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Examining the Development of Latinx Adolescents’ Science Intrinsic and Utility Values: A Family Systems Approach

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Examining the Development of Latinx Adolescents' Science Intrinsic and Utility Values: A Family Systems Approach

DISSERTATION

submitted in partial satisfaction of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

in Education

by

Kayla Puente

Dissertation Committee:
Professor Sandra D. Simpkins, Chair
Associate Professor Glenda M. Flores
Distinguished Professor Jacquelynne Sue Eccles

2022

DEDICATION

For

my parents, Sonia and Mario, my brother Michael, my husband Aurelio, and son Diego

for always inspiring me and supporting my dreams.

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ACKNOWLEDGEMENTS

I would like to first acknowledge and thank my advisor and mentor, Dr. Sandi Simpkins, who I have learned so much from the past five years. The past five years have been the most challenging, intense, but exciting years of my life so far. Thank you, Sandi, for guiding me throughout this journey and providing the support that I needed every step of the way. I admire your dedication to your students and the way you have created a positive environment where we are allowed to make mistakes, be vulnerable, and grow both personally and professionally. I would also like to thank Dr. Jacque Eccles and Dr. Glenda Flores. Thank you, Jacque, for your guidance throughout my graduate journey and always having your door open. I appreciate all of the conversations we had and will continue to have. Thank you, Glenda, for the classes you taught that informed much of my work and were spaces where we could have important conversations about research on Latinx/es and other marginalized groups.

I would also like to acknowledge and thank my labmates, who were my support system in graduate school: Yangyang Liu, Diane Hsieh, Mark Yu, Nestor Tulagan, Stephanie Soto-Lara, Christy Starr, Zehra Gülseven, Su Jiang, Glona Lee, Perla Ramos Carranza, Fuko Kiyama, and Julie Nguyen. Thank you for the memories and many conversations about our research, life, and dreams. I am excited to see where life takes us and am immensely proud of the work that we produced.

Finally, I would like to acknowledge and thank my family. Para mis padres, gracias por siempre apoyarme en todos mis sueños y metas. Gracias por su sacrificio y amor incondicional. To my brother, thank you for always believing in me and encouraging me to keep going. This dissertation was in part inspired by you. To my husband and son, thank you for bringing me joy and supporting my endeavours. This degree is for all of you.

VITA
Kayla Puente

Education

2022	**Ph.D. Education** with a Chicanx/Latinx Emphasis University of California, Irvine *Dissertation*: "Latinx Adolescents' Science Subjective Task Values and Choices: A Family Systems Approach" Advisor: Sandra D. Simpkins, Ph.D.
2020	**M.A. Education** University of California, Irvine *Master's Thesis:* "Understanding the Role of Older Sibling Support in the Science Motivation of Latinx Adolescents" Advisor: Sandra D. Simpkins, Ph.D.
2016	**B.A. Psychology** with a Minor in Sociology Pomona College, Claremont, CA *Senior Thesis*: "Intrinsic Motivation Across Generations of Latino High School Students" Thesis Advisor: Raymond Buriel, Ph.D.

Grants & Fellowships

2021	American Educational Research Association Minority Dissertation Fellowship ($25,000)
2021	Division of Teaching Excellence and Innovation Summer Fellowship, University of California, Irvine ($5,000)
2021	University of California Adolescent Consortium Grant ($500)
2018	Honorable Mention, National Science Foundation Graduate Research Fellowship Program
2017	Eugene Cota-Robles Fellowship, University of California, Irvine ($62,000)
2017	Provost Ph.D. Fellowship, University of California, Irvine ($20,000)
2017	Diversity Recruitment Fellowship, School of Education, University of California, Irvine ($5,000)
2017	Competitive Edge Summer Research Program, University of California, Irvine ($5,000)

Publications

Tulagan, N., **Puente, K.,** & Simpkins, S. D. (2022). Latinx youths' science conversations with family members: Longitudinal associations with youths' science self-concept and task value in high school. *Applied Developmental Science.*

Ma, T. L., Zarrett, N., **Puente. K**, Liu, Y., Vandell, D. L., Simpkins, S. D, & Yu. M. V. B. (2022). Longitudinal links between profiles of social emotional behaviors in childhood and functioning in early adolescence. *Journal of Early Adolescence.*

Puente, K., Starr, C. R., Simpkins, S. D., & Eccles, J. S. (2021). Developmental trajectories of science identity beliefs: Within-Group differences among Black, Latinx, Asian, and White students. *Journal of Youth and Adolescence*.

Yu, M. V. B., Liu, Y., Soto-Lara, S., **Puente, K.,** Carranza, P. R. , Pantano, A., & Simpkins, S. D. (2021). Culturally responsive practices: Insights from a high-quality math afterschool program serving underprivileged Latinx youth. *American Journal of Community Psychology*. https://doi.org/10.1002/ajcp.12518

Puente, K. & Simpkins, S. D. (2020). Understanding the role of older sibling support in the science motivation of Latinx adolescents. *International Journal of Gender, Science and Technology, 11*(3), 405-428. Retrieved from: http://genderandset.open.ac.uk/index.php/genderandset/article/view/661/1094

Ma, T. L., Simpkins, S. D., & **Puente, K.** (2019). Latinx and White adolescents' reasons behind organized activity participation: The connections with cultural orientations, psychological engagement, and activity experiences. *Applied Developmental Science*, 1-15. https://doi.org/10.1080/10888691.2019.1571416

Manuscripts Under Review

Puente, K., & Simpkins, S. D. (under review). Latinx family support in science and its links to adolescents' science intrinsic and utility values.

Gülseven, Z, **Puente, K.**, Tulagan, N., Zarrett, N., Vandell, D. L., & Simpkins, S. D. (revise & resubmit). Developmental trajectories of children's self-control: Insights from mothers and teachers.

Selected Presentations

[1]due to COVID-19.

Puente, K., & Simpkins, S. D. (2022, March). *Examining associations between parent support, Latinx adolescent science motivation and STEM job expectations.* Poster presented (virtually) at the biennial meeting for the Society for Research on Adolescence, New Orleans, LA.

Puente, K., & Simpkins, S. D. (2020, March). *Math and science identity trajectories among Latinx students from high School and beyond.* Poster accepted at the biennial meeting for the Society for Research on Adolescence, San Diego, CA (Conference canceled)[1]

Puente, K., Tulagan, N., Simpkins, S. D., Vandell, D., & Zarrett, N. (2019, March). *Developmental trajectories of youth emotion regulation and self-control: Insights from mothers and teachers*. Poster presented at the Society for Research in Child Development Biennial Meeting, Baltimore, MA.

Puente, K., & Simpkins, S. D. (2019, March). *The role of sibling support in the science motivation of high school Latinx students*. Paper presented at the Society for Research in Child Development Biennial Meeting, Baltimore, MA.

Puente, K., & Simpkins, S. D. (2018, September). *The role of siblings and familism values in the science motivation of Latinx high school students.* Poster session presented at the School of Education's First Year Poster Session, University of California, Irvine.

Puente, K., & Simpkins, S. D. (2017, August). *Biculturalism and its Effect on the Relationship between Science Engagement and Science Motivation*. Poster session presented at the meeting of Competitive Edge Summer Program Symposium, University of California, Irvine.

Puente, K., & Buriel, R. (2016, May). *Intrinsic motivation across generations of Latino high school* *students.* Thesis presentation presented at Pomona College.

Invited Presentations

Yu, M. V. B., **Puente, K.,** Pantano, A., & Simpkins, S. D. (2020, February). *A collaborative approach to developing digital resources for community outreach*. UC Links digital resources workshop. Workshop presented at the University Community Links Annual Conference, University of California, Berkeley.

Yu, M. V. B., **Puente, K.,** Simpkins, S. D., Lao, J. (2019, March). *Strengthening university students' mentoring practices in a math enrichment program.* Presented at the University Community Links conference, University of California, Berkeley.

Honors & Awards

2019	**Outstanding Social Justice Activist Award**, Dynamic Womxn of UCI Awards 2019 Ceremony, University of California, Irvine
2016	**Distinction in the Senior Exercise**, Psychology Department, Pomona College
2012-2014	**Price Family 1st Generation Scholarship**, Pomona College

Research & Professional Experiences

University Community Links Graduate Research Assistant September 2018 – June 2020
University of California, Irvine

- Observed and evaluated student engagement in activities related to literacy, digital literacy, and critical thinking and global skills to inform UC Links reporting.
- Sustained the partnership between the UCI School of Education and five afterschool programs located in Orange County and at UCI through email communications and meetings.
- Maintained and updated the Certificate in After School Education (CASE) program website to give current information to undergraduate students taking CASE courses.

Competitive Edge Summer Research Program June – August 2017
University of California, Irvine

- Collaborated with Dr. Sandra Simpkins on a research project and produced a poster, which was presented at the end of the summer during the Symposium.
- Attended a two-month long summer program aimed at professional development and equipping incoming graduate students with campus resources.
- Participated in professional development workshops each week, such as a Teaching Assistant Strategies Workshop and Poster Presentation Workshop.

Senior Thesis September 2015 – May 2016
Department of Psychology, Pomona College

- Conducted and implemented an experimental psychology thesis, which involved creating survey materials and analyzing the collected data.
- Focused on evaluating intrinsic motivation among different generations of Latino high

school students.

Undergraduate Assistant **September 2015 – December 2015**
Autism Center, Claremont McKenna College

- Provided behavioral therapy for children between the ages of 5-10 with Autism for four hours a week through a course offered at Claremont McKenna College.
- Worked with children on developing their social skills by creating lesson plans three times throughout the semester and by working with them individually during activities.

Research Assistant **January 2015 – May 2015**
Cultural Neuroscience Lab, Pomona College

- Performed and analyzed EEG readings on participants in order to study the interaction between culture and neurological mechanisms.
- Gained knowledge about group collaboration, research writing skills, and proper researcher-participant interaction.

Research Assistant **February 2014 – December 2015**
Child Attachment, Relationships, and Emotion Lab, Pomona College

- Assisted for five hours every week in various research projects including transcribing therapy sessions, coding facial expressions of children, and interviewing participants for research projects.

Teaching and Mentoring Experience

Division of Teaching Excellence and Innovation Summer Fellowship **June – Sept. 2021**
Foundations in Out-of-School and Summer Learning, University of California, Irvine

- Collaborated with a faculty in designing and restructuring an existing in-person course for a hybrid format
- Created active learning activities and assignments for the course that were equitable and inclusive for all students

Culturally Relevant Pedagogy Lecture **October 2019**
Multicultural Education Undergraduate Course, University of California, Irvine

- Guest-lectured for a one-hour undergraduate multicultural education course on the topic of why culturally relevant pedagogy matters.
- Engaged with undergraduate students in discussion on topics such as implicit bias, culturally deficit perspectives, and stereotype threat.

DECADE Mentor Training Workshop **September 2019**
School of Education DECADE, University of California, Irvine

- Led a one-hour workshop with others in best practices for building strong mentor-mentee relationships.
- Created resource list and activity sheets for mentors to utilize throughout their mentoring journey.

Undergraduate Mentoring Resources **June – August 2019**
University Community Links, University of California, Irvine

- Led a team in creating mentoring resources for undergraduate students in Math CEO, a math enrichment program at UC Irvine, and the Certificate in Afterschool and Summer Education in the form of five videos with accompanying tip sheets.
- Planned topics to be covered in the videos with the team throughout the summer by meeting bi-weekly, researching each topic, and reaching out to graduate students and community members who were experts in the topic.
- Topics covered included community building practices, culturally responsive practices, scaffolding, inquiry, and growth mindset (see https://simpkinslab.weebly.com/mentoring-resources.html).

Graduate Student Mentor
School of Education DECADE, University of California, Irvine **September 2018 – June 2019**

- Mentored a first year Ph.D. student in the School of Education on the Ph.D. journey and process by offering knowledge on resources and my own experiences.

Teaching Fellow **June 2015 – July 2015**
Breakthrough Houston Collaborative

- Taught two Geometry classes composed of 12 rising ninth graders.
- Co-taught one Psychology class to rising 7^{th}, 8^{th}, and 9^{th} graders with another Teaching Fellow.
- Created a safe and fun learning environment through cheers and relationship-building.

Counselor **June 2013**
Young Owls Leadership Program, Rice University

- Mentored 9 high school students about the college process and experience along with 2 other advisors for two weeks at Rice University.

