialization were found to significantly predict motivational belief development for some groups but not all. Our findings highlight that not all students decrease in their motivational beliefs as suggested by many prior studies (e.g., Jacobs et al., 2002) and that socializers matter in shaping adolescents' motivational belief development.

Developmental Patterns of Expectancies for Success and Interest

Similar patterns of decreases and stability were found across expectancies for success and interest. Expectancies for success are often positively correlated with interest, where students find high or low enjoyment in tasks depending on their perceived ability (Eccles & Wigfield, 1995). Aligned with prior research that found decreases in motivational beliefs to be more typical in development (Fredricks & Eccles, 2002; Jacobs et al., 2002; Nagy et al., 2010), we found similar decreasing patterns among many students in the White and Latinx groups for expectancies for success (i.e., 42% for White, 44% for Latinx) and in the White, Latinx, and Black groups for interest (i.e., 44% - 50%). Some adolescents' beliefs may decrease because they find math courses to be more challenging and difficult to learn during high school compared to prior years (Peterson & Hyde, 2017). Students from marginalized groups may display decreases (i.e., Latinx and Black students) due to their placement in lower math tracks, low quality interactions with social agents, and limited resources (Martin, 2009). For example, math experiences are less interesting in lower track math courses as the class materials tend to be more repetitive and students tend to have lower quality relationships with their teachers (McKown, 2013). Interventional efforts in academic environments may be especially helpful to boost expectancies for success and interest in youth, especially among youth marginalized in math.

However, many adolescents also displayed stability than change during this period. In all racial/ethnic groups, we found that many students often maintained either high or low expectancies for success and interest from Grade 9 to Grade 11 (i.e., 56 – 69% for expectancies for success, 50% – 71% for interest). Adolescents are often placed into math course tracking based on their ability in middle school, which often continues throughout high school —these experiences could serve to reinforce their expected ability in math (Simpkins et al., 2006; Wang, 2012). Additionally, given that our participants were in high school, it may be that some students have already identified with the socio-cultural expectations toward them and internalized these beliefs (Brown & Bigler, 2005; Wang & Degol, 2013). For example, across both expectancies for success and interest, we found that the majority of Asian students, who are traditionally privileged in math, were more likely to maintain high expectancies for success and interest than decrease (i.e., 61% for expectancies for success, 63% for interest). Our findings suggest that creating a more equitable math environment may be important to address the racial/ethnic disparities in math. Also, the variability that exists in change patterns warrants future studies to test motivational belief development in diverse populations across a longer developmental span while accounting for potential variations in growth during various developmental stages.

Asian students were more likely to display high stability than decreases in expectancies for success and interest. Prior studies also noted that Asian students were more likely to display higher expectancies for success and interest compared to other groups, such as White students (Chen & Stevenson, 1995). Asian students often encounter the model minority stereotype and are perceived to be high performers in math (Trytten et al., 2012). In high school, these students may experience events that help them to positively evaluate their math abilities, such as being placed in a higher math course (Wang, 2012). Asian students often outperform and enroll in more advanced courses than students of other racial/ethnic backgrounds, including White students, in math and science (e.g., NSF, 2019). Factors such as selections into higher math courses, high performance, or downward social comparisons with their peers may be some of the factors associated with high math expectancies for success and interest among Asian students. Nevertheless, we also note that some Asian students displayed decreases (i.e., 39% for expectancies for success, 37% for interest). Model minority stereotype may not always work in favor of all Asian students; it has been associated with negative academic attitudes as the pressure to conform to the stereotype can be challenging and stressful (McGee, 2018). Additionally, these students may endorse high expectancies for success or interest in other domains and perceive their math motivational beliefs to be lower compared to their motivational beliefs in other subjects (Eccles, 2009; Wang et al., 2013). The mechanisms that shape motivational beliefs in Asian students, such as the potential buffering or hindering role of the model minority stereotype, may need to be further examined.

Contrary to our hypothesis, the majority of Black (62%) students were more likely to maintain high expectancies for success than decrease in their expectancies for success. For Black students, despite being marginalized in math, prior studies also noted that they endorsed high expectancies for success (e.g., Seo et al., 2019). Though Black students may display lower academic performance, they have been found to maintain positive self-regard and display higher expectancies for success than their White counterparts (e.g., Graham, 1994). Additionally, though Black students were less likely to see themselves as math person (66%), they still endorsed high expectancies for success (70 – 77%; NSF, 2019). Our findings suggest potential variability in the experiences of Black students. That is, some Black students in this study may experience more support in their learning, such as from their families or communities, that helps them maintain their high expectancies for success (e.g., Carlo, Murry et al., 2022). Additionally, our findings suggest that math motivational beliefs other than expectancies for success, such as interest, may matter more for Black students when they are making decisions about pursuing math or STEM. Exploring the mechanisms associated with Black students' math trajectories will be important to address the racial/ethnic gaps in STEM.

Developmental Patterns of Utility Value

In all racial/ethnic groups, students were substantially more likely to find math to be useful in Grade 9 and maintain their high utility value than switch from high to low utility value (86% – 91%). Even among the small percentage of students who did not find math to be useful in Grade 9, most of them switched from low to high utility value by Grade 11 (66% – 76%). Similar patterns of high utility value during adolescence have been noted in other studies (e.g., Lee et al., 2023). Given that math is part of the core curriculum at the beginning of high school, students may have found math to be useful for their future. Furthermore, their utility value may reflect high utility value endorsed by their parents (Simpkins et al., 2015b). Parents' beliefs are directly associated with their child's beliefs (Eccles & Wigfield, 2020). When parents believe their child is skilled in math or find math to be useful for their child, it is likely to influence the child's own beliefs toward math for themselves (Simpkins et al., 2015b). Given that many parents are likely to perceive math to be useful during this period, students may perceive high utility value as well. Additionally, math is often a gateway to many educational and occupational choices (Hulleman & Harackiewicz, 2021; Watt et al., 2017). Students may have found math to be useful as they make close connections between their learning material and its personal relevance. That is, as students consider going to college or finding a job, they may be more likely to consider math to be useful.

Socializers Matter

Perceived teacher unfairness was negatively associated with Grade 9 motivational beliefs in all racial/ethnic groups. Perceived teacher unfairness can lead to lower academic functioning in students by triggering their lack of belongingness (McKown, 2013). In addition to racial/ethnic identity, teachers may reinforce students' lack of belongingness in math due to other factors, such as their gender identity or their math abilities, and hinder their motivational belief development. Thus, we found that adolescents of all racial/ethnic backgrounds displayed lower concurrent expectancies for success, interest, and utility value, when they perceived teacher unfairness, suggesting that equitable treatment in classrooms and by teachers matter in shaping students' math motivational beliefs.

Many significant associations emerged between socializers and motivational beliefs concurrently but not longitudinally. The relations may have been often not significant longitudinally because socializers' involvement changes in its nature over time. For example, teachers are likely to change as students move up grade levels. If they have positive experiences with their new teacher, the effects of encountering unfair treatment from their previous teachers may diminish. Additionally, there may be an interaction between socializers and students' developing identity, where socializers' support in math is beneficial long-term if students see themselves as math person or want to pursue math. Future studies could test multiple types of socializer involvement, include multiple time points, or examine interactions to further understand the relations between socializers and adolescents' motivational belief development.

Nevertheless, there were a few significant longitudinal associations that emerged between socializers and motivational beliefs. Particularly, perceived teacher unfairness was predictive of a negative change in interest among Black students. Black students who perceived high teacher unfairness in Grade 9 were less likely to maintain high interest but switch from high to low interest across Grades 9 to 11. Prior studies noted that the perceptions of negative stereotypes in academic contexts, especially in math, are likely to function as an identity threat for Black students (Steele, 1997; Wang & Degol, 2013; Wigfield & Gladstone, 2019). Given the strong correlations between interest and identity (e.g., Trautwein et al., 2012), the negative experiences that hinder Black students' identity in math may have led to decreases in their interest as well. Nevertheless, having a supportive teacher who displays high expectations for these students and practices equity-minded teaching may also foster positive motivational belief development in these students (Joseph et al., 2019). Teacher support that challenges the traditional negative stereotypes may be especially critical for positive motivational belief development among Black students. Overall, we found that addressing the challenges that students face in their classrooms and with their teachers may matter for many students of all racial/ethnic groups, and especially for Black students.