Community Engagement and Service

DECADE Mentorship Program Committee Member **August 2018 – present**
School of Education DECADE, University of California, Irvine

- Match current Ph.D. students to incoming Ph.D. students in order to provide incoming students with a mentor.
- Facilitate a mentor training workshop with the team as well as provide mentors with resources to help build strong mentor-mentee relationships.
- Coordinate quarterly socials where mentors and mentees can check-in as well as meet others in DECADE.

DECADE Higher Education Outreach Committee Member **August 2018 – June 2019**
School of Education DECADE, University of California, Irvine

- Worked with undergraduate student organizations to organize workshops designed for undergraduate students on topics such as: graduate application process, undergraduate research assistant positions, etc.

DECADE Member **October 2017 – present**
School of Education DECADE, University of California, Irvine

- Attend monthly, hourly meetings where event planning and resources needed are discussed.

Culturally Responsive Practices Workshop Facilitator **March 2019**
Math CEO, University of California, Irvine

- Facilitated a one-hour workshop with others in best culturally responsive practices mentors can use and engage in when working with Latinx middle school students. Workshop included an overview of Latinx youth in the United States, adolescent development, and out-of-school literature on mentor-mentee relationships as well as activities to reflect on implicit bias and privilege.

Student Representative **December 2015 – February 2016**
Department of Chicano/a Studies, Pomona College

- Coordinated student participation in the process of choosing a new professor who would have a joint position in the Psychology and Chicano Studies.
- Engaged in Skype interviews and conversations about potential candidates and gave personal and student input to professors reviewing candidates.

Tutor **January 2014 – December 2015**
Upward Bound, Harvey Mudd College

- Tutored three high school students on various subjects for two and a half hours on Saturdays.
- Motivated and encouraged them to use study skills, such as reviewing notes, which would help them gain an understanding on how to be successful both in their studies in high school and in college.

Sponsor **August 2013 – May 2016**
Chicano Latino Student Affairs, Claremont Colleges

- Trained for one week prior to fall semester on how best to assist incoming minority students whom identified as Latino/Latina.
- Mentored eight students throughout their time at Pomona.

Education Outreach Coordinator, IDEAS **September 2013 – May 2014**
Improving Dreams, Equality, Access and Success, Claremont Colleges

- Managed the off-campus team of the organization by planning events and high school visits.
- Introduced college process resources and materials to high school students, including those who were undocumented.

Member, IDEAS **January 2013 – May 2016**
Improving Dreams, Equality, Access and Success, Claremont Colleges

- Joined organization that focuses on supporting undocumented students through community outreach both on campus and the surrounding community.

Professional Development

Summer 2021	Certificate in Course Syllabus Design
Fall 2020	SRCD Student Reviewer
Fall 2019	Activate to Captivate Public Speaking course
Fall 2019	University Teaching: Concepts and Practices course
Summer 2018	Certificate in Mentoring Excellence Program, University of California, Irvine.
April 2018	Attended Tri-Caucus Pre-Conference, Society for Research on Child Development, University of Minnesota, Minneapolis, Minnesota.

Professional Memberships

2020-Present	American Educational Research Association
2019- Present	Society for Research in Child Development
2018-Present	Society for Research on Adolescence
2018 – Present	Latinx Caucus of the Society for Research in Child Development

ABSTRACT OF THE DISSERTATION

Examining the Development of Latinx Adolescents' Science Intrinsic and Utility Values: A Family Systems Approach

by

Kayla Puente

Doctor of Philosophy in Education

University of California, Irvine, 2022

Professor Sandra D. Simpkins, Chair

Due to the importance of motivational beliefs and family support, this dissertation used the situated expectancy-value theory, family systems theory, and the Latino youth development model to focus on motivational and family processes related to science during adolescence among Latinx families. Using the Latinx subsample from a nationally representative dataset, Paper 1 focused on the relations between parent support at 9^{th} grade, adolescents' 11^{th} grade science intrinsic and utility values, and 11^{th} grade STEM occupational expectations. Moreover, Paper 1 also tested whether these indicators and relations differed by adolescent gender and parent education. Findings indicated that parent science support was related to adolescents' science utility value and girls' science intrinsic value, with only adolescents' science utility value predicting whether they had a STEM occupational expectation. Also, adolescent girls were more likely than boys to have a STEM occupational expectation and adolescents who had parents with a higher education received greater parent support compared to their peers. Expanding upon Paper 1 with a smaller dataset, Paper 2 tested whether parents' and siblings' respective familism values and parent education predicted parent and older sibling science support. Also, Paper 2 examined associations between parent and older sibling science support and adolescents' science intrinsic and utility values. Findings from this study suggested that parents' and siblings' familism values were not associated with how much support they gave in science. When compared to each other, parents provided greater support compared to siblings. Lastly, both parent and sibling support predicted adolescents' science utility value. Finally, using qualitative data that consisted of 14 interviews with Latinas who successfully persisted in science in college, Paper 3 focused on identifying how parents and siblings supported the development of Latina adolescents' science intrinsic and utility values in high school. The main themes that emerged for both parents and older siblings included conversations, emotional support, and coactivity. Moreover, Latina adolescents with high familism values had greater parent and sibling science support compared to Latina adolescents with low familism values. Also, in families where only older siblings had higher education experience, older siblings gave more support than parents for certain types of support. Findings from these dissertation papers not only unpacked family support by examining the extent to which parents and siblings work together to support adolescents, but it also bridged the gap between literatures on Latinx family support and adolescent science intrinsic and utility values.

INTRODUCTION

Science has made a vast impact on our society, from advancing quality of life to helping us develop critical thinking skills during childhood, adolescence, and adulthood (Hofstein et al., 2010). Having access to science knowledge and engaging in science leads to informed citizens about current societal issues, such as environmental and public policy issues (Hofstein et al., 2010; Marincola, 2006; Rull, 2014). Rull (2014) notes that not only has science helped society in terms of economic growth, public health, and technological advancements, but engaging in science education also provides people "with a basic understanding of how science has shaped the world and human civilization" (p. 919). Thus, science education plays a key role in continuing to equip people with knowledge about societal issues and culture. Latinxs are currently the largest minoritized ethnic group in the United States and one of the main groups that are underrepresented in science. Although they comprise approximately 16% of the United States population, they comprised less than 9% of all workers in science fields with a bachelor's degree or higher in 2017 (Khan et al., 2020).

The science educational trajectories of students depend on a variety of factors, such as how much support they receive and the value they attach to science (Eccles & Wigfield, 2020; Wigfield, 1994; Wigfield & Cambria, 2010; Wigfield & Eccles, 2000). Adolescent motivational beliefs and family support in high school are related to whether adolescents decide whether they want to pursue science in college or not (Cox, 2010; Cox & Paley, 1997; Harackiewicz et al., 2012; Hulleman & Harackiewicz, 2009; Tai et al., 2006). Adolescents' interest in science is a key determinant, but interest alone is often not enough (Hecht et al., 2019; Jacobs et al., 2005). Another key motivational factor includes how important they think science is (i.e., utility value) (Wigfield & Eccles, 2000). Moreover, families can serve as a source of support and help these motivational beliefs flourish. Researchers have found that parental support predicts adolescents' science motivational beliefs and choices, such as science high school course-taking (Harackiewicz et al., 2012; Simpkins, Price & Garcia, 2015). An additional important family member that can offer support are adolescents' older siblings. Though parents and siblings may offer some of the same types of support (e.g., encouragement), they may also offer additional unique types of support that are complementary (e.g., specific advice on courses and college from siblings). For example, parents who have limited knowledge on science courses may rely on older siblings who do have experience in science courses to support their younger siblings in this aspect (Ramos Carranza & Simpkins, 2021).

Family members' support and the associations between that support and adolescents' science motivational beliefs may also vary by family members' educational backgrounds as well as adolescents' cultural values and gender. Within Latinx families, older siblings who have experience with higher education can complement or add to the support parents without a higher education experience can provide (Azmitia et al., 2009; Azmitia et al., 1996; Valenzuela, 1999). Moreover, there is also great variability within the U.S. Latinx population where some have stronger familism values than others and, thus, may have closer relationships with their families, which may be associated with the support that family members give (Gonzales et al., 2009). Additionally, family support and the development of motivational beliefs in science are further complicated by the many identities adolescents have, including gender. Scholars have noted that Latinas and other women of color may experience negative stereotypes and discrimination not only related to their racial/ethnic background, but also related to their gender (Grossman & Porche, 2013; Johnson, 2011). Furthermore, some studies have found that male adolescents receive more math and science support than female adolescents (Bhanot & Jovanovic, 2005;

Wang & Degol, 2013). Overall, when studying science and who pursues science, it is important to understand how the intersecting identities of ethnicity and gender are related to their contextual experiences, motivational beliefs, and choices.

Because much of the literature on Latinx adolescents focuses on the barriers and challenges they face in education and science (Beasley & Fischer, 2012; Strayhorn et al., 2013), this dissertation takes a positive youth development approach to look at Latinx adolescents' value of science and the extent to which family support promotes these motivational beliefs (Larson, 2000; Lerner et al., 2005). The main aims of this dissertation are to 1) investigate the extent to which Latinx high school students' science intrinsic and utility values are associated with their STEM occupational expectations, 2) test the extent to which parents' and older siblings' science-related support is associated with Latinx adolescents' science intrinsic value and science utility value, 3) investigate similarities and differences between parents' and older siblings' support, and finally 4) test the extent to which these indicators and their relations vary by adolescent gender, adolescent familism values, and family education experience.

Main Theoretical Frameworks

There are three main theoretical frameworks this dissertation draws upon to collectively frame the three dissertation papers: situated expectancy-value theory (Eccles & Wigfield, 2020), family systems theory (Cox, 2010; Cox & Paley, 1997), and the theoretical model of Latino youth development (Raffaelli et al., 2005). These three main theoretical frameworks are used to frame the dissertation studies due to components that complement and inform one another (see Figure 1 for a conceptual model). This technique has recently been coined as "theory bridging," where two or more theories are utilized and bridged in order to inform studies that are multi-faceted (Leaper, 2011; Starr, in press).

The Eccles' situated expectancy-value theory argues that individuals' expectancies and values are the most proximal determinants of their achievement-related choices and behaviors (Eccles, 1994; Eccles et al., 1983; Eccles & Wigfield, 2020; Wigfield & Eccles, 2000). For this dissertation, I focus on two components of subjective task value: intrinsic and utility values. Intrinsic value refers to a personal interest, which includes independent engagement with the activity and desire to engage with the activity (Eccles & Wigfield, 2020). Utility value refers to individuals' views on the importance of the subject or task in which they are engaging with, including how useful they think it is for their future, and whether it fulfills a goal. Intrinsic and utility values have been underscored as factors that promote individuals' achievement-related choices, engagement, and persistence, with some researchers creating interventions on these two constructs (Harackiewicz & Hulleman, 2010; Hulleman et al., 2010; Hulleman & Harackiewicz, 2009).

According to situated expectancy-value theory, social experiences and parent socialization processes are important aspects that are related to subjective task value beliefs. Additionally, a subtheory of the situated expectancy-value theory is the parent socialization model (Eccles, 1993; Eccles, 2005). This model theorizes that parent behaviors (e.g., support) are associated with motivational development. Most studies note positive associations between parent socialization and youth's motivational beliefs, including intrinsic and utility values in varying subjects and fields (Gottfried et al., 2009; Hsieh et al., 2019; Simpkins et al., 2012). Parenting socialization includes a variety of support-related behaviors, such as engaging in activities together (e.g., going to science museums, reading books together) and having conversations about the future (Eccles, 1993; Hill & Tyson, 2009). Although studies have explored varying domains, including music, sports, and math (Jacobs & Eccles, 2000; Simpkins et al., 2012; Simpkins et al., 2015), less research has specifically focused on science-related parent socialization.

Another family member who may also socialize adolescents are older siblings (Cox, 2010). Situated expectancy-value theory notes there are multiple socializers in individuals' lives in addition to parents, and argues that other socializers, such as older siblings, also influence youth's perceptions and experiences that then inform the development of their subjective task value beliefs. Theoretically, older siblings' support-related behaviors also should be related to adolescents' science intrinsic and utility values because they are within the family microsystem (Bronfenbrenner & Morris, 1998), though nearly all of the existing work on family socializers of youth's motivation focuses on parents.

In alignment with these processes, family systems theory further expands upon these components of situated expectancy-value theory by specifically focusing on the family as a system rather than focusing on the influence of separate family socializers. It describes the family as a "complex, integrated whole" where each family member's development is interdependent and reciprocally influenced by one another (Cox & Paley, 1997, p. 246). Although situated expectancy-value theory underscores socializers' behaviors as important aspects to consider when studying adolescents' subjective task values, family systems theory more intricately defines the way that socializers function as a within this microsystem. Thus, it adds to situated expectancy-value theory by defining socialization processes formed by both parents and siblings whereas situated expectancy-value theory informs our understanding of how these concomitant socialization processes may collectively influence adolescents' subjective task values. In sum, we draw upon family systems theory to further understand how science-related support provided by parents and older siblings might be related, complement each other, and act as a promotive system to support Latinx adolescents in science.

According to family systems theory, most research on child and adolescent development has focused on parent-child relationships and less so on sibling relationships (Cox, 2010; Cox & Paley, 1997). However, families have multiple members whom each uniquely bring capital and interact with the developing child, including older siblings who are often more developmentally advanced than their younger siblings (Conger & Little, 2010; Cox, 2010). In other words, older siblings are an immediate family member that contributes to the proximal processes that adolescents engage in daily (Cox, 2010). The following dissertation addresses interdependent family processes by studying specifically the extent to which parent and sibling support is related and complement each other to help support adolescents in science. Theoretically, family systems theory suggests that older sibling support will be related to parent support and vice versa.

The last main aim of the dissertation papers was to examine the extent to which adolescent familism values and gender as well as family education were related to family support and adolescent subjective task values. According to situated expectancy-value theory, these indicators are part of the cultural milieu, which includes the broader context the developing individual is nested within which is defined by family characteristics, individual demographics, and culture (Eccles & Wigfield, 2020; Wigfield et al., 2004). Individual motivational and family processes are influenced by the broader cultural milieu in which the individual and family are situated. For example, culture shapes family processes that are then related to the development of individuals' motivational beliefs (Eccles & Wigfield, 2020; Wigfield et al., 2004). Although situated expectancy-value theory outlines broadly the role of culture in the development of achievement motivation, we can further draw upon more specific theoretical frameworks that center culture and racialized experiences at the core of development in order to further inform what specific aspects of ethnic/racial-related cultural processes experienced by Latinx youth and families may be relevant for individuals' motivational beliefs and related family processes (García Coll et al., 1996; Raffaelli et al., 2005).

Historically, theoretical frameworks in the literature often have not clearly defined the role of culture or have often treated it as a separate, distant entity when looking at culture within family processes (García Coll et al., 1996; Grau et al., 2009; Raffaelli et al., 2005; Rogoff, 2003). Scholars, such as Cynthia García Coll and Barbara Rogoff, have argued that culture needs to have a larger emphasis in developmental frameworks due to the diverse social contexts in which individuals live that shape their experiences and therefore their development. Due to the focus on Latinx adolescents in the current dissertation, I drew upon the theoretical model of Latino youth development (Raffaelli et al., 2005). This theoretical model is a recent developmental framework that looks at development specifically among Latinx youth, whom the authors note have unique experiences and demographic characteristics (e.g., immigration-related factors) that should be considered when studying their development. A key aspect of the model is that it focuses on the strengths that Latinx youth have, including strong cultural values, that help them in their psychological development. Raffaelli and colleagues (2005) outline how culture should be the "core of developmental research" and thus view culture at the center of their model (p. 29). They also include culturally relevant variables (e.g., familism) in their models to understand within-group differences among Latinx youth and families. By examining the unique factors, challenges, and resources associated with Latinx adolescent development, this theoretical model outlines how unique factors may be related to the development of science intrinsic and utility values.

Using the mentioned theoretical frameworks, one family-level characteristic examined in the current dissertation studies is family education. According to situated expectancy-value theory (Eccles & Wigfield, 2020), the parent socialization model (Eccles, 1993), and the Latino youth development model (Raffaelli et al., 2005), individual family members' educational background can influence socialization processes due to the capital that is associated with having knowledge of college and careers with those with higher education experience (Bourdieu, 1986; Hurtado-Ortiz & Gauvain, 2007). According to the theoretical model of Latino youth development (Raffaelli et al., 2005), family education experience relates to adolescent cognitions, acculturative stress, and overall development, echoing arguments outlined in situated expectancy-value theory (Eccles & Wigfield, 2020).This specific demographic characteristic would then theoretically be related to adolescent science motivational beliefs, including intrinsic and utility values, since it may shape the supportive behaviors that parents and older siblings engage in (Jabbar et al., 2019).

In addition to a family-level characteristic, an adolescent-level indicator that was examined in the dissertation studies was adolescent gender. Adolescent gender is an adolescent-level characteristic that is theorized to be related to socializers' beliefs and behaviors due to the societal norms attached to certain genders, including societal gender norms surrounding types of careers and fields (Eccles, 2007; Ceci & Williams, 2007; Frome et al., 2006; Su & Rounds, 2015). The situated expectancy-value theory (Eccles & Wigfield, 2020) and the Latino youth development model (Raffaelli et al., 2005) both highlight how adolescents' science values (i.e., a type of cognition) may be related to adolescent gender through the experiences adolescents have based on their gender. For example, a common finding is that parents support their sons more than their daughters in science (Frome & Eccles, 1998; Simpkins, Price, & Garcia, 2015; Wang & Degol, 2013).

The final adolescent-level and family-level indicator examined was familism values which refers to the importance of the family to one's identity (Knight et al., 2010; Umaña-Taylor et al., 2009). Adolescents' cultural strengths and resources, including their cultural values (e.g., familism), are related to developmental and socialization processes, including that of family support (Alfaro & Umaña-Taylor, 2010; Gonzales et al., 2009; Knight et al., 1993; Puente & Simpkins, 2020). When applied to youth's motivational beliefs, the Latino youth development model suggests that high endorsement of familism values would be associated with greater family support which would then relate to stronger motivational beliefs.

Overall, these three theoretical frameworks inform the family and motivational processes examined in the current dissertation papers. Through theory bridging, I use the situated expectancy-value theory (Eccles & Wigfield, 2020) to examine two subcomponents of subjective task value, family systems theory (Cox & Paley, 1997; Cox, 2010) to inform two key socializers' behaviors (i.e., science support), and the Latino youth development model (Raffaelli et al., 2005) to inform the role of cultural factors, family characteristics, and individual characteristics within these processes (see Figure 1).

Marginalization of Latinxs within Science

In addition to understanding Latinx adolescents' science motivational beliefs and their correlates, it is also essential to understand why studying science education among Latinx adolescents during this historical time period is important. Despite efforts to increase equitable access to science knowledge and opportunities among underrepresented groups, Latinxs continue to be one of the largest U.S. marginalized groups when it comes to science during high school, higher education, and the workforce (National Science Board, 2018; Rochin & Mello, 2007). To understand the roots of the marginalization of Latinxs, it is important to look at science education historically.

Science education and the respective workforce has historically created a culture that has excluded people of color while being overrepresented by White males, and more recently Asians (Beasly & Fischer, 2012; Hazari et al., 2013). Because of the stark distinction of who has and continues to represent science, it can be seen as a field that has been racialized. In a historical review of STEM education, Vakil and Ayers (2019) highlight how science has erased the histories and voices of certain groups through omitting science scholars of color in Western schooling, further racializing the science field. This erasure continues to be clearly seen in the textbooks that students read in K-12 education, where the writing and content reinforces White males as scientists while excluding other groups of people (Hickman & Porfilio, 2012). Hickman and Porfilio (2012) further note how this curriculum deters minority students, such as Latinx students, from pursuing science. The historical implications of this erasure can ultimately be related to the science motivation of Latinx adolescents.

In the following literature review, I outline the extent to which the science motivational beliefs of intrinsic value and utility value are related to later achievement and persistence in science. Knowing the role of motivational beliefs, I then expand into specifically the role that families can have in the development of these motivational beliefs, focusing on parents and siblings as sources of support and capital. Finally, I outline the way that adolescent gender, adolescent familism values, and parent and older sibling education may be related to these processes.

Science Intrinsic and Utility Values and Persistence

Intrinsic and utility values are important motivational beliefs that shape individuals' science choices throughout the life course, including college majors and how engaged individuals are with science (Hulleman & Harackiewicz, 2009; Wigfield et al., 2017; Tai et al., 2006). Scholars have argued that individuals' beliefs about their abilities are not enough for them to pursue a domain like science; for example, in one study, even though adolescent girls thought highly of their abilities in math and did well in math, they were less interested in math compared to adolescent boys and were less likely pursue math (Jacobs et al., 2005). Interventions aimed at improving science utility values among underrepresented minorities have not only increased their utility values in science, but also their persistence, engagement, interest, and ability self-concept in science (Hecht et al., 2019). In sum, intrinsic and utility values are important motivational beliefs that are related to later expectations and academic and career choices. These two types of subjective task value beliefs may give insight into how we can help support Latinx adolescents pursue and engage with science.

Having an interest in science has generally been positively related to individuals' engagement, choices, and performance (Hidi, 2006; Hidi & Renninger, 2006; Rosenzweig & Wigfield, 2016). For example, researchers found that increasing student interest in science was related to science achievement and future choices among a Finnish sample of 15-year-old adolescent students as well as a sample of majority White U.S. students (Kang & Keinonen, 2018; Hulleman & Harackiewicz, 2009). There is also research on the National Education Longitudinal Study of 1988 (NELS: 88) suggesting adolescents in 8th grade who had an interest in science early on and expected to have a career in science were more likely to have a college major related to science (Tai et al., 2006). This is further evidenced in a study by Jiang and Simpkins (2020) where they investigated associations between math and science motivational beliefs, high school STEM course-taking and GPA, and whether adolescents pursued a STEM major in college using the High School Longitudinal Study (HSLS) of 2009. They highlight how both math and science subjective task values were related to STEM performance and choices in high school and choices in college. Furthermore, among a majority White college sample, Morgan and colleagues (2001) found that students who showed interest in a field (STEM and non-STEM related) were more likely to pursue that career. These findings support situated expectancy-value theory, which theorizes that intrinsic values are related to achievement-related choices, engagement, and persistence (Eccles & Wigfield, 2020). Other scholars consistently find that math and science overall subjective task values are related to outcomes such as science achievement, having science career aspirations and expectations, taking more science courses, and pursuing a STEM degree in college (Ahmed & Mudrey, 2019; Andersen & Ward, 2013; Wang & Degol, 2013; Wang et al., 2015). Overall, the consistent findings on the positive associations between science intrinsic value and a range of outcomes indicates the importance of understanding what supports this aspect of motivational beliefs during adolescence.

Utility values are also usually positively associated with students' engagement and academic outcomes, such as choosing more advanced science courses in high school (Jiang & Simpkins, 2020; Maltese & Tai, 2011; Harackiewicz et al., 2012; Rosenzweig & Wigfield, 2016). In their review of the literature on experimental and quasi-experimental studies on STEM motivation interventions for adolescents, Rosenzweig and Wigfield (2016) highlight how those focused on increasing utility value were associated with better academic outcomes. Among these studies was Hulleman and Harackiewicz's (2009) utility intervention where adolescents wrote essays on how the material was useful for their everyday lives. This exercise was associated with increased interest and academic grades compared to the control group. In addition, researchers have implemented interventions aimed at increasing science utility value to encourage individuals, especially underrepresented minorities, to pursue a major and career in science (Harackiewicz et al., 2012; Rozek et al., 2015; Rozek et al., 2017). Similarly, Andersen and Ward (2013) found that Latinx adolescents who had greater utility value had greater persistence in STEM. These findings support other studies as well that find strong associations between utility values and positive outcomes, including in science (Banerjee et al., 2018; Harackiewicz et al., 2012)

Though some research on science intrinsic and utility values was based on nationally representative samples that included some Latinx students (Andersen & Ward, 2013; Jiang & Simpkins, 2020; Tai et al., 2006), less work has focused on science intrinsic and utility values among Latinx adolescents specifically. Among the few studies on Latinx adolescents and science motivational beliefs, intrinsic values are often investigated along with utility values and framed under subjective task value as a whole (Simpkins et al., 2018; Puente & Simpkins, 2020). They are also noted to predict outcomes, such as persistence in science (Andersen & Ward, 2013). Other studies on motivation among Latinx adolescents mainly focus on general academic motivation and not science specifically (Alfaro & Umaña-Taylor, 2015; Alfaro et al., 2009). From the broad literature on science subjective task value beliefs and especially from interventions focused on underrepresented minorities (Harackiewicz et al., 2016; Hecht et al., 2019), I hypothesize that findings among Latinx adolescents will suggest similar patterns as those for science intrinsic and utility values for other racial/ethnic groups, with greater science intrinsic and utility values associated with positive science outcomes, including occupational expectations.