Parent socialization was positively related to some changes in motivational beliefs for Latinx, Asian, and White students. Notably, we found that parents promote positive changes in students' expectancies for success for both Asian and Latinx students, where parent socialization was related to maintaining high expectancies for success among Latinx students and switching from low to high expectancies for success among Asian students. Given that family connectedness and parental involvement are some of the core values in these cultures, parental involvement might have been especially helpful in fostering their motivational beliefs (i.e., familism; Carlo, Cheah et al., 2022). For example, familism has been found to be a cultural value that serves to facilitate positive development in Latinx adolescents (Carlo, Murry et al., 2022). Despite many challenges that are experienced in these families, such as cultural differences and structural barriers, parents who devote their time to discuss about STEM and future plans with their students may help these adolescents to develop positive motivational beliefs in math (Hsieh & Simpkins, 2022; Lee & Simpkins, 2021; Starr, Ramos, & Simpkins, 2022).

Interestingly, parent socialization was not a significant predictor of Black students' motivational belief development. For Black students, parental support other than parent socialization may be more strongly associated with promoting their motivational beliefs. Effective parenting practices are likely to vary by racial/ethnic group (McKown, 2013). For example, McKown (2013) noted that Black parents may be more strict and less sensitive in their parenting compared to White parents, but these practices still predict positive academic outcomes in the students. Parental beliefs also influence students' motivational beliefs (Eccles & Wigfield, 2020). Though not tested in this study, parents' high expectations for their students or beliefs that challenge the existing stereotypes may help Black students to display high motivational beliefs (e.g., Fredricks & Eccles, 2002). For example, Black parents are more likely to hold gender egalitarian views in math compared to Asian and White parents (Starr, Gao et al., 2022) In fact, unlike other racial/ethnic groups, we found that the Black group consistently displayed no gender differences across all motivational beliefs in Grade 9 and one gender difference across Grades 9 to 11 where female students were more likely than male students to switch from low to high interest rather than maintain low interest. To better understand the diverse experiences of adolescents from different races/ethnicities, various types of parental support will need to be explored.

Limitations and Future Directions

Despite the significant findings of this study, it is not without limitations. Students' perceptions of teacher unfairness may have been inferred from teachers' behaviors toward other students and not themselves. The items asked how teachers treat students generally and not how teachers treat the individual. Even though our correlations displayed significant negative associations between perceived teacher unfairness and students' motivational beliefs (Tables 2.2 & 2.3), future studies could utilize measures that refer to students' experiences of perceived teacher unfairness directed towards them as a better test of the associations between these constructs. We measured parent socialization in terms of parents' discussions with students about academic plans, math course-taking, and STEM. Though parent socialization has been found to be a strong predictor of adolescents' motivation development, other types of parental involvement may also be critical in fostering adolescents' motivational beliefs. Particularly, our findings suggest that it may be worth exploring various types of parental support in diverse racial/ethnic groups as there may be differences in parental involvement that is more beneficial than others by race/ethnicity. Lastly, we examined race/ethnicity as an indicator of social identities, but other social identities (e.g., gender, immigration status), may also be worth examining. Future studies could extend this study and include more elaborative measures of teacher/parental involvement and indicators of social identities.

Conclusion

In this study, we found that there were various changes in motivational beliefs across adolescence in all racial/ethnic groups. In general, students often maintained their expectancies for success than change. Whereas students often maintained or decreased in their interest, they were more likely to maintain high or increase in their utility value. Socializers were significantly predictive of motivational beliefs more concurrently than longitudinally. Nevertheless, parent socialization significantly predicted positive expectancies for success development among Asian and Latinx students. Perceived teacher unfairness increased the likelihood of Black students to switch from high to low interest. The findings from this study highlight the various trends in adolescents' motivational belief development by race/ethnicity and the role of social contexts in shaping students' motivational beliefs. Consequently, this study demonstrates the need to continue our effort to implement effective intervention programs in high schools targeted toward students, teachers, and parents. Until now, there have been many interventional efforts to boost students' utility value (Hulleman & Harackiewicz, 2021; Rosenzweig et al., 2022). Our findings suggest, at least in high school, interventions to boost other constructs of the situated expectancy-value theory, especially interest, may be particularly effective in addressing the disparities in math. Another critical implication of our findings is that equity-minded support from parents and teachers that challenge the existing societal stereotypes may serve as sources of strength to adolescents and especially to those from marginalized groups. Moving forward, researchers should continue to investigate diversity in adolescent development and various factors that can influence adolescent development to suggest ways to foster positive motivational beliefs in all youth.

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Tables and Figures

Table 2.1

Descriptive Statistics Within Each Race/Ethnicity

	White adolescents		Asian adolescents		Latinx adolescents		Black adolescents	
	n	*M* (*SD*)	*n*	*M* (*SD*)	*n*	*M* (*SD*)	*n*	*M* (*SD*)
Grade 9								
Expectancies for success	10740	0.57 (0.50)	1480	0.69 (0.40)	3000	0.55 (0.50)	1880	0.64 (0.48)
Interest	10740	0.53 (0.50)	1490	0.64 (0.48)	3000	0.58 (0.49)	1880	0.61 (0.49)
Utility value	10680	0.69 (0.46)	1480	0.77 (0.42)	2980	0.78 (0.42)	1870	0.83 (0.38)
Grade 11								
Expectancies for success	10400	0.47 (0.50)	1460	0.59 (0.49)	2910	0.48 (0.50)	1860	0.55 (0.50)
Interest	10410	0.41 (0.49)	1460	0.56 (0.50)	2910	0.47 (0.50)	1860	0.46 (0.50)
Utility value	10410	0.81 (0.39)	1450	0.88 (0.33)	2920	0.84 (0.37)	1860	0.87 (0.34)
Perceived teacher unfairness	10720	1.86 (0.65)	1470	1.78 (0.59)	2990	1.84 (0.63)	1870	1.82 (0.67)
Parent socialization	11730	0.67 (0.30)	1650	0.67(0.31)	3400	0.58 (0.31)	2140	0.60 (0.30)
Female	11770	0.49 (0.50)	1660	0.49(0.50)	3430	0.50 (0.50)	2160	0.49 (0.50)
Math achievement	11610	41.47 (11.49)	1630	48.62 (12.11)	3380	37.02 (11.14)	2130	34.80 (10.95)
Socioeconomic status	11640	0.20 (0.74)	1640	0.38(0.89)	3400	-0.38 (0.73)	2130	-0.15 (0.73)

Note. Sample size rounded to the nearest tens place in accordance to the NCES regulations. Each motivational belief variables are dichotomized (e.g., 0 = *Low expectancies for success*, 1 = *High expectancies for success*).
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, High School Longitudinal Study of 2009 (HSLS:09), Base Year and First Follow-Up.

Table 2.2

Bivariate Correlations for White (Below the Diagonal) and Asian (Above the Diagonal) Adolescents

Variables	1	2	3	4	5	6	7	8	9	10	11
1. Gr.9 expectancies for success	-	.26*	.19*	.24*	.14*	.10*	-.20*	.13*	-.07*	.25*	.14*
2. Gr.9 interest	.33*	-	.25*	.09*	.20*	.04	-.30*	.07*	.04	.06	.02
3. Gr.9 utility value	.23*	.30*	-	.04	.13*	.20*	-.19*	-.01	-.04	-.06	-.13*
4. Gr.11 expectancies for success	.28*	.15*	.11*	-	.35*	.17*	-.08*	.09*	-.10*	.20*	.05
5. Gr.11 interest	.20*	.24*	.15*	.43*	-	.19*	-.10*	.05	-.06	.14*	.02
6. Gr.11 utility value	.11*	.14*	.19*	.22*	.25*	-	-.06	.02	-.04	.02	-.06
7. Perceived teacher unfairness	-.20*	-.36*	-.19*	-.08*	-.11*	-.07*	-	-.11*	.00	-.12*	-.05
8. Parent socialization	.15*	.14*	.09*	.09*	.10*	.05*	-.11*	-	.05	.28*	.33*
9. Female	-.10*	.02	-.03*	-.10*	-.01	-.02	-.01	.06*	-	-.01	.04
10. Math achievement	.27*	.15*	.02	.24*	.17*	.08*	-.11*	.29*	-.01	-	.44*
11. Socioeconomic status	.14*	.05*	-.03*	.12*	.08*	.01	-.06*	.26*	-.01	.41*	-

Note. **p* < .01.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, High School Longitudinal Study of 2009 (HSLS:09), Base Year and First Follow-Up.

Table 2.3

Bivariate Correlations for Latinx (Below the Diagonal) and Black (Above the Diagonal) Adolescents

Variables	1	2	3	4	5	6	7	8	9	10	11
1. Gr.9 expectancies for success	-	.31*	.20*	.21*	.15*	.07*	-.15*	.09*	-.09*	.16*	.02
2. Gr.9 interest	.30*	-	.19*	.10*	.21*	.03	-.34*	.12*	.04	.14*	.03
3. Gr.9 utility value	.21*	.24*	-	.04	.11*	.13*	-.13*	.06	-.01	-.04	-.07*
4. Gr.11 expectancies for success	.26*	.15*	.09*	-	.37*	.15*	-.06	.06*	-.05	.15*	.02
5. Gr.11 interest	.15*	.18*	.14*	.41*	-	.17*	-.12*	.06	.01	.10*	-.01
6. Gr.11 utility value	.15*	.07*	.15*	.18*	.22*	-	-.02	-.01	-.01	.02	-.05
7. Perceived teacher unfairness	-.18*	-.36*	-.13*	-.07*	-.10*	-.06*	-	-.10*	-.04	-.10*	-.05
8. Parent socialization	.12*	.11*	.07*	.11*	.07*	.05*	-.12*	-	.06*	.23*	.20*
9. Female	-.10*	.04	-.04	-.10*	.00	-.05*	.01	.05*	-	.03	-.01
10. Math achievement	.22*	.10*	.00	.19*	.13*	.08*	-.09*	.25*	.02	-	.34*
11. Socioeconomic status	.11*	.00	-.07*	.10*	-.01	-.03	-.02	.27*	.03	.35*	-

Note. *$p < .01$.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, High School Longitudinal Study of 2009 (HSLS:09), Base Year and First Follow-Up.

Table 2.4

Logistic Regression Results with Grade 9 Motivational Beliefs as Outcomes Within Each Race/Ethnicity

	High expectancies for success in Grade 9 (vs low expectancies for success)	High Interest in Grade 9 (vs low interest)	High Utility value in Grade 9 (vs low utility value)
	OR [95%CI]	OR [95%CI]	OR [95%CI]
White (*n* = 10,810)			
Perceived teacher unfairness	**.56 [.51, .61]*** **	**.28 [.25, .30]*** **	**.52 [.47, .57]*** **
Parent socialization	**1.58 [1.29, 1.95]*** **	**2.23 [1.82, 2.73]*** **	**2.04 [1.62, 2.56]*** **
Female	**.62 [.56, .69]*** **	1.05 [.95, 1.16]	**.87 [.79, .97]* **
Prior achievement	**1.04 [1.04, 1.05]*** **	**1.02 [1.01, 1.02]*** **	1.00 [.99, 1.00]
Socioeconomic status	1.07 [.99, 1.16]	**.90 [.83, .97]** **	**.88 [.80, .96]** **
Asian (*n* = 1,470)			
Perceived teacher unfairness	**.63 [.45, .88]** **	**.30 [.20, .46]*** **	**.47 [.34, .67]*** **
Parent socialization	1.90 [.91, 4.00]	.96 [.41, 2.23]	1.19 [.44, 3.23]
Female	.61 [.36, 1.03]	1.04 [.74, 1.44]	**.58 [.39, .86]** **
Prior achievement	**1.04 [1.02, 1.06]*** **	1.00 [.99, 1.02]	1.00 [.97, 1.03]
Socioeconomic status	1.05 [.76, 1.44]	.92 [.69, 1.22]	**.61 [.46, .81]*** **
Latinx (*n* = 2,980)			
Perceived teacher unfairness	**.69 [.49, .96]* **	**.30 [.24, .37]*** **	**.79 [.63, 1.00]* **
Parent socialization	**2.42 [1.32, 4.45]** **	**2.25 [1.27, 3.98]** **	**2.58 [1.59, 4.19]*** **
Female	**.62 [.47, .83]** **	1.04 [.80, 1.34]	.91 [.63, 1.34]
Prior achievement	**1.04 [1.02, 1.05]*** **	1.02 [1.00, 1.04]	.99 [.98, 1.01]
Socioeconomic status	.91 [.75. 1.10]	**.81 [.65. 1.00]* **	**.63 [.49, .80]*** **
Black (*n* = 1,860)			
Perceived teacher unfairness	**.65 [.50, .84]** **	**.34 [.26, .44]*** **	**.46 [.34, .64]*** **
Parent socialization	1.28 [.63, 2.56]	1.41 [.74, 2.67]	1.37 [.67, 2.79]
Female	.96 [.65, 1.43]	1.23 [.86, 1.77]	.89 [.53, 1.49]
Prior achievement	**1.03 [1.01, 1.05]*** **	**1.03 [1.00, 1.05]* **	.99 [.97, 1.01]
Socioeconomic status	.83 [.60, 1.14]	**.73 [.56, .94]* **	**.75 [.57, .99]* **

Note. OR: Odds Ratio; CI: Confidence Interval.
**p* < .05. ***p* < .01. ****p* < .001.
SOURCE: U.S. Department of Education, Institute of Educational Sciences, National Center for Education Statistics, High School Longitudinal Study of 2009 (HSLS:09), Base Year.

Table 2.5

Logistic Regression Results with Grade 11 Expectancies for Success (ES) as an Outcome Within Each Race/Ethnicity

	Maintaining high ES in Grade 11 (vs switching to low ES) for students with high ES in Grade 9	Switching to high ES in Grade 11 (vs. maintaining low ES) for students with low ES in Grade 9
	OR [95%CI]	OR [95%CI]
	White (*n* = 10,810)	
Perceived teacher unfairness	.93 [.83, 1.03]	.95 [.83, 1.08]
Parent socialization	1.11 [.84, 1.46]	.94 [.68, 1.29]
Female	**.61 [.53, .71]***	**.82 [.69, .97]***
Prior achievement	**1.04 [1.03, 1.05]*****	**1.03 [1.02, 1.04]*****
Socioeconomic status	.98 [.88, 1.09]	1.01 [.89, 1.14]
	Asian (*n* = 1,470)	
Perceived teacher unfairness	1.14 [.71, 1.84]	1.01 [.51, 1.99]
Parent socialization	1.25 [.49, 3.16]	**4.07 [1.44, 11.46]****
Female	.81 [.49, 1.33]	.75 [.40, 1.40]
Prior achievement	1.02 [1.00, 1.04]	**1.03 [1.00, 1.07]***
Socioeconomic status	.90 [.66, 1.24]	**.59 [.38, .92]***
	Latinx (*n* = 2,980)	
Perceived teacher unfairness	.81 [.59, 1.09]	1.24 [.93, 1.65]
Parent socialization	**3.00 [1.11, 8.11]***	1.70 [.80, 3.61]
Female	.96 [.67, 1.38]	**.64 [.43, .97]***
Prior achievement	**1.03 [1.01, 1.04]****	1.02 [1.00, 1.04]
Socioeconomic status	.93 [.71, 1.23]	1.04 [.76, 1.42]
	Black (*n* = 1,860)	
Perceived teacher unfairness	1.05 [.78, 1.39]	.94 [.59, 1.51]
Parent socialization	1.05 [.41, 2.70]	.46 [.17, 1.26]
Female	.78 [.46, 1.35]	1.15 [.61, 2.18]
Prior achievement	**1.02 [1.00, 1.04]***	**1.03 [1.01, 1.06]***
Socioeconomic status	.76 [.57, 1.02]	1.10 [.70, 1.72]

Note. *$p < .05$. **$p < .01$. ***$p < .001$.
SOURCE: U.S. Department of Education, Institute of Educational Sciences, National Center for Education Statistics, High School Longitudinal Study of 2009 (HSLS:09), Base Year.