Parent Support in Science

Parent Support and Adolescents' Intrinsic and Utility Values

Researchers have highlighted the role that parents play in promoting adolescents' intrinsic and utility values during this important developmental period through the support they give. The situated expectancy-value theory (Eccles & Wigfield, 2020) as well as its subtheory (i.e., parent socialization model; Eccles, 1993), outline how parent support behaviors are related to children and adolescents' motivational development. In a chapter on how achievement-related motivations and engagement are developed, Eccles (2007) noted that subjective task values are influenced by parents' supportive behaviors, such as doing certain activities together. These relations have been tested in multiple studies looking at a range of fields, including math, reading, and sports (for a review, see Simpkins et al., 2012; Jacobs & Eccles, 2000; Simpkins, Fredricks, & Eccles, 2015; Simpkins, Price, & Garcia, 2015). For example, Simpkins and colleagues (2012) found that parent support among elementary-aged youth positively predicted youth's motivational beliefs including subjective task value for sports, music, and math.

To further highlight the positive role that parent support has on specifically science subjective task values, Harackiewicz and colleagues (2012) conducted an intervention that was aimed at increasing White adolescents' motivational beliefs by providing parents with multiple informational packets and a website on the utility value of STEM (for a review, see Harackiewicz et al., 2014). Results showed that students in the intervention group took significantly more math and science courses both in high school and in college and also took more advanced courses compared to the control group. The difference in adolescents' coursework was partially explained by the increased mother-adolescent conversations and mothers' positive STEM utility values, which were related to students' perception of STEM utility value after graduation. Follow up studies of this intervention confirm the strong impact the intervention had on outcomes, including increased math and science standardized test scores in high school (for follow up studies see: Rozek et al., 2015; Rozek et al., 2017). These experimental findings support the positive associations between parent support and adolescents' intrinsic and utility value of science or math in correlational studies (Simpkins et al., 2015; Simpkins et al., 2005). Overall, these studies consistently show that, for mainly White adolescents, parents' support is associated with adolescents' science motivational beliefs and outcomes.

Moreover, the associations between parent support and adolescents' subjective task values have been sparsely documented among Latinx families (Hsieh et al., 2019; Simpkins et al., 2020; Simpkins et al., 2015). In one study specifically on science and Latinx adolescents, Simpkins and colleagues (2015) found that overall, Latinx and White students' perceptions of their parents' support in 9th grade were positively associated with their concurrent value of biology, chemistry, and physics. In a second study, Simpkins and colleagues (2020) also tested the extent to which perceived supports from parents, siblings/cousins, teachers, and friends predicted not only Latinx adolescents' science ability self-concepts, but also their science values, which they defined broadly by combining indicators of science intrinsic and utility values. Their findings suggest that greater overall perceived support from different socializers in 10th grade, including parents, was related to having greater science values. Similarly, Hsieh and colleagues (2019) found that greater perceived science support from parents, older siblings, science teacher, and friends when Latinx adolescents were in 9th grade was associated with greater biology, chemistry, physics, and overall science values. These recent studies on Latinx adolescents strongly upholds the positive associations between parent support and adolescents' science motivational beliefs, especially those related to intrinsic and utility values.

Non-Traditional Parent Support in Latinx Families

Recently, scholars have also examined if Latinx parents support their adolescents in additional ways that are not emphasized in the current literature (LeFevre & Shaw, 2012; Soto-Lara & Simpkins, 2020). As suggested by the Latino youth development model (Raffaelli et al., 2005), Latinx parents may have unique experiences and characteristics that inform their supportive behaviors, such as coming from an immigrant background. A large portion of the parenting literature focuses on mainstream cultural models of parental support and involvement (Hill & Tyson, 2009). Most of the empirical work is based on White, middle-class families and thus may not capture other strategies and types of supports that parents from other ethnic groups and cultures use. Scholars focused on the general academic support Latinx parents provide mention both the traditional forms of support (e.g., homework help) and additional nontraditional forms of support they offer, such as giving *consejos* (i.e., advice) and providing moral support (Auerbach, 2007; Azmitia & Brown, 2002; Azmitia et al., 2009; Delgado Bernal, 2001; LeFevre & Shaw, 2012). For example, in one of the few studies on Latinx parent support in science, Soto-Lara and Simpkins (2020) found that Mexican-descent parents used not only traditional forms of support, but also nontraditional forms of support, such as giving *consejos* and leveraging resources (e.g., "being an economic provider and discouraging their children from having part-time jobs", p. 17). Moreover, Latinx parents are frequently found to support a well-rounded education, or *educación*, that included both academics as well as morality and respect (Auerbach, 2007; Cooper et al., 2005). Scholars have also highlighted parents' immigrant backgrounds as related to motivating youth to succeed academically in order to give back to their families (Ceballo et al., 2014; Sánchez et al., 2006a). Even though Latinx parents have additional types of support that they offer, findings are consistent with studies on traditional views of parental support where Latinx-specific parental strategies and support are also found to be tied to adolescents' general academic motivation and achievement (Alfaro et al., 2006; Ceballo et al., 2014). Because most of these studies have focused on general academic motivation and achievement, this dissertation further expands upon the literature by focusing on the associations between Latinx parent support and adolescents' science motivational beliefs.

Sibling Support in Science

Though the literature on Latinx parent support and its association to youth's science motivational beliefs is limited, even less is known about the support older siblings give and how it is related to adolescents' science utility value and intrinsic value. Older siblings in Latinx families can serve as educational or cultural brokers for their younger siblings where they help guide them on their educational journeys in ways that their parents may not be able to, especially if their parents are foreign-born and do not have experience with the U.S. educational system (Azmitia et al., 2009; Azmitia et al., 1996; Valenzuela, 1999). In 2017, approximately 54% of Latinx children had at least one parent that was foreign-born in the U.S. (Child Trends, 2018). Older siblings in these families may thus help and support their younger siblings in unique ways.

Although Latinx parents provide various types of support, including encouragement, some parents may be limited in providing other forms of support (e.g., homework help). As suggested by family systems theory, sibling support can complement parent support, such as by serving as mentors and guides who give advice to their younger siblings on courses to take and instilling cultural values, such as *ganas* (i.e., "the desire and drive to succeed;" Cabrera et al., 2012), that further motivate their younger sibling to persist in school. Specifically, older siblings who have experience with K-12 education and higher education in the U.S. can serve as mentors, passing down advice and information to their younger siblings that help them overcome challenges. Cooper and colleagues (1999) describe the complementary ways that parents and siblings support Latinx youth where parents give moral guidance, which iterates the importance of a good moral and academic education, while siblings act as role models, tutors, and offer emotional support. Similarly, Azmitia and colleagues (1996) found that, compared to White families, Mexican American older siblings were more likely to increasingly help with homework over time as parents recruited them for help, suggesting that older siblings may become more involved as they reach adolescence. When looking at math pathways, Azmitia and colleagues (2009) highlight how Latinx adolescents not only relied on parents for support and guidance, but also siblings, especially when it came to homework help. These findings overall emphasize how families work together as a whole and are dependent upon one another for the development and socialization of each family member (Cox & Paley, 1997).

When looking at the available studies on Latinx older sibling support, many scholars underscore the extent to which older sibling support is related to general academic motivation (not a specific subject) and access to higher education (Azmitia et al., 2009). For example, Alfaro and Umaña-Taylor (2010) found direct associations between sibling academic support and general academic motivation, where greater sibling academic support predicted greater general academic motivation among Latinx siblings. These associations were further evidenced in the qualitative literature. Carolan-Silva and Reyes (2013) found that older siblings who were in college often thought about their younger siblings and advised them on how to prepare for college, including discussing courses that they should be taking in high school. Because older siblings had experience with college, they provided social and cultural capital for their younger siblings who might attend college in the future and potentially face similar barriers and costs. Carolan-Silva and Reyes (2013) also underscore the large role that family relationships had in adolescents' choices, which further supports the situated expectancy-value theory where socializers influence achievement choices (Eccles & Wigfield, 2020). Thus, older siblings are highlighted as using their experiences and knowledge to support their younger siblings.

Regarding science, there are some scholars that have looked at the associations between older sibling support and Latinx adolescent motivational beliefs. Simpkins and colleagues (2019) found that home-based support, which was an average of parent and sibling support, positively predicted Latinx adolescents' science ability self-concept and subjective task value in 10th grade. In one of the few studies on older sibling support and its relation to science motivation, Puente and Simpkins (2020) also found a similar pattern as Alfaro and Umaña-Taylor (2010), such that older sibling support, which consisted of social, emotional, and academic support, was related to Latinx adolescents' science self-concept and subjective task value, but only among older siblings with high familism values. In a qualitative study framed by family systems theory, Ramos Carranza and Simpkins (2021) highlight how Latinx parents and older siblings engaged not only in traditional forms of support, but also leveraged their social networks when necessary. Additionally, they found that Latinx adolescents in high school received increased homework help from their older siblings because many took similar high school science classes, especially when parents had limited experience with high school science through their own education. Aligned with family systems theory, more studies are needed that examine parent and older sibling support in order to gain a more comprehensive understanding of overall family support.

Considering the Cultural Milieu

According to the situated expectancy-value theory (Eccles & Wigfield, 2020), the cultural milieu, which includes cultural processes (e.g., cultural stereotypes), family demographics, and gender/role stereotypes, is related to processes that lead to achievement-related choices, engagement, and persistence (Eccles & Wigfield, 2020). The Latino youth development model (Raffaelli et al., 2005) also theorizes how cultural factors, family-level, and individual-level characteristics are associated with Latinx adolescents' development. The current dissertation examines three main areas of the cultural milieu: family higher education experience, adolescent gender, and familism values.

Family Higher Education Experience

A factor that plays a role in how parents and older siblings leverage their resources and knowledge that is related to adolescent intrinsic and utility values is the level of education they have. The following dissertation papers aim to look at how parent support, sibling support, and adolescent intrinsic and utility values differ by family education as well as how family education may moderate these associations. Family education refers to the consideration of both parent and older sibling educational levels (e.g., families where both parents and siblings have a higher education degree).

The literature generally highlights how parents with higher education experience engage in certain support-related behaviors compared to parents without higher education experience who engage in other types of support-related behaviors (Aschbacher et al., 2010; Davis-Kean, 2005; Jabbar et al., 2019; Sheldon, 2002). Parents and siblings with higher education experience are noted as being able to help adolescents more often with homework, engage in conversations about career expectations, and also use connections to further educational goals (Aschbacher et al., 2010; DePlanty et al., 2007; Ramos Carranza & Simpkins, 2021; Sheldon, 2002). For example, Hurtado-Ortiz and Gauvain (2007) emphasized that Mexican American parents without a higher education degree provided some types of support, such as encouraging their adolescent, but not other types of support, such as helping with homework. Aschbacher and colleagues

(2010) also note that students who persisted in the sciences had more opportunities, such as participating in extracurricular activities, because their parents helped provide these opportunities through their resources and connections. Overall, parents and older siblings with different educational backgrounds may support their adolescent in similar (e.g., encouragement) but also different ways (e.g., college applications) due to resources and access that come from having experience with higher education. Thus, it is important to examine in what ways parents and older siblings support adolescents depending on educational backgrounds in order to understand how to better support families.

In addition to mean-level differences, the associations between parent support and adolescent science motivational beliefs may also be stronger for adolescents who have parents with higher education experience. Among the studies on parent education and family processes, Davis-Kean (2005) noted that families who had parents with greater education was indirectly associated to child achievement through parent beliefs and behaviors at home. In science, Aschbacher and colleagues (2020) highlight how parents with more resources would help facilitate opportunities that helped foster interest in science among adolescents who ended up persisting in science. Thus, it may be that the advantage of additional resources and opportunities that families with higher education experience have access to have moderating effects on these associations.