Table 2.6

Logistic Regression Results with Grade 11 Interest as an Outcome Within Each Race/Ethnicity

	Maintaining high interest in Grade 11 (vs switching to low interest) for students with high interest in Grade 9	Switching to high interest in Grade 11 (vs. maintaining low interest) for students with low interest in Grade 9
	OR [95%CI]	OR [95%CI]
	White (n = 10,810)	
Perceived teacher unfairness	.87 [.76, 1.00]	1.09 [.96, 1.24]
Parent socialization	**1.30 [1.01, 1.65]***	**1.34 [1.00, 1.79]***
Female	**.86 [.76, .99]***	**1.02 [.86, 1.20]***
Prior achievement	**1.03 [1.02, 1.04]*****	**1.02 [1.01, 1.03]*****
Socioeconomic status	.93 [.84, 1.03]	1.06 [.93, 1.22]
	Asian (n = 1,470)	
Perceived teacher unfairness	1.03 [.65, 1.64]	1.05 [.60, 1.84]
Parent socialization	1.32 [.55, 3.19]	2.49 [.88, 7.00]
Female	1.09 [.67, 1.78]	**.58 [.34, .96]***
Prior achievement	**1.03 [1.00, 1.06]***	1.03 [1.00, 1.07]
Socioeconomic status	.71 [.5-, 1.01]	.80 [.50, 1.27]
	Latinx (n = 2,980)	
Perceived teacher unfairness	.96 [.70, 1.30]	.81 [.52, 1.25]
Parent socialization	1.73 [.82, 3.63]	1.10 [.55, 2.22]
Female	1.06 [.73, 1.55]	.99 [.69, 1.40]
Prior achievement	**1.04 [1.02, 1.05]*****	1.02 [.99, 1.05]
Socioeconomic status	.77 [.59, 1.00]	.89 [.65, 1.22]
	Black (n = 1,860)	
Perceived teacher unfairness	**.75 [.56, .99]***	1.20 [.86, 1.67]
Parent socialization	.72 [.24, 2.20]	.81 [.32, 2.06]
Female	1.05 [.73, 1.50]	**2.02 [1.11, 3.67]***
Prior achievement	1.01 [.99, 1.03]	1.02 [1.00, 1.05]
Socioeconomic status	1.01 [.72, 1.41]	**.64 [.41, .99]***

Note. *p < .05. **p < .01. ***p < .001.
SOURCE: U.S. Department of Education, Institute of Educational Sciences, National Center for Education Statistics, High School Longitudinal Study of 2009 (HSLS:09), Base Year.

Table 2.7

Logistic Regression Results with Grade 11 Utility Value (UV) as an Outcome Within Each Race/Ethnicity

	Maintaining high UV in Grade 11 (vs switching to low UV) for students with high UV in Grade 9 OR [95%CI]	Switching to high UV in Grade 11 (vs. maintaining low UV) for students with low UV in Grade 9 OR [95%CI]
	White (*n* = 10,810)	
Perceived teacher unfairness	**.75 [.65, .87]*** **	.99 [.85, 1.17]
Parent socialization	1.09 [.76, 1.55]	1.14 [.81, 1.60]
Female	.96 [.81, 1.14]	.82 [.66, 1.02]
Prior achievement	**1.02 [1.02, 1.03]*** **	**1.01 [1.00, 1.02]** **
Socioeconomic status	.91 [.79, 1.06]	**.85 [.73, .98]* **
	Asian (*n* = 1,470)	
Perceived teacher unfairness	1.39 [.72, 2.67]	1.89 [.92, 3.86]
Parent socialization	2.67 [.65, 10.90]	.63 [.19, 2.17]
Female	1.29 [.63, 2.65]	.82 [.32, .2.10]
Prior achievement	1.02 [.99, 1.06]	1.00 [.95, 1.05]
Socioeconomic status	.62 [.34, 1.16]	.83 [.48, 1.47]
	Latinx (*n* = 2,980)	
Perceived teacher unfairness	1.01 [.73, 1.39]	.86 [.56, 1.33]
Parent socialization	.92 [.53, 1.58]	.81 [.29, 2.28]
Female	.75 [.43, 1.31]	1.19 [.66, 2.16]
Prior achievement	**1.03 [1.00, 1.06]* **	1.02 [.98, 1.05]
Socioeconomic status	.90 [.65, 1.24]	.77 [.51, 1.17]
	Black (*n* = 1,860)	
Perceived teacher unfairness	1.02 [.61, 1.70]	.86 [.44, 1.69]
Parent socialization	1.07 [.33, 3.51]	2.65 [.45, 15.56]
Female	.81 [.41, 1.59]	1.47 [.62, 3.48]
Prior achievement	.99 [.97, 1.02]	1.00 [.95, 1.06]
Socioeconomic status	.98 [.65, 1.48]	.83 [.48, 1.41]

Note. *p < .05. **p < .01. ***p < .001.
SOURCE: U.S. Department of Education, Institute of Educational Sciences, National Center for Education Statistics, High School Longitudinal Study of 2009 (HSLS:09), Base Year.

Figure 2.1

Proportions and Latent Transition Probabilities for Expectancies for Success From Grades 9 to 11

White (*n* = 11,770)

	Grade 9	Patterns of stability and change	Grade 11
High expectancies for success	57%	58% maintained high motivation 42% switched from high to low	47%
Low expectancies for success	43%	32% switched from low to high 68% maintained low motivation	53%

Asian (*n* = 1,660)

	Grade 9	Patterns of stability and change	Grade 11
High expectancies for success	66%	61% maintained high motivation 39% switched from high to low	53%
Low expectancies for success	34%	39% switched from low to high 61% maintained low motivation	47%

Latinx (*n* = 3,430)

	Grade 9	Patterns of stability and change	Grade 11
High expectancies for success	54%	56% maintained high motivation 44% switched from high to low	45%
Low expectancies for success	46%	31% switched from low to high 69% maintained low motivation	55%

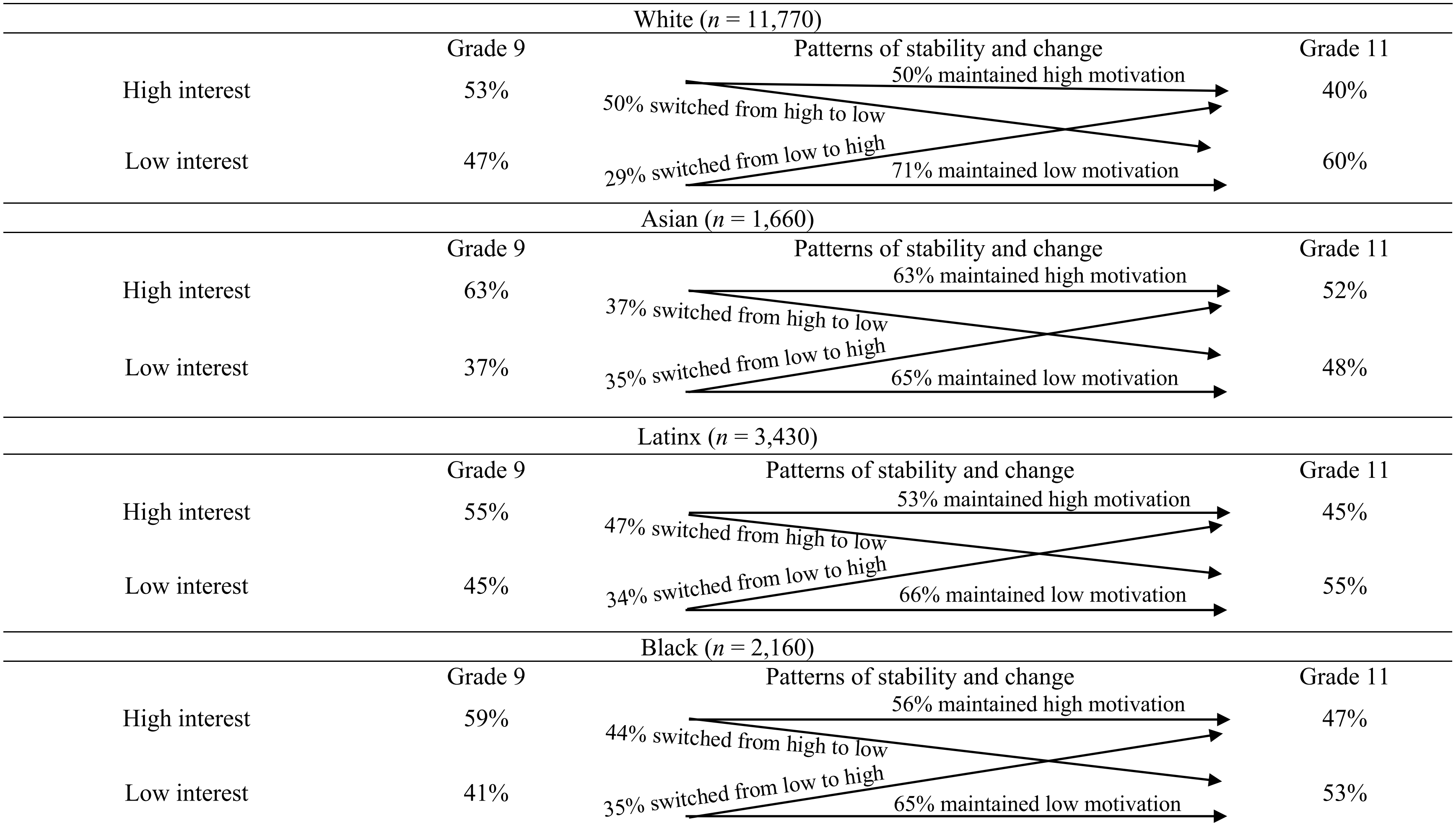
Black (*n* = 2,160)