Gender and Science Motivation

In addition to family higher education experience, the following dissertation papers also investigate the role of adolescent gender in the study indicators and processes. There are prominent gender differences associated with science that are in part due to the historical representations and messages portrayed by society. Gender stereotypes and gender role beliefs impact socialization in our culture and which fields are valued by men and women (Eccles, 2007; Ceci & Williams, 2007; Su & Rounds, 2015). The situated expectancy-value theory considers the potential influence that gender-related beliefs youth internalize have on their motivational beliefs and choices (Eccles & Wigfield, 2020; Simpkins et al., 2018; Wigfield & Eccles, 2000). Because certain science fields have been mainly male dominated, areas such as physics and engineering have been considered a more "masculine" field, deterring females from pursuing STEM careers as early as adolescence (Frome et al., 2006; Robnett, 2016; Schoon & Eccles, 2014).

The STEM motivation literature has investigated gender differences in science motivational beliefs and outcomes, but typically in math. When looking at the math literature, males and females tend to have similar intrinsic and utility values (Jacobs et al., 2002; Simpkins et al., 2006; Simpkins, Fredricks, & Eccles, 2015; Updegraff et al., 1996). In a study that examined both science and math, Simpkins and colleagues (2006) studied mean-level differences among math and science intrinsic and utility values using data from the Michigan Childhood and Beyond Study and noted that there were more similarities than differences among their values in both math and science. This aligns with other findings that suggest there are more similarities than differences among genders among various factors, including motivational factors (i.e., gender similarities hypothesis; Hyde, 2005; Hyde & Kling, 2001; Hyde & Linn, 2006). However, other findings are mixed when considering the specific science area/subject, with some studies citing gender differences (Hazari et al., 2013; Hyde & Kling, 2001; Su et al., 2009). Su and colleagues (2009) note that vocationally, women were more interested in careers that were more people-oriented whereas men were interested in things-oriented careers, which indicates that women overall may have less interest in STEM fields that do not involve working with people. Regarding Latinxs, Hsieh and colleagues (2019) note that Latinas had lower intrinsic values for physics and chemistry than Latinos but not biology when adolescents were in 9th grade. Moreover, they only found lower utility value for physics among Latinas, but no gender differences for biology and chemistry. Thus, there may be gender differences for science intrinsic and utility value among Latinx adolescents.

Other research focuses on mean-level and process-level gender differences regarding parent support. The numerous studies on White adolescents suggests that parent support and beliefs are generally greater for adolescent males than females in both math and science (Eccles & Jacobs, 1986; Frome & Eccles, 1998; Simpkins, Price, & Garcia, 2015; Wang & Degol, 2013). In one of the only studies on gender differences in Latinx parent support, Simpkins and colleagues (2015) also found certain types of parent support to differ by gender for Latinx adolescents, but these gender differences became non-significant when taking into parent education and Spanish language use. The following dissertation studies will greatly contribute to the literature by understanding the extent to which there are mean-level differences in parent support by adolescent gender. Latinx adolescent gender can also moderate the associations between parent support and their motivational beliefs, as some have noted in the few studies investigating these relations (Ing, 2013; Rozek et al., 2015; Simpkins et al., 2018). For example, Rozek and colleagues (2015) found that the association between parents' STEM utility values and adolescents' STEM course-taking was stronger for girls with high STEM GPAs and boys with low GPAs compared to girls with low GPAs and boys with high GPAs. However, there are also other studies that do not find that these associations differ by gender, or they report small effect sizes (Simpkins et al., 2005; Simpkins et al., 2015; Simpkins et al., 2018). Overall, these findings suggest that the associations between parent support and adolescent science motivational beliefs may differ significantly by adolescent gender, such that this association may be stronger for males compared to females.

Familism Values in Relation to Family Support

Finally, the Latino youth development model (Raffaelli et al., 2005) notes that Latinx families have unique experiences and characteristics that are related to Latinx adolescent development. Among Latinx families, familism values refer to the importance of the family to one's identity and decision-making (Umaña-Taylor et al., 2009). In general, scholars have noted that adolescents who have stronger cultural values aligned with their family's culture of origin also tend to have greater family support (Alfaro & Umaña-Taylor, 2010; Luna & Martinez, 2013). This may be due to the stronger family relationships and better communication present when family members and adolescents endorse higher familism values (Delgado et al., 2011; Fuligni et al., 1999; Stein et al., 2014). Additionally, studies on Latinx older siblings and their support often highlight sibling familism values as determinants of their support (Alfaro & Umaña-Taylor, 2010; Puente & Simpkins, 2020; Tucker et al., 1997). These family and cultural processes have also been studied alongside motivational beliefs (Simpkins et al., 2018). When studying adolescent science ability self-concept and values among Latinx adolescents, Simpkins and colleagues (2018) found that parent support was more strongly predictive of science values when adolescents had high familism values. Overall, studies on cultural processes note the importance of family support for academic outcomes. Thus, cultural values such as familism should be considered when examining developmental processes among Latinx families.

Adolescent Development Period

Adolescence is a time in youth's lives when they are roughly between the ages of 10 and 20 and is usually categorized into early, middle, and late adolescence (Jaworska & MacQueen, 2015; Wigfield et al., 2006). The main focus of this dissertation is middle and late adolescence, as each of the papers focus on either high school or college-aged participants. The high school period, with ages ranging from 14 to 18 years old, is defined as middle adolescence with the beginning early college years (18-22) defined as late adolescence or emerging adulthood (Arnett, 2007; Spano, 2004). The high school years are noted to be a significant time in individuals' lives as it sets the foundation for the development of different identities and college and career goals (Eccles et al., 1991; Eccles et al., 1997; Education Commission of the States, 2019).

Similar to early adolescence, middle adolescence is characterized by the transitions and shifts that youth face in their educational contexts. During middle adolescence, youth are going into high school and thus may have peer groups shift as well as encounter different teachers and experience more autonomy (Wigfield et al., 2006). Early research on middle and late adolescence focused on investigating problem behaviors, substance use, and the many stressors that adolescents encounter (Steinberg & Morris, 2001). However, more recently scholars have also viewed adolescence as a period for fostering positive youth development (Larson, 2000; Lerner et al., 2005). These studies have included exploring what promotes science motivation, such as family support, and how in turn science motivation is related to future science career expectations.

In terms of the pattern of science motivational beliefs during adolescence and emerging adulthood, research highlights typical declines in science motivational beliefs over time (Jacobs et al., 2002; Wigfield & Cambria, 2010). In their review, Wigfield and Cambria (2010) indicate that motivational development is associated with both experiences that they have in school (e.g., failure or successes within a subject) as well as the differing microsystems and contexts (e.g., home and school) youth grow up in. When looking at motivational beliefs within science, findings are somewhat mixed (Hsieh et al., 2019). Hsieh, Liu, and Simpkins (2019) note that Latinx adolescents' utility values in chemistry, biology, and physics declined over time from 9th to 11th grade whereas intrinsic values did not significantly change over time and remained stable across these three science subjects. More studies are needed in examining what the development of science intrinsic and utility values looks like for Latinx adolescents.

As previously discussed, a large amount of research in achievement motivation has focused on the role of parents by studying how parent behaviors and beliefs are associated with the development of achievement motivation among youth (Eccles, 2007; Gottfried et al., 2009; Koutsoulis & Campbell, 2001). Although adolescence is well-known as a period for increased autonomy, parents are still involved in the education of their adolescents and in their identity formation (Beyers & Goossens, 2008; Sartor & Youniss, 2002). Certain parent support behaviors, such as homework help, begin to decline whereas other forms of support, such as supporting adolescent autonomy and conversations, remain stable or increase as adolescents move into the emerging adulthood period (Hill & Tyson, 2009; Singh et al., 1995). Studies have shown that certain types of parent support are, at times, related to negative academic outcomes, which suggests having a certain amount of parent support may be an indicator for a struggling adolescent (Jeynes, 2005). Among Latinx families, parents may begin to rely more on older siblings as evidenced by Azmitia and colleagues (2009) and Ramos Carranza and Simpkins (2021) due to more specialized science domains that parents may not have knowledge about. Thus, Latinx parents may work with older siblings to adjust the types of support they each give in order to foster autonomy among adolescents and optimize their positive development.

Overarching Summary of the Dissertation Studies

The following three dissertation papers aimed to address various gaps in the literature regarding Latinx adolescents' science motivational beliefs and the support they receive from their parents and older siblings. Latinx adolescents experience numerous, significant barriers and challenges in education, especially in science education (Barron & Hulleman, 2015; Grossman & Porche, 2014; McGee, 2016). Adolescence is a period marked by profound changes in individuals' motivational beliefs and identity (Jacobs et al., 2002; Wigfield & Cambria, 2010). It is also characterized as a turning point in preparing those that wish to pursue a career in science (Simpkins et al., 2006; Updegraff et al., 1996). It is also when Latinx adolescents begin to seriously think about higher education and seek resources that promote their higher education and career aspirations, especially as many are potential first-generation college students.

According to situated expectancy-value theory, individuals' expectancies for success and values are related to their academic performance and choices (Eccles & Wigfield, 2020; Wigfield & Eccles, 2000). Adolescents' value of a domain predicts academic outcomes even beyond prior achievement (Wigfield & Eccles, 2000). Researchers have highlighted the role that parents play in promoting science motivational beliefs in subjective task values, particularly for underrepresented youth who are often marginalized in schools (Simpkins et al., 2015; Harackiewicz et al., 2012). However, most of this work is on White, middle-class families and thus may not capture other strategies and types of supports that parents from underrepresented groups offer. Most studies that look at Latinx parent support have mainly focused on adolescents' general academic motivation. These studies highlight the positive association between parent support and general motivational beliefs (Alfaro et al., 2006; Ceballo et al., 2013). Because most studies have focused on general academic motivation and achievement, this dissertation expands upon this literature by focusing on the associations between parent support and high school adolescents' science values and occupational expectations.

Although the literature on parent support gives great insight into some of the resources and capital that Latinx adolescents are benefiting from, the literature has largely overlooked a second, critical source of family support – the support of older siblings who may provide resources and forms of capital that parents may not be able to offer. Scholars in higher education have underscored how older Latinx siblings provide unique forms of support that parents with lower educational levels are unable to offer (Carolan-Silva & Reyes, 2013; Cooper et al., 1999; Ramos Carranza & Simpkins, 2021). Though very little exists on sibling support of high school students in science, I previously found that Latinx high school adolescents had stronger science motivational beliefs when they received support from an older sibling, particularly from older siblings with high familism values (Puente & Simpkins, 2020). This thereby emphasizes how the field must consider culture and family supports to further understand the rich variability among Latinxs' educational trajectories. In sum, including older siblings into the conversation allows us to further understand the variability among Latinx families. Those who have older siblings with higher education and science experience may have different developmental processes compared to Latinx adolescents without older siblings or parents who possess this knowledge.

Due to the underrepresentation of Latinx adolescents in science and the strong literature on how family support can promote positive motivational beliefs, this dissertation aims to bridge the literatures on parent and sibling support to understand how parents and siblings complement each other to support Latinx adolescents' motivational beliefs and their persistence in pursuing a science career. Using situated expectancy-value theory (Eccles & Wigfield, 2020), family systems theory (Cox, 2010), and the Latino youth development model (Raffaelli et al., 2005), I addressed the themes of science values (i.e., intrinsic value and utility value), parent and sibling support and its predictors, science occupational expectations, and the role of adolescent gender and adolescent familism values among these processes in the following three dissertation papers.