	Grade 9	Patterns of stability and change	Grade 11
High expectancies for success	61%	62% maintained high motivation 38% switched from high to low	53%
Low expectancies for success	39%	38% switched from low to high 62% maintained low motivation	47%

Note. Expectancies for success was dichotomized (0 = *Low expectancies for success*, 1 = *High expectancies for success*).
SOURCE: U.S. Department of Education, Institute of Educational Sciences, National Center for Education Statistics, High School Longitudinal Study of 2009 (HSLS:09), Base Year.

Figure 2.2

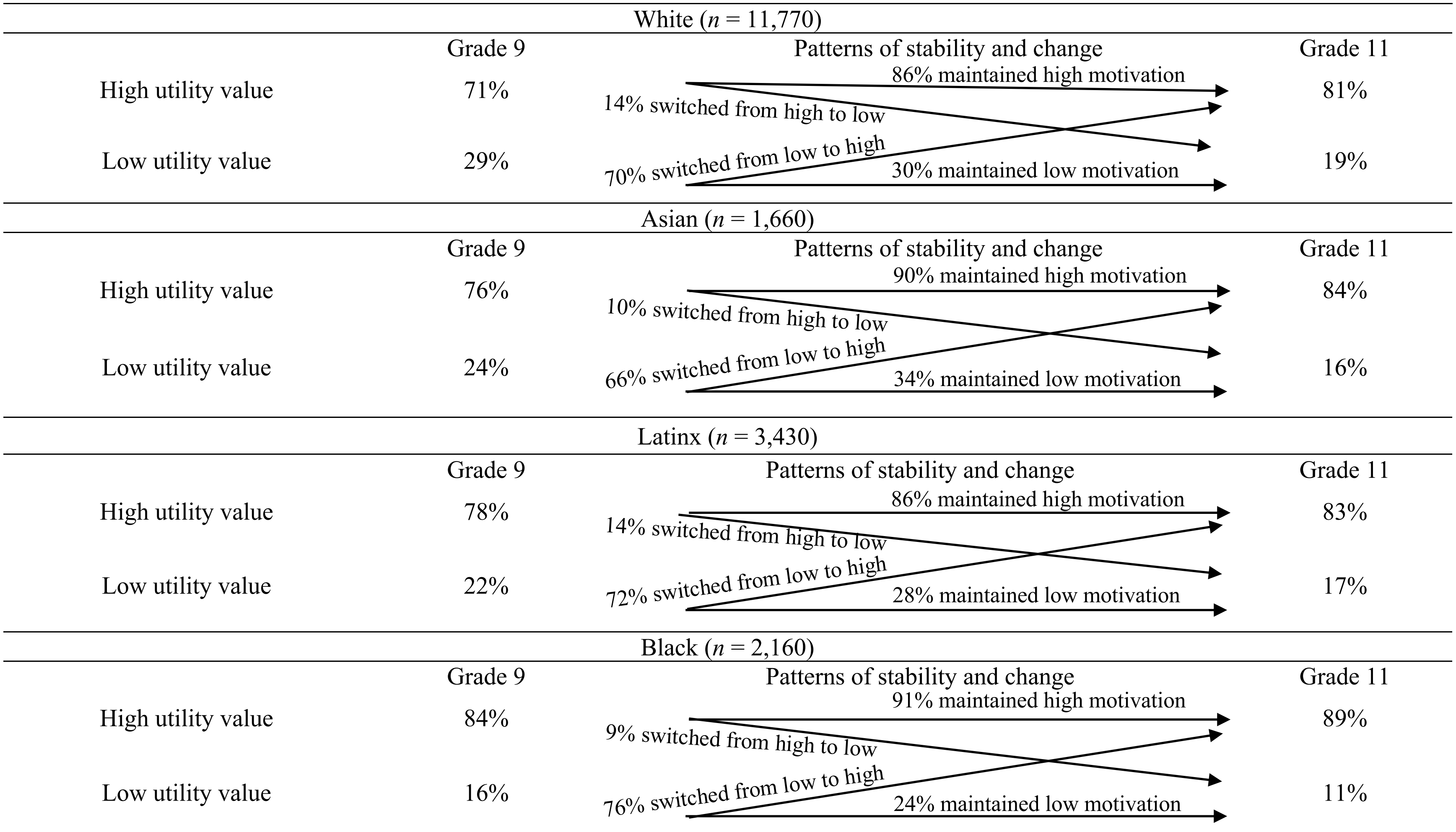
Proportions and Latent Transition Probabilities for Interest From Grades 9 to 11



Note. Interest was dichotomized (0 = *Low interest*, 1 = *High interest*).
SOURCE: U.S. Department of Education, Institute of Educational Sciences, National Center for Education Statistics, High School Longitudinal Study of 2009 (HSLS:09), Base Year.

Figure 2.3

Proportions and Latent Transition Probabilities for Utility Value From Grades 9 to 11



Note. Utility value was dichotomized (0 = *Low utility value*, 1 = *High utility value*).
SOURCE: U.S. Department of Education, Institute of Educational Sciences, National Center for Education Statistics, High School Longitudinal Study of 2009 (HSLS:09), Base Year.

Supplemental Materials

Table 2.S1

Analytic Sample Versus Excluded Sample

	Analytic sample					Excluded sample					Effect size
	n	*M*	*SD*	Min	Max	*n*	*M*	*SD*	Min	Max	
Grade 9 Expectancies for success	17100	0.58	0.49	0	1	1990	0.57	0.50	0	1	.01[a]
Grade 9 Interest	17110	0.56	0.50	0	1	2000	0.55	0.50	0	1	.01[a]
Grade 9 Utility value	17010	0.73	0.44	0	1	1960	0.73	0.44	0	1	.00[a]
Grade 11 Expectancies for success	16620	0.49	0.50	0	1	3480	0.48	0.50	0	1	.01[a]
Grade 11 Interest	16640	0.44	0.50	0	1	3490	0.42	0.49	0	1	.02[a]
Grade 11 Utility value	16640	0.83	0.38	0	1	3480	0.84	0.37	0	1	.01[a]
Perceived teacher unfairness	17040	1.85	0.65	1	4	1990	1.87	0.65	1	4	.03[b]
Parent socialization	18920	0.64	0.31	0	1	2840	0.61	0.33	0	1	.09[b]
Female	19010	0.49	0.50	0	1	6130	0.47	0.50	0	1	.02[a]
White	19010	0.62	0.49	0	1	4220	0.12	0.32	0	1	.39[a]
Asian	19010	0.09	0.28	0	1	4220	0.10	0.31	0	1	.01[a]
Latinx	19010	0.18	0.38	0	1	4220	0.14	0.34	0	1	.04[a]
Black	19010	0.11	0.32	0	1	4220	0.12	0.32	0	1	.01[a]
Math achievement	18750	40.53	11.94	15.85	69.93	2700	37.79	11.97	15.93	69.93	.23[b]
Socioeconomic status	18810	0.07	0.79	-1.93	2.88	3180	-0.12	0.72	-1.75	2.57	.25[b]

Note. Sample size rounded to the nearest tens place in accordance to the NCES regulations. Each motivational belief variables are dichotomized (e.g., 0 = low expectancies for success, 1 = high expectancies for success). Convention for [a]Phi coefficient: small = .1, medium = .3, large = .5. [b]Cohen's *d*: small = .2, medium = .5, large = .8.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, High School Longitudinal Study of 2009 (HSLS:09), Base Year and First Follow-Up.