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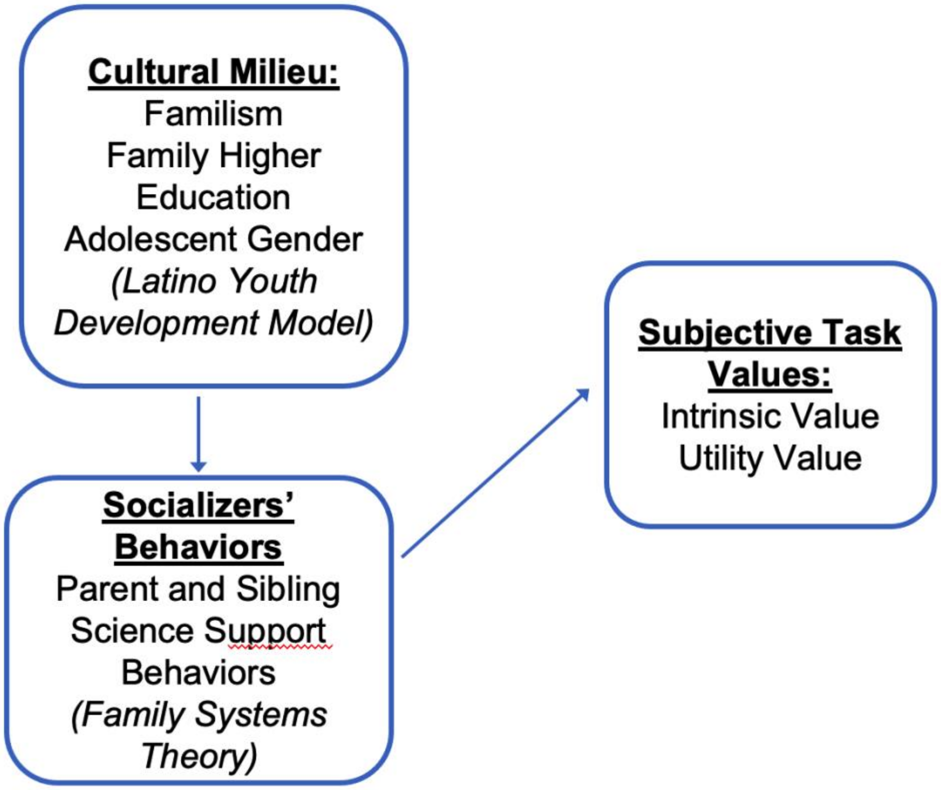

Figure 1. Conceptual model bridging situated expectancy-value theory, family systems theory, and the Latino youth development model.

CHAPTER 1

Examining Associations Between Latinx Parent Support, Adolescent Science Motivation and STEM Occupational Expectations

Abstract

As argued by situated expectancy-value theory, adolescent motivational beliefs and family support are related to whether high school students value science; however, most of these relations have been investigated among White, middle-class students (Cox, 2010; Harackiewicz et al., 2012). Scholars have argued the need for more research focusing on Latinx families, their socialization processes, and individual outcomes as there are certain factors, such as cultural values, at hand within the Latinx population that may not be present in other racial/ethnic groups (Grau et al., 2009). Framed by situated expectancy-value theory, the current study investigated: (1) the associations between parent science support in 9^{th} grade and adolescents' science intrinsic and utility value in 11^{th} grade and STEM occupational expectations, and (2) whether these indicators and the relations between them differed by adolescent gender or parent education. Study participants included Latinx students (n = 3,060; M_{age} = 14.4 years old; 49% female) from the High School Longitudinal Study (HSLS) of 2009. Results revealed a significant, positive association between parent science support and Latinx adolescents' science utility value and Latina girls' science intrinsic value. Additionally, science utility value, but not science intrinsic value, was predictive of STEM occupational expectations. Girls were also more likely to have a STEM occupational expectation compared to boys. Finally, adolescents who had parents with a higher education degree received greater parent science support compared to adolescents who had parents without a higher education degree. These findings underscore what motivational

processes related to science look like for Latinx adolescents and also highlight the influence of parents.

Keywords: Parent support, science motivation, utility value, intrinsic value, Latinx adolescents

Examining Associations Between Latinx Parent Support, Adolescent Science Motivation and STEM Occupational Expectations

Limited diversity within science, including racial/ethnic diversity, is a barrier to further innovation and advancement of society. Having diversity within fields such as science allows for greater growth in innovation that allows the United States to compete in a global economy as people bring in their own experiences and knowledge (Hong & Page, 2004). Although more Latinx students have majored in the sciences than in previous years, Latinx students are one of the largest groups that continue to be underrepresented in the sciences and even more so in the science workforce (Camacho & Lord, 2013; National Science Foundation, 2021). Despite concerns around this inequity, very little is known about Latinx students' motivation to pursue science and the factors that help promote their success, including family support. Studies suggest that motivational beliefs and family support during high school are related to whether White adolescents want to pursue science as a career (Cox, 2010; Harackiewicz et al., 2012). Though comparable work does not exist for Latinx adolescents, studying these developmental pathways in relation to family support is instrumental due as families are a source of unwavering strength for Latinx adolescents and for young people who are marginalized from schools (Knight et al., 2009; Puente & Simpkins, 2020; Umaña-Taylor et al., 2009). To successfully support Latinx adolescents, scholars argue that research needs to focus specifically on Latinx adolescents as certain factors at hand within the Latinx population, such as specific cultural values and the contexts in which they live (e.g., immigrant households), may not be present in other racial/ethnic groups (Grau et al., 2009).

Yet, few scholars have examined the variability within Latinx families, particularly regarding STEM. Prior studies on racial/ethnic groups have largely focused on between-group ethnic/racial differences, with many of these studies focusing on the low STEM motivational beliefs and achievement that underrepresented populations have on average compared to White and Asian populations (e.g., Andersen & Ward, 2013; Aschbacher et al., 2010). However, these findings and perspectives provide a limited view of marginalized populations. Moreover, within-group variability is often greater than between-group variability due to the intersectional identities and background characteristics that people hold (Causadias et al., 2018). Of these, college generational status, which is based on parents' level of education, has been recently emphasized as a factor that should be considered due to the large underrepresentation of first-generation college students in science compared to continuing-generation college students (Chen, 2005; Khan et al., 2020; National Science Board, 2018). Though it remains untested, these significant science gaps in college likely stem from experiences and developmental pathways that occur during adolescence as suggested by theory (Eccles & Wigfield, 2020). In addition, another central influence on family supports and adolescent science motivational beliefs is adolescents' gender due to the gendered dynamics within certain sciences where men are stereotyped to be seen as scientists more so than women (Starr, 2018). Overall, there continues to be a need to examine these developmental processes for Latinx adolescents specifically. The current study aims to investigate: (1) the associations between parent science support and adolescents' science values (i.e., intrinsic and utility value) in 11th grade (2) the association between adolescents' science values and their STEM occupational expectations, and (3) whether these indicators and the relations between them differ by parent education or adolescent gender.

Adolescence and Subjective Task Values

Adolescence is a critical developmental period for individuals' career expectations and occupational outcomes, with adolescents gaining greater autonomy and choosing whether to enroll in upper-level science courses or not (Eccles et al., 1991; Eccles et al., 1997; Education Commission of the States, 2019). In particular, the final years in high school (i.e., 11th and 12th grades) are pivotal as adolescents begin to form future college and career goals as they plan their next steps after graduation. According to the situated expectancy-value theory, the most proximal determinant of such choices is individuals' expectancies and subjective task values (Eccles & Wigfield, 2020). Subjective task values are theorized to be more strongly related to achievement choices and career aspirations/expectations compared to individuals' expectancies of success; for example, in one study, even though adolescent girls thought highly of their abilities in math and did well in math, they were less interested in math compared to adolescent boys and were less likely pursue math (Jacobs et al., 2005). This underscores the importance of not only developing strong expectancies, but also strong task value beliefs for achievement related choices and future expectations (Eccles & Wigfield, 2020; Hulleman & Harackiewicz, 2009; Wigfield et al., 2017). Two core promotive components of individuals' overall subjective task values are their intrinsic value and utility value. Intrinsic value refers to individuals' personal interest in the subject whereas utility value refers to individuals' view of the importance of the subject, including how useful they think it is for their future and whether it fulfills a goal (Eccles & Wigfield, 2020).

Science Intrinsic and Utility Values and Related Outcomes

Overall, research on science intrinsic and utility values consistently concludes that both values are positively associated with individuals' engagement, choices, academic performance as well as future STEM career expectations (Hidi & Renninger, 2006; Jiang et al., 2020). Related to intrinsic and utility value, Banerjee and colleagues (2018) found qualitatively that among White women in their 30s and 40s, interest and the perceived value of STEM were related to their career aspirations. Further, in a quasi-experimental study among a largely White population, 8^{th} grade students' motivational beliefs were related to career planning (Hiller & Kitsantas, 2014). As noted, most of the existing research on the development of STEM motivational beliefs, including intrinsic and utility values, has focused on the domain of math and among White adolescents (Rozek et al., 2015). Though some research on science intrinsic and utility values is based on nationally representative samples that included some Latinx students (Andersen & Ward, 2013; Tai et al., 2006), there is a large gap in the literature regarding the development of science intrinsic and utility values and its relation to their career expectations among Latinx adolescents specifically. Scholars have noted that research, which is usually conducted among White families, is sometimes erroneously generalized to all racial/ethnic groups despite the evidence that Latinx families have differing experiences within the United States (Grau et al., 2009). Various theoretical models, such as Garcia Coll and colleagues' (1996) integrative model and Raffaelli and colleagues' Latino youth development model (2005), describe the different experiences Latinx families have that may influence development, including acculturation processes such as acculturative stress. Moreover, it is also a more pervasive issue across developmental science, where certain underrepresented groups (e.g., racial/ethnic minorities) are *invisible* because they historically have been excluded from developmental research and theoretical frameworks (Syed et al., 2018).

Parent Support in Science

According to theory, social experiences and socialization processes shape individuals' development (Cox & Paley, 1997) including the development of motivational beliefs (Eccles & Wigfield, 2020). More specifically, the parent socialization model, which is a theoretical model nested within situated expectancy-value theory, argues that parents' supportive behaviors in a domain (i.e., parent socialization) influences youth's motivational development in that same domain (Eccles, 2005; Eccles & Wigfield, 2020; Fredricks et al., 2005). Among studies framed by situated expectancy-value theory and the parent socialization model, many of them focus on parents and note the positive associations between parent supportive behaviors (e.g., visiting science museums together, having conversations about the future; Eccles, 1993; Hill & Tyson, 2009), and youth's intrinsic and utility values in varying domains (Gottfried et al., 2009; Hsieh et al., 2019; Simpkins et al., 2012).

As with much of the literature, there is less information on what these processes look like among Latinx families, with some qualitative studies highlighting the variety of supportive behaviors that Latinx parents engage in such as helping with homework and having conversations about the future (Ramos Carranza & Simpkins, 2020; Soto-Lara & Simpkins, 2020). Given the endorsement of strong Latinx cultural values that place an emphasis on the family (e.g., familism) (Fuligni et al., 1999; Killoren et al., 2016; Stein et al., 2014; Updegraff et al., 2005), the associations between parent support and motivational beliefs may be stronger among Latinx adolescents than their peers. Simpkins and her colleagues have begun to look at these processes among Latinx families using a small sample of 104 families and have found positive associations between parent support and adolescents' science motivational beliefs. For example, in one study specifically on science, Simpkins and colleagues (2015b) found that Latinx 9th grade students' perceptions of their parents' support were positively associated with their concurrent value of biology, chemistry, and physics. The findings from various other studies emphasize the role that parents play in promoting science task values, particularly for underrepresented youth who are often marginalized in schools (Hsieh et al., 2019; Simpkins et al., 2020; Simpkins et al., 2015a). More studies are needed to further understand these parent-adolescent science processes among Latinx families.

Group Differences and Their Relation to Science Motivation and Expectations

The literature and situated expectancy-value theory argue that researchers need to consider child and family characteristics to identify *for whom* parent science support STEM matters most (Eccles & Wigfield, 2020; Simpkins et al., 2018). However, much of the existing literature in STEM compares racial/ethnic groups rather than considering intersectional differences among Latinx students. The current study aims to extend the literature by examining mean-level differences based on adolescent gender and parent education as both play an important role in science persistence due to barriers that girls and first-generation college students face within STEM fields (Leaper & Starr, 2019; Puente et al., 2021).

Adolescent Gender

Historically, boys have been stereotyped to be scientists leading to girls facing more barriers and discrimination (Leaper & Starr, 2019; Miller et al., 2018). This holds true among Latinxs, where Latina girls face not only discrimination due to their race/ethnicity, but also their gender within science fields (Camacho & Lord, 2013). Gender differences among motivational beliefs, however, may vary by racial/ethnic group as noted by a few emerging studies that find gender differences among some racial/ethnic groups but not others (e.g., Hsieh et al., 2021; Puente et al., 2021). Among Latinx adolescents, Simpkins and colleagues (2015) found that Latina girls had lower science utility value for physics compared to Latino boys, but not for biology or chemistry. More research is needed to test whether gender differences emerge among science intrinsic and utility values as well. Other research focuses on gender differences in parent support, with most studies focusing on White adolescents (Fredricks et al., 2005; Simpkins et al., 2010). The current research suggests that parent support and beliefs are generally greater for boys than girls in both math and science (see Wang & Degol, 2013 and Starr et al., in press for a review). More work needs to be done on whether these findings are similar or different among Latinx families.

There is less support for gender differences at the process-level among Latinx families. Using a small Latinx sample, Simpkins and colleagues (2018) tested associations between parent support and adolescent motivational beliefs in science and found that this association did not vary across girls and boys. These nonsignificant differences among the relations have emerged in other studies examining Latinx adolescent motivational beliefs (Hsieh et al., 2019; Simpkins et al., 2015). This finding somewhat aligns with prior findings on gender moderation among White adolescents where gender moderation is usually not evident (Simpkins et al., 2015).

Parent Education

Theoretically, parents' characteristics, such as their level of education, should also be related to adolescents' science intrinsic and utility values (Eccles, 2005). Several scholars have focused specifically on parents' educational backgrounds, with many emphasizing how having at least one parent with a higher educational degree (i.e., an associate's or higher) gives their adolescent greater social and cultural capital that is then related to academic achievement and overcoming challenges (Engle, 2007; Gibbons & Borders, 2010). In some studies, parents with higher education degrees are better able to help adolescents with homework, engage in conversations about career aspirations, and also use connections to further educational goals (Aschbacher et al., 2010; Ramos Carranza & Simpkins, 2020). Due to the large portion of Latinx adolescents whose parents have a high school degree or less (Postsecondary National Policy

Institute, 2020), this remains an important family characteristic to study when testing the correlates of adolescents' motivational beliefs.

First-generation college students (i.e., students whose parents have a high school degree or less) are underrepresented in science college majors and tend to have lower motivational beliefs compared to continuing-generation college students who have parents with higher education degrees (Chen, 2005; Puente et al., 2021). Science intrinsic value also is lower for first-generation college students compared to continuing-generation college students, with some studies noting some reasons for lower science intrinsic value including the non-communal (e.g., lack of collaboration) nature of STEM fields that misaligns with the culture of first-generation college students (Allen et al., 2015; Boucher et al., 2017). Though most research on college generational status focuses on college students, it is likely that some of these differences evident in college were also prevalent in high school. In one of the few studies on college generational status and science motivational beliefs, Snodgrass Rangel and colleagues (2020) noted that among high school students in 11th grade, those who were prospective first-generation college students tended to be in the low math and science motivational beliefs group, which included low intrinsic and utility values. Similarly, Jiang and colleagues (2020) also found that for math and science, prospective first-generation college adolescents in 9th grade had lower motivational beliefs, including science subjective task value, compared to their continuing-generation college counterparts. Overall, more research is needed on the extent to which processes and constructs related to science values significantly vary by parent education among Latinx adolescents. To our knowledge, no study has examined these process-level differences by parent education among Latinx adolescents.

Current Study

Several gaps remain in our understanding of the positive development of Latinx adolescents' science motivational beliefs and family processes. We hypothesized that greater parent science support in 9th grade would be related to stronger science intrinsic and utility values in 11th grade among Latinx adolescents. Moreover, the literature and theory also emphasize the importance of utility and intrinsic values for later achievement-related behaviors, such as the career expectations adolescents have (Dorsen et al., 2006; Hiller & Kitsantas, 2014). Thus, we also expected adolescents' 11th grade science values to positively predict their 11th grade STEM occupational expectations. Lastly, these science-related indicators and associations could differ by gender due to the underrepresentation of females in certain science fields and the traditional gender stereotypes associated with STEM (Leaper & Starr, 2019). They may also differ by parents' educational levels, such that parents with more education may be able to provide more support-related behaviors or resources compared to parents who do not have a higher education (Engle, 2007; Gibbons & Borders, 2010). For our last research aim, we hypothesized that female adolescents and separately those with parents who did not have higher education degrees would have lower science intrinsic and utility values as well as lower parent support compared to male adolescents and those with parents with higher education degrees, respectively. Also, we expected the relations between parent support, science values, and STEM occupational expectations would be stronger for males and stronger for families who have parents with higher education degrees compared to their peers.

Method

Participants

This study included Latinx participants from the High School Longitudinal Study (HSLS) of 2009. HSLS is a nationally representative, longitudinal dataset that focuses on high school adolescents and STEM outcomes. The full study includes 25,210 adolescents from 944 high schools across the United States (Ingels et al., 2011; for more information, see https://nces.ed.gov/surveys/hsls09/index.asp)[1]. This study focuses on the Latinx subsample comprised of 4,000 students. From that sample, we excluded Latinx students who did not have 11th grade intrinsic and utility values or who did not have parent education information (n = 950; see Tables 1.1 and 1.2 for descriptive statistics). The final analytic sample had 3,060 Latinx students who were on average 14.4 years old. When comparing the analytic and excluded samples, there were significant differences for parent science support (t[3,586] = 8.69, p < .001, Cohen's d = .36) and 9th grade GPA (t[3,365] = 11.30, p < .001, Cohen's d = .51). The effect sizes of the other significant differences were less than small (see Table 1.2 for all comparisons). Among the analytic sample (n = 3,060), 34% of participants had parents with a higher education degree (i.e., parents had at least an associate's degree) and the average annual family income was around $55,000. In terms of nativity, 81% of Latinx adolescents were U.S. born. On average, Latinx adolescents in this sample had a GPA of 2.35 out of a 4.0 scale. When looking at the gender composition of the sample, 49% were female. In terms of ethnic heritage, most identified as Mexican, Mexican-American, or Chicano (50%) whereas others identified with other Latin American nationalities (11% Puerto Rican, 7% Central American, 3% Dominican, 4% Cuban, 6% South American, or 13% other Hispanic or Latino/a).

Procedures

We focused on the adolescent and parent surveys when adolescents were in 9th and 11th grade. Descriptive statistics are provided in Tables 1.1 and 1.2, and all items are listed in Appendix A.

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[1] All numbers reported from the HSLS study are required to be rounded to the nearest tens place for confidentiality purposes.

Measures

Parent Science Support in 9th Grade

In 9th grade, parents and adolescents reported on a variety of parent science-related support, such as conversations that parents had with their adolescent about the value of education and expectations for achievement as well as discussing adolescents' future educational and career aspirations (e.g., "You talked to your mother about science courses to take in [year]"; "During the last 12 months, have you or another family member visited a zoo, planetarium…or a similar museum with your 9th grader?"). These items align with other measures of parent support-related behaviors found in the literature, with many of the items relating to home-based involvement strategies and academic socialization (Fredricks et al., 2005; Hill & Tyson, 2009). These indicators covered a variety of strategies parents can utilize to support their adolescents. Much like other scales including the Home Observation Measurement of the Environment (HOME) and risk scales, the indicators of this scale are cause indicators (Bradley, 2004). Cause indicators are combined into a single scale because all of the indicators theoretically cause or influence the same outcome. All nine items were summed, such that higher scores indicated greater overall parent science support.

Adolescent Science Values in 11th Grade

The two science values examined were science intrinsic and utility values at 11th grade, with items for both indicators drawn from situated expectancy-value theory (Eccles & Wigfield, 2020). Items were averaged to create composite scores for each scale. Science intrinsic value in 11th grade was measured using three items ($\alpha = .79$) that indicated whether adolescents experienced enjoyment, boredom, and if they believed their science course was a waste of time or not (e.g., "Would you say you are taking it because you really enjoy science?"). Science utility value in 11th grade referred to how useful adolescents believed science was for their future and were measured with three items that asked if adolescents believed their current science course was useful for their everyday life, college, and future career (α = .83; e.g., "You are taking fall 2009 science course because it is useful for your future career"). When necessary, items were reverse coded so higher scores indicated stronger science intrinsic and utility values (1 = *Strongly Disagree* to 4 = *Strongly Agree*).

STEM Occupational Expectations in 11th Grade

Adolescents reported the job they expected or planned to have at age 30. Adolescents were coded as having a STEM occupational expectation (0 = *non-STEM occupation,* 1 = *STEM occupation*) if they included an occupation in at least one of the following areas: life and physical science, engineering, mathematics, and information technology occupations, or health occupations (Ingels et al., 2011; National Science Board, 2018). These occupations included those needing a college degree or higher as well as occupations that did not require higher education.

Adolescent Gender

A variable created by NCES was utilized to measure gender, which included adolescent, parent, and/or school-reported adolescent gender to minimize missingness. Gender was measured dichotomously (0 = *Boys*, 1 = *Girls*).

Parent Education

Parent education was defined as those who had a degree from a 2-year or 4-year college (i.e., AA or BA/BS degree; Engle et al., 2006; Engle, 2007; Pascarella et al., 2004). Parents were divided into two categories: those with at least one parent with a college degree and those with parents who had a high school degree or less (0 = *Parents with a high school degree or less*, 1 = *At least one parent with a college degree or higher*).

Covariates

Adolescents' nativity, GPA in 9th grade, family language, and family income were included as covariates in the models. These covariates were chosen due to their theoretical relations to the processes tested in the current study (Eccles & Wigfield, 2020). Adolescent nativity referred to whether the adolescent was U.S. or foreign-born (0 = *Foreign-born*, 1 = *U.S. born*). Due to the historical background behind Puerto Rico and identification of Puerto Ricans, those who were born in Puerto Rico were also considered foreign-born despite their U.S. citizen status (Duany, 2003; Rivera Ramos, 2001). Information from parent and adolescent reports was combined across the two waves of data collection when adolescents were in 9th and 11th grade to minimize the amount of missing data. Adolescents' GPA at 9th grade referred to a composite GPA based on all courses that adolescents had taken throughout 9th grade (0 to 4.0 scale). In 9th grade, parents reported if there was a language other than English regularly spoken in the home (0 = *No*, 1 = *Yes*). Family income was parent-reported and referred to the total family income from all sources when adolescents were in 9th grade (1 = *Family income less than or equal to $15,000* to 13 = *Family income > $235,000*).

Data Analysis Plan

The current study examined associations between parent science support, adolescent science utility and intrinsic values, adolescent STEM occupational expectations, as well as how these indicators and associations varied by parent education and separately adolescent gender (see Figure 1.1). To test these associations, structural equation models (SEM) were estimated in Mplus 8.0 (Muthén & Muthén, 2012).

Due to the stratified, two-stage random sampling design of the dataset, strata, primary sampling units (PSUs), and weights were utilized to account for nonresponse and to reduce bias. The command TYPE = COMPLEX was utilized in order to include the strata, primary sampling unit, and the selected sampling weight. To account for the dichotomous outcome variable and any non-normally distributed data, the weighted least square mean and variance adjusted (WLSMV) estimator was used. To assess model fit, chi-square, standardized root mean square residual (SRMR), root mean square error of approximation (RMSEA), Tucker-Lewis index (TLI), and the comparative fit index (CFI) were utilized (Grimm et al., 2017; Hu & Bentler, 1999). Good model fit was characterized by the following standards: a small chi-square with a nonsignificant p-value, an SRMR < .08, an RMSEA < .05, and a CFI/TLI > .90 (Hu & Bentler, 1999).

Prior to estimating the SEMs to test the hypotheses, measurement invariance was tested to examine the extent to which the constructs in this study had similar measurement properties across gender and parent education (Bialosiewicz et al., 2013; Little, 2013). Measurement invariance was analyzed among boys and girls and, separately, among parents with and without a higher education degree. We tested for configural, weak, and strong measurement invariance separately for adolescent intrinsic value and utility value (Grimm et al., 2017; Little, 2013). Models were determined to be invariant when the change in the CFI was less than 0.01 at each step (Chen, 2007; Cheung & Rensvold, 2002; Putnick & Bornstein, 2016). Based on these guidelines, science utility value exhibited full configural, weak, and strong invariance across gender and across parent education (see Table 1.S2). Science intrinsic value exhibited full configural, weak, and strong invariance across parent education, but not across gender. Thus, models including science intrinsic value were estimated separately for boys and girls as the lack of measurement invariance signifies that science intrinsic values varied across Latina girls and Latino boys and could not be compared.