Table 2.S2

Comparisons Between Sample with Complete Data and with Some Missing Data From the Entire Analytic Sample

	Sample with complete data					Sample with missing data					Effect size
	n	*M*	*SD*	Min	Max	*n*	*M*	*SD*	Min	Max	
Grade 9 Expectancies for success	14320	0.59	0.49	0	1	2780	0.53	0.50	0	1	.04[a]
Grade 9 Interest	14320	0.57	0.50	0	1	2790	0.51	0.50	0	1	.04[a]
Grade 9 Utility value	14320	0.73	0.44	0	1	2690	0.72	0.45	0	1	.01[a]
Grade 11 Expectancies for success	14320	0.50	0.50	0	1	2300	0.47	0.50	0	1	.02[a]
Grade 11 Interest	14320	0.44	0.50	0	1	2320	0.43	0.50	0	1	.01[a]
Grade 11 Utility value	14320	0.83	0.38	0	1	2320	0.84	0.37	0	1	.01[a]
Perceived teacher unfairness	14320	1.84	0.64	1	4	2720	1.91	0.67	1	4	.11[b]
Parent socialization	14320	0.66	0.30	0	1	4600	0.59	0.33	0	1	.22[b]
Female	14320	0.51	0.50	0	1	4690	0.46	0.50	0	1	.04[a]
White	14320	0.64	0.48	0	1	4690	0.56	0.50	0	1	.07[a]
Asian	14320	0.09	0.28	0	1	4690	0.09	0.28	0	1	.00[a]
Latinx	14320	0.17	0.37	0	1	4690	0.22	0.41	0	1	.06[a]
Black	14320	0.11	0.31	0	1	4690	0.14	0.34	0	1	.04[a]
Math achievement	14320	41.80	11.74	15.87	69.93	4430	36.44	11.66	15.85	69.93	.46[b]
Socioeconomic status	14320	0.13	0.79	-1.93	2.88	4490	-0.12	0.75	-1.82	2.57	.32[b]

Note. Sample size rounded to the nearest tens place in accordance to the NCES regulations. Each motivational belief variables are dichotomized (e.g., 0 = low expectancies for success, 1 = high expectancies for success). [a]Phi coefficient: small = .1, medium = .3, large = .5. [b]Cohen's *d*: small = .2, medium = .5, large = .8.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, High School Longitudinal Study of 2009 (HSLS:09), Base Year and First Follow-Up.

Table 2.S3

Logistic Regression Results with ***Grade 9 Motivational Beliefs*** *as Outcomes* ***Within Each Race/Ethnicity*** *Without Covariates*

	High expectancies for success in Grade 9 (vs low expectancies for success)	High Interest in Grade 9 (vs low interest)	High Utility value in Grade 9 (vs low utility value)
	OR [95%CI]	OR [95%CI]	OR [95%CI]
White (*n* = 10,810)			
Perceived teacher unfairness	**.54 [.50, .59]*** **	**.27 [.25, .30]*** **	**.52 [.48, .58]*** **
Parent socialization	**2.31 [1.91, 2.79]*** **	**2.52 [2.06, 3.07]*** **	**1.78 [1.45, 2.19]*** **
Asian (*n* = 1,470)			
Perceived teacher unfairness	**.57 [.41, .79]*** **	**.30 [.20, .45]*** **	**.50 [.35, .72]*** **
Parent socialization	**2.42 [1.22, 4.80]* **	.94 [.41, 2.13]	.84 [.35, 2.10]
Latinx (*n* = 2,980)			
Perceived teacher unfairness	**.64 [.47, .88]** **	**.29 [.23, .36]*** **	.79 [.62, 1.00]
Parent socialization	**2.78 [1.51, 5.12]*** **	**2.25 [1.34, 3.76]** **	**1.85 [1.19, 2.89]** **
Black (*n* = 1,860)			
Perceived teacher unfairness	**.62 [.47, .82]*** **	**.33 [.25, .42]*** **	**.48 [.35, .67]*** **
Parent socialization	1.62 [.87, 3.03]	1.73 [.98, 3.04]	1.07 [.51, 2.24]

Note. *$p < .05$. **$p < .01$. ***$p < .001$.
SOURCE: U.S. Department of Education, Institute of Educational Sciences, National Center for Education Statistics, High School Longitudinal Study of 2009 (HSLS:09), Base Year.

Table 2.S4

Logistic Regression Results with Grade 11 Expectancies for Success (ES) as an Outcome Within Each Race/Ethnicity Without Covariates

	Maintaining high ES in Grade 11 (vs switching to low ES) for students with high ES in Grade 9	Switching to high ES in Grade 11 (vs. maintaining low ES) for students with low ES in Grade 9
	OR [95%CI]	OR [95%CI]
	White (*n* = 10,810)	
Perceived teacher unfairness	.92 [.21, 1.02]	.93 [.81, 1.06]
Parent socialization	**1.51 [1.17, 1.96]****	1.15 [.85, 1.55]
	Asian (*n* = 1,470)	
Perceived teacher unfairness	1.10 [.67, 1.79]	.96 [.48, 1.94]
Parent socialization	1.33 [.58, 3.04]	**3.39 [1.26, 9.11]***
	Latinx (*n* = 2,980)	
Perceived teacher unfairness	.77 [.56, 1.07]	1.21 [.92, 1.58]
Parent socialization	**3.30 [1.25, 8.72]***	1.87 [.94, 3.73]
	Black (*n* = 1,860)	
Perceived teacher unfairness	1.06 [.80, 1.40]	.85 [.52, 1.39]
Parent socialization	1.22 [.50, 2.98]	.62 [.24, 1.59]

Note. *$p < .05$. **$p < .01$. ***$p < .001$.
SOURCE: U.S. Department of Education, Institute of Educational Sciences, National Center for Education Statistics, High School Longitudinal Study of 2009 (HSLS:09), Base Year.

Table 2.S5

Logistic Regression Results with Grade 11 Interest as an Outcome Within Each Race/Ethnicity Without Covariates

	Maintaining high interest in Grade 11 (vs switching to low interest) for students with high interest in Grade 9	Switching to high interest in Grade 11 (vs. maintaining low interest) for students with low interest in Grade 9
	OR [95%CI]	OR [95%CI]
	White (*n* = 10,810)	
Perceived teacher unfairness	**.86 [.75, .98]***	1.06 [.93, 1.20]
Parent socialization	**1.65 [1.30, 2.10]*****	**1.66 [1.27, 2.18]*****
	Asian (*n* = 1,470)	
Perceived teacher unfairness	.99 [.62, 1.58]	1.02[.58, 1.77]
Parent socialization	1.23 [.52, 2.93]	**3.00 [1.17, 7.66]***
	Latinx (*n* = 2,980)	
Perceived teacher unfairness	.98 [.72, 1.34]	.77 [.48, 1.22]
Parent socialization	1.93 [.96, 3.88]	1.14 [.59, 2.17]
	Black (*n* = 1,860)	
Perceived teacher unfairness	**.74 [.55, .99]***	1.02 [.73, 1.43]
Parent socialization	.80 [.27, 2.36]	1.02 [.41, 2.55]

Note. *p < .05. **p < .01. ***p < .001.
SOURCE: U.S. Department of Education, Institute of Educational Sciences, National Center for Education Statistics, High School Longitudinal Study of 2009 (HSLS:09), Base Year.

Table 2.S6

Logistic Regression Results with Grade 11 Utility Value (UV) as an Outcome Within Each Race/Ethnicity Without Covariates

	Maintaining high UV in Grade 11 (vs switching to low UV) for students with high UV in Grade 9	Switching to high UV in Grade 11 (vs. maintaining low UV) for students with low UV in Grade 9
	OR [95%CI]	OR [95%CI]
	White (*n* = 10,810)	
Perceived teacher unfairness	**.72 [.63, .83]*** **	.99 [.84, 1.17]
Parent socialization	1.31 [.94, 1.83]	1.17 [.85, 1.62]
	Asian (*n* = 1,470)	
Perceived teacher unfairness	1.36 [.69, 2.70]	1.89 [.93, 3.87]
Parent socialization	2.44 [.71, 8.37]	.57 [.20, 1.64]
	Latinx (*n* = 2,980)	
Perceived teacher unfairness	.95 [.68, 1.32]	.85 [.55, 1.32]
Parent socialization	1.06 [.66, 1.70]	.77 [.29, 2.03]
	Black (*n* = 1,860)	
Perceived teacher unfairness	1.05 [.64, 1.75]	.81 [.36, 1.84]
Parent socialization	.96 [.27, 3.41]	2.76 [.29, 25.87]

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

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

CHAPTER 4

Overarching Discussion

Prior studies have often highlighted the decreasing trends in students' motivational beliefs with age, particularly across childhood to adolescence (Fredricks & Eccles, 2002; Jacobs et al., 2002; Wigfield et al., 2015). These patterns were also highlighted in theoretical frameworks, such as the stage-environment fit theory, that stress the misfit between adolescents' developmental needs and academic settings including high schools (Eccles et al., 1993). In my dissertation studies, I found that not all students displayed decreasing patterns in their motivational beliefs. Varying patterns of stability as well as increasing trends were noted across different types of motivational beliefs (i.e., expectancies for success, interest, utility value, and attainment value) and in different racial/ethnic groups. The findings from this dissertation extend the current literature that focused mostly on the motivational belief development of White students and contribute to the growing evidence that, contrary to the decreasing trends that were previously characterized, some students' motivational beliefs increase or are stable during this period.

The Variability in Motivational Belief Development

Alike the findings from my dissertation, several recent studies have noted interindividual differences in the changes of motivational beliefs and displayed qualitatively different developmental trends including decreases, stability, and increases in students' motivational beliefs during adolescence (Gaspard et al., 2020; Guo et al., 2018; Musu-Gillette et al., 2015). Nevertheless, most literature still emphasizes the decreasing trends across development rather than to highlight the more positive motivational belief development (Wigfield et al., 2019). Particularly in STEM, we discuss ideas, such as the leaky pipeline, to stress the decreasing motivational beliefs or fewer selections into STEM in marginalized groups (e.g., Jacobs & Simpkins, 2005). That is, those who are marginalized in STEM are considered to continue to fall out of STEM trajectories throughout high school to career by selecting courses, majors, and careers in non-STEM fields. However, several studies have displayed that students not only move from STEM to non-STEM fields, but they also move from non-STEM to STEM fields (Starr, Ramos, & Simpkins, 2022; Xie & Shauman, 2003). Likewise, I found that the leaky pipeline metaphor may not be appropriate for describing motivational belief development in math as some students displayed stable or increasing trends in their motivational beliefs. Our next steps may involve understanding what accounts for the decreasing trends in some students and the stability or increasing trends in other students. Moreover, the increasing trends suggest that high school can still be an important time for interventions to boost students' motivational beliefs. Below, I describe further the types of interventions that may be particularly effective.

I found varying developmental patterns by motivational beliefs. In both studies, many students displayed stable expectancies for success during this period. Adolescence is when students develop stronger cognitive skills to evaluate their own academic ability or socio-cultural expectations toward them (e.g., Watt, 2004). Further, students are often placed in an environment where they receive information about their math ability, such as being placed in different math course sequences (Simpkins et al., 2006; Wang, 2012). Given that the course tracking often starts in middle school and continues in high school (Simpkins et al., 2006; Wang, 2012), students' continued experiences in a math track placement may explain the stability in their expectancies for success. The experiences that have accumulated over time, including their own mastery experiences and feedback from society, may make students' math expectancies for success to be more stable and less likely to change during adolescence.

Across the two studies, I found that many students belonged to low and stable groups for interest, but high groups for utility value. Additionally, Study 2 demonstrated that many students also switched from low to high utility value in all racial/ethnic groups. Middle school is when math classes tend to be less interesting, more abstract, and more challenging compared to elementary school (Eccles et al., 1993; Hidi & Renninger, 2006). My studies involved students who are transitioning from middle to high school or are in high school, meaning that they have already experienced the changes in the characteristics of their math courses and have taken math classes for many years. For many students, their interest may have become low during middle school and this low level may maintain during the transition to high school and in high school as it has already become individualized and less likely to change (Hidi & Renninger, 2006). On the other hand, utility value is likely to develop later in middle childhood to adolescence as students begin to develop a better understanding of why they are engaging in tasks and how it is important to their personal identity (Wigfield et al., 2009). Hulleman and Harackiewicz (2021) also stressed that utility value is more likely to develop as students become more proficient at making connections between the tasks and their personal relevance. High school is also when students are making decisions for their future, including educational plans. Given that math is often essential to get into colleges and finding a prestigious job (Rosenzweig et al., 2019), students may find math to be useful. Therefore, despite having low interest, many students may hold or develop high utility value during high school as they start to create a more concrete plan for their life post high school.

Though related, each motivational belief is a unique construct (Wigfield et al., 2009). Consistently, I found varying developmental patterns for each motivational construct. These findings have several implications. The stable trends in expectancies for success in all racial/ethnic groups suggests that the socio-cultural influences may set their beliefs about their ability earlier than high school. One way to reduce the existing racial/ethnic gaps in STEM may be to address these systematic issues where their achievement level or course placement translates to their ability beliefs (Crisp et al., 2015; Murphy & Zirkel, 2015). Students often displayed more negative development in interest and attainment value compared to utility value. Recently, scholars have suggested the need for interventions that target constructs other than utility value from situated expectancy-value theory (Rosenzweig et al., 2022). At least in math and in high school, interventions that target promoting interest and attainment value may be particularly critical to foster positive motivational changes in the students. Enhancing students' motivational beliefs is key to their academic success and as my findings suggest, the next step for the motivation researchers may be to explore interventions that target motivational belief constructs other than utility value.

The Intersection of Race/Ethnicity and Gender

Examining the average trends masked the multiple, underlying developmental trends, including the positive changes in the marginalized groups, such as Latinx students. For example, the average patterns within the Latinx group displayed that many Latinx students decreased or maintained low expectancies for success and interest over time rather than increasing or maintaining high motivational beliefs. By testing the racial/ethnic and gender differences in the developmental trajectories, however, I found that whereas Latina students were more likely to maintain lower expectancies for success compared to Asian male students, Latino students did not significantly differ in their trajectories from Asian students. For interest, both Latino and Latina students were more likely to demonstrate increasing trajectories than decreasing trajectories compared to Asian male students. Though examining the average changes in each racial/ethnic group was helpful to understand the general patterns, taking a different methodological approach and examining the questions at the intersection of race/ethnicity and gender were important to display subgroups that did not follow the average trends. Likewise, researchers should consider various analytic strategies, including person-centered approaches, to highlight the trends and subgroups that are invisible in the average patterns and to avoid generalizing an individual's development to any group membership.

I found that students who belonged to marginalized groups in math also displayed positive motivational development. Despite the marginalization status in math, not all math experiences of Latinx and Black students may be negatively stereotyped social experiences that hinder their motivational belief development. For example, some students may have supportive parents who do not affirm the stereotypes but rather help the adolescents to overcome systematic barriers and display resilience (Starr, Tulagan, & Simpkins, 2022). Taking the intersectionality approach can help examine the diversity within groups to further identify the issues with marginalization and privilege status in math and demonstrate not just the challenges but also the strengths of marginalized groups.

The Role of Background Variables

It is important to note the individual factors that can play a role in adolescent development (Eccles & Wigfield, 2020; Wigfield & Eccles, 2020). For example, I found differences in the developmental patterns based on race/ethnicity or on race/ethnicity and gender identities, as well as depending on whether the background variables, such as prior achievement and family socioeconomic status, were included in the models. One of the strongest predictors of students' motivational beliefs is their prior achievement because it serves to indicate their level of mastery in the domain, as a positive or negative feedback toward their ability, and as a measure of social comparison with peers (Wigfield et al., 2009). Socioeconomic status shapes motivational beliefs because depending on socioeconomic status, students often experience different levels of socio-emotional and academic support from their parents, access to resources in schools, and teacher quality (e.g., Crisp et al., 2015). These environmental factors are important to examine in research that includes diverse races/ethnicities because they often intersect with one's social identities (Parker et al., 2020). That is, students' experiences may differ based on their social identities (e.g., race/ethnicity) because these experiences are also socially constructed (Martin, 2000). Students who are marginalized in math, often come from families of lower socioeconomic backgrounds or experience lower quality classes, and less access to resources compared to students who are privileged in math (e.g., Crisp et al., 2015; Riegle-Crumb, 2006*)*.

In the two studies, I tested my research questions with and without background variables. Specifically, the developmental patterns in Study 2 were tested without covariates whereas the racial/ethnic comparisons were tested both with and without covariates in Study 1, ruling out the influence of factors, such as family socioeconomic status and prior achievement. Thus, some of the differences across the two studies, such as most students displaying high and decreasing trajectories in utility value in Study 1 but high and stable or increasing patterns in utility value in Study 2, may have been due to the presence of covariates. The robustness check in Study 1 without the covariates also suggested different patterns than the findings with covariates. Thus, some of the patterns changed depending on whether some of the structural barriers (e.g., lower socioeconomic background) were controlled for in the analyses. My findings demonstrate the significant role of different social backgrounds or academic experiences in the development of students of diverse races/ethnicities and the need to address the academic and social challenges experienced by students from marginalized groups.

In these studies, background variables may have been particularly critical because the populations of the two studies were different. Whereas Study 2 was conducted with a nationally representative sample, Study 1 was conducted with students who were from predominantly low-income families and school districts with a high representation of the Latinx population. These students may have been fundamentally different in their experiences of stereotypes or their exposure to resources. The strong influence of the environmental constraints on students' motivation development warrants researchers to think carefully about the role of covariates in future research involving various social identities, including race/ethnicity (Rubach et al., 2022).

Socio-Cultural Influences on the Developmental Changes

Prior studies on motivational belief development that utilized the situated expectancy-value theory framework often involved White, middle-class families (e.g., Fredricks & Eccles, 2002; Jacobs et al., 2002; Watt, 2004). However, one of the tenets of situated expectancy-value theory is that the cultural milieu influences how motivational beliefs are shaped (Eccles & Wigfield, 2020; Wigfield & Eccles, 2020). In my dissertation, I found that students' social identities (i.e., race/ethnicity, gender) predict various patterns in their motivational belief development in math – a domain that has been historically considered a White, male domain (McGee, 2018). The findings suggested that positive or negative experiences based on cultural stereotypes, such as the model minority stereotype for Asians or negative stereotypes toward Latinx and Black students may shape their math motivational beliefs.

Also, situated expectancy-value theory posits that these societal expectations and stereotypes are often communicated to the students through socializers, especially their parents and teachers (Wigfield & Eccles, 2020). My findings highlighted that social experiences that affirm negative stereotypes, such as perceived teacher unfairness, can hinder the motivational beliefs of racially/ethnically marginalized students, whereas receiving parent socialization can promote their motivational beliefs. That said, socializers may have the power to help students from marginalized groups to display resilience by challenging the structural barriers and the traditional stereotypes themselves. Educating socializers in adolescents' lives, including parents and teachers, may be one of the strategies to foster positive motivational beliefs in all youths and address the disparities that exist in math.

Additionally, my findings suggest that motivational beliefs may not always decrease during adolescence, and especially in high school. Theories like the stage-environment fit theory have been used to explain that students often experience decreases in their motivational beliefs during adolescence due to the misfit between the school settings and the developmental needs of the adolescents (Eccles et al., 1993). Though the theory was primarily focused on the experiences during the transition period between elementary to middle school, some researchers have used it to emphasize that decreasing trends can also be observed across the transition from middle to high school given the similar structural issues in high school (Lee & Smith, 2021; Wigfield et al., 2019). My findings suggest that not all students display decreases in their motivational beliefs during this period and highlight that some may not experience the misfits between their developmental needs and the academic environment, or they may experience the misfits but they also have other experiences that help them display resilience. Understanding the differences in the academic contexts, such as different classroom experiences, for individuals may help identify what helps or hinders motivational belief development for youths.

Limitations and Future Directions

Despite the significant findings from the two studies of this dissertation, they are not without limitations. First, some of the different findings in the patterns across the two studies may be due to the dataset characteristics. I utilized the regional dataset with mostly Latinx and Asian participants from low-income families for Study 1 whereas the nationally representative sample was used for Study 2. Thus, Asian students in Study 1, who were predominantly Vietnamese students from lower-income families, may have not been a representation of the Asian group at the national level. Even though I was able to test whether the findings replicated across similar groups in these two studies that involved different datasets (e.g., Latinx & Asian students), researchers could extend these two studies and conduct replications across multiple datasets to test whether the contextual or methodological differences determine the differences in the findings (e.g., Rubach et al., 2022).

Second, I grouped the students by four major racial/ethnic groups in the U.S., specifically, White, Asian, Black, and Latinx groups. However, there is heterogeneity within these groups as well. For example, Asians can be comprised of East Asians (e.g., Chinese, Japanese, Koreans), Southeast Asians (e.g., Thai, Vietnamese), and more. Study 1 was comprised mostly of Southeast Asians, whereas the distinction was not made in the Asian population in Study 2. The different patterns may have arisen based on their more specific racial/ethnic backgrounds. For example, whereas Eastern Asian Americans often outperform students of other racial/ethnic backgrounds, Southeastern Asian Americans often perform at lower levels than the other groups (Lee & Madyun, 2008). Future studies could consider variability that exists within racial/ethnic groups.

Third, I used different approaches to examine multiple racial/ethnic groups in the two studies. I did not examine the intersectionality of race/ethnicity and gender in Study 2 because I was interested in examining the role of socializers in different racial/ethnic groups rather than in different racial/ethnic and gender groups. Additionally, too many models would have been estimated if the participants were grouped based on their race/ethnicity, gender, and their initial level of motivational beliefs in Grade 9 (e.g., Black female students with low expectancies for success in Grade 9). There are various ways to examine group differences, such as at the intersectionality of race/ethnicity and gender, racial/ethnic differences controlling for gender, racial/ethnic differences within each gender, and more. By looking at the intersection of race/ethnicity and gender, I was able to test how the interplay between both social identities shapes motivational beliefs and especially highlight individuals from the often-invisible subgroups, such as Latina students. Testing for motivational belief development in each racial/ethnic group while controlling for gender helped me to identify different developmental patterns that still exist within each race/ethnicity and highlight the role of parents and teachers in shaping motivational beliefs among individuals from the same racial/ethnic group. Depending on the research questions, researchers could explore various ways to identify diversity within groups, including racial/ethnic and gender differences.

Lastly, I examined the role of socializers by using the measures on parent socialization and perceived teacher unfairness. However, there are other indicators of structural barriers in academic settings, such as the racial/ethnic compositions in schools, perceived discrimination from peers, or lack of resources (e.g., Shifrer et al., 2023; Wong et al., 2003). Additionally, there are other aspects of family support critical to the development of marginalized youths, such as parents' cultural socialization or the role of siblings (Garcia Coll et al., 1996; Huguley et al., 2019; Tulagan et al., 2022; Umaña-Taylor & Hill, 2020). The studies from this dissertation could be extended to examine other types of support and challenges.

Conclusion

Mainly guided by situated expectancy-value theory, I examined adolescents' math motivational belief development by race/ethnicity, at the intersection of race/ethnicity and gender, and the potential promotive or hindering role of socializers. I found that there is variability in the patterns of motivational belief development in different racial/ethnic groups. Not all students displayed decreasing patterns that are typically suggested to occur across adolescence. Some students, including those from marginalized groups in math, displayed stability and increasing patterns of motivational beliefs. Additionally, I found that perceived teacher unfairness hindered motivational belief development particularly among Black students, whereas parent socialization predicted positive motivational belief development among Asian and Latinx students. The studies from my dissertation highlight the role of socio-cultural factors in shaping motivational beliefs among adolescents from diverse racial/ethnic backgrounds and the variability in their motivational belief development.

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