The SEMs were estimated for the analytic sample (*n* = 3,060) to address our first and second research aims. Our first hypothesis was that higher parental support in 9^{th} grade would be related to stronger adolescent science values in 11^{th} grade. For our second hypothesis, we expected that adolescents' science intrinsic and utility values would each predict adolescents' STEM occupational expectations. Covariates in every model included adolescent nativity, adolescent GPA in 9^{th} grade, family language, and family income. These covariates were used to predict all study variables. Parent support at 9^{th} grade was an observed variable. Science intrinsic and utility values at 9^{th} grade were latent variables each composed of the three items outlined in the measures (see Appendix A for a list of items). Two separate models were estimated; one model included science intrinsic value and the other model included science utility value. These models were estimated separately due to multicollinearity issues that are common with individuals' values and the differences between these indicators in terms of their measurement invariance. Within these models, the associations between parent support, adolescent science intrinsic or utility value, and STEM occupational expectations were examined. Direct and indirect effects from parent support to STEM occupational expectations via science intrinsic or utility value were also estimated. To account for the dichotomous outcome of STEM occupational expectations, it was listed as a categorical variable.

The third research aim of the current study was to understand the extent to which the means and processes differed by (a) adolescent gender and (b) parent education. We first hypothesized that girls and separately those with parents who did *not* have a higher education degree would have lower science intrinsic and utility value as well as lower parent support compared to boys and separately those with parents *with* a higher education degree. Our final hypothesis under this research aim was that the relations between parent science support, science values, and STEM occupational expectations would be weaker for girls and weaker for families who had parents without a higher education degree compared to their peers. Because strong invariance was not achieved for the construct of science intrinsic value by gender, separate science intrinsic value models were estimated for boys and girls to analyze mean-level differences. We analyzed mean-level differences in Stata 14.2 by estimating linear regressions with controls and the variable of interest (e.g., parent education) followed by a Wald test for all continuous study variables (i.e., science intrinsic value, science utility value, and parent science support) and estimating a logistic regression with controls and the variable of interest for STEM occupational expectations. Linear and logistic regressions were estimated instead of ANCOVAs and chi-square tests in order to account for strata, primary sampling units (PSUs), and weights associated with the dataset.

To test for differences in the relations by adolescent gender and by parent education, the SEM model depicted in Figure 1.1 was re-estimated through multi-group analyses. Specifically, two multi-group models were estimated: (1) a model where the three paths among parent science support, adolescent values, and adolescent STEM occupational expectations were freely estimated for each of group, and (2) a model where each of those three paths was constrained to be equal across the groups (Little, 2013). The Satorra-Bentler chi-square difference test was used to determine if relations differed across groups (Muthén & Muthén, 2012; Satorra & Bentler, 2001). A statistically significant change in chi-square across the two models suggests the relations differ by group. If the change in chi-square was statistically significant, we estimated follow-up models to test which specific paths differed by group and across which groups. This was performed by constraining each path to be equal across groups and assessing the change in chi-square (Little, 2013). Because science intrinsic value did not exhibit strong measurement invariance across gender, we could not test for gender differences in the relations among the indicators. Only the science utility value model was tested for relational differences by gender. Additionally, relational differences based on parent education were tested on the science utility value model and the two separate science intrinsic value models estimated for boys and girls.

Missing Data

Within the analytic sample, 1,870 participants had complete data whereas 1,190 participants had one or more pieces of missing information among the study variables (see Table 1.S1). When comparing the two samples, there were no significant differences in adolescent gender, adolescent nativity, family income, nor STEM occupational expectations (Cohen's d = .07; Cramer's V = -.03 - -.01). However, there were significant differences by parent higher education (χ^2 [1] = 14.32, $p < .001$, Cramer's V = -.07), 9th grade GPA (t[2,773] = 7.59, $p < .001$, Cohen's d = .31), science intrinsic value (t[3,053] = 2.64, p = .01, Cohen's d = .10), and science utility value (t[3,053] = 3.11, p = .002, Cohen's d = .12). Participants with some missing data had lower 9th grade GPAs, science intrinsic value, and science utility value than those with complete data. There were also differences in parent science support (t[2,868] = 30.63, $p < .001$, Cohen's d = 1.20), where participants with complete data had greater levels of parent support than participants with some missing data. To address the missing data, full information maximum likelihood (FIML) was utilized in Mplus, which uses all available data to estimate missing values (Cham et al., 2017; Enders, 2010).

Results

Descriptive Statistics

A comprehensive summary of the analytic sample's descriptive statistics can be found in Table 1.1. When they were in 11^{th} grade, Latinx adolescents, on average, agreed that science had intrinsic (M = 2.81, SE = .04 on a 1 to 4 scale) and utility value (M = 3.01, SE = .03 on a 1 to 4 scale). Moreover, 36% of 11^{th} grade Latinx adolescents expected to have a STEM-related occupation when they were older. Parents on average engaged in about three science-related supportive behaviors (M = 3.34, SE = .14 on a 0 to 9 scale).

There were also several significant associations between the indicators. There were moderate, positive associations between science intrinsic and utility values at 11^{th} grade (r = .43, p < .001), such that adolescents who had greater science intrinsic value were likely to also have greater science utility value. Additionally, there were small positive associations between parent science support in 9^{th} grade and adolescents' science intrinsic (r = .10, p < .001) and utility values (r = .14, p < .001) in 11^{th} grade. Regarding parent education, parents who had higher education tended to give greater science support compared to those who did not have higher education (r = .20, p < .001). Lastly, there was a small positive association between adolescent gender and STEM occupation expectations, such that girls were likely to have greater STEM occupation expectations compared to boys (r = .17, p < .001).

Associations Between Parent Science Support, Science Values, and STEM Occupational Expectations

Two separate models were estimated to test the associations between parent science support, science intrinsic or utility value, and STEM occupational expectations (see Figure 1.1 & 1.2). Due to a lack of measurement invariance across gender for the construct of science intrinsic value, we estimated separate models for boys and girls to address the research aims. Both the science intrinsic value model for boys, χ^2 (12) = 17.10, p = .15, CFI = .91, RMSEA = .017, SRMR = .057, and girls, χ^2 (12) = 22.89, p = .03, CFI = .922, RMSEA = .024, SRMR = .035, had adequate model fit. Additionally, the science utility value model, χ^2 (12) = 9.74, p = .64, CFI = 1.00, TLI = 1.00, RMSEA = .00, SRMR = .015, had excellent model fit. Controls for all models included adolescent nativity, 9th grade GPA, family language, and family income (see Tables 1.S3 & 1.S4 for more details).

Science Intrinsic Value Model

We expected parent science support to positively predict adolescents' science intrinsic value, which in turn would positively predict their STEM occupational expectations. The models partially confirmed our first hypothesis for girls, but not for boys. (see Figure 1.1A & 1.1B). Adolescent girls who had greater parent science support in 9th grade had greater science intrinsic value in 11th grade (B = .03, SE = .02, p = .04). However, there was no association between parent science support and adolescent boys' science intrinsic value (B = .01, SE = .03, p = .69). Both adolescent boys' and girls' science intrinsic value were not significantly associated with their STEM occupational expectations in 11th grade. Lastly, direct and indirect effects were examined from parent science support to STEM occupational expectations via science intrinsic value. For girls, there was no direct effect (B = .03, SE = .05. p = .61) or indirect effect (B = -.01, SE = .01, p = .40) present. For boys, there was also no direct effect (B = .02, SE = .05, p = .72) or indirect effect (B = .00, SE = .01, p = .66) present.

Science Utility Value Model

We also expected parent science support to positively predict adolescents' science utility value in 11th grade and for science utility value to predict STEM occupational expectations. Both hypotheses were supported (see Figure 1.2). Greater parent science support was related to greater adolescent science utility value (B = .03, SE = .01, p = .03). Additionally, adolescents with a greater science utility value were more likely to expect or plan to have a STEM job expectation when they were older (B = .52, SE = .16, *p* = .001). No significant direct effect (B = .01, SE = .03, *p* = .89) was found between parent science support and adolescent STEM occupational expectations (B = .01, SE = .03, *p* = .89). However, there was a significant indirect effect (B = .02, SE = .01, *p* = .01) for parent science support on adolescent STEM occupational expectations.

Mean-Level Differences by Adolescent Gender and Parent Education

Another research aim was to examine whether there were mean-level differences among study indicators by adolescent gender and parent education. Below we present the findings for this aim (see Tables 1.S5 & 1.S6 for more details).

Adolescent Gender

The findings indicated that there were no significant gender differences in adolescents' science utility value (B = -.06, SE = .07, *p* = .45) or parent science support (B = .06, SE = .25, *p* = .80). For STEM occupational expectations, there was a trend for a significant difference in STEM occupational expectations by adolescent gender (OR = 1.73, B = .55, SE = .28, *p* =.05), such that the odds of having a STEM job expectation for girls is 1.73 times that of boys. Thus, adolescent girls had a higher probability of having a STEM job expectation compared to adolescent boys. Mean-level differences of science intrinsic value by adolescent gender were not performed due to a lack of measurement invariance across girls and boys.

Parent Education

Findings indicated that there were no significant differences by parent education for adolescents' science utility value (B = -.01, SE = .07, *p* = .91) nor STEM occupational expectations (OR = .83, B = -.19, SE = .28, *p* = .51). There were also no significant differences by parent education for adolescent girls' (B = -.14, SE = .13, *p* = .27) and adolescent boys' (B =

.03, SE = .13, p = .82) science intrinsic value. However, in support of our hypothesis, adolescents who had parents with a higher education had greater parent science support (B = .55, SE = .23, p = .02).

Relational Differences by Adolescent Gender and Parent Education

Science Intrinsic Value Model

Due to a lack of measurement invariance in adolescents' science intrinsic value by gender, we only tested whether the relations differed a parent education with a multi-group SEM. Specifically, we examined the differences based on parent education within boys and, separately, within girls. We expected the relations to be stronger for adolescents who had parents with a higher education degree when compared to their peers. Contrary to our hypothesis, there were no relational differences based on parent education for both boys ($\Delta\chi^2$ [3] = 4.38, p = .22) or girls ($\Delta\chi^2$ [3] = 1.86, p = .60) based on the nonsignificant chi-square difference tests. Thus, the relations between parent science support, adolescent science intrinsic value, and adolescent STEM occupational expectations as shown in Figure 1.2 did not significantly vary based on parent education.

Science Utility Value Model

Under this research aim, we hypothesized that the relations among the science utility value model shown in Figure 1.1 would be weaker for adolescent girls than boys, and weaker for adolescents whose parents who did not have a higher education degree compared to those whose parents had a higher education degree. When looking at whether gender moderated any of the relations for the science utility value model, the chi-square difference test suggested no relational differences by gender ($\Delta\chi^2$ [3] = 3.74, p = .29). Also contrary to our hypothesis, there were no relational differences by parent education ($\Delta\chi^2$ [3] = 3.53, p = .32). Thus, the relations between parent science support, adolescent science utility value, and adolescent STEM occupational expectations did not significantly vary by gender nor parent education.

Discussion

According to situated expectancy-value theory, individuals' motivational beliefs help determine the choices they make and their eventual persistence in subjects including science (Eccles & Wigfield, 2020). Coupled with the importance of adolescence as a period for the development of motivational beliefs and occupational expectations and the need to understand these normative processes among Latinx adolescents, the current study examined the associations between parent science support in 9th grade, Latinx adolescents' science intrinsic and utility values, and STEM occupational expectations when adolescents were in 11th grade. The current study also addresses the gap in the literature regarding within-group variability among Latinxs by examining whether these indicators and the associations between them differed by two main indicators theoretically related to these processes and indicators: parent education and adolescent gender. Results indicated that parent science support was related to adolescents' science utility value and girls' science intrinsic value. Further, science utility value was predictive of adolescents' STEM occupational expectations. These findings also revealed that adolescent girls were more likely to have a STEM occupational expectation compared to adolescent boys and adolescents who had parents with a higher education received greater parent science support compared to adolescents who had parents without a higher education. Lastly, there were no relational differences by adolescent gender nor parent education.

Associations Between Parent Science Support, Science Values, and STEM Occupational Expectations

Situated expectancy-value theory highlights the importance of parent behaviors, such as their support, for the development of science values and achievement choices (Eccles & Wigfield, 2020). In partial support of our hypothesis, we found that greater parent science support was predictive of adolescents' science utility value and, only for girls, of their science intrinsic value. These findings align with prior studies on mainly White adolescents that find parent support is related to greater subjective task values (Eccles, 1993; Gottfried et al., 2009; Hsieh et al., 2019; Simpkins et al., 2012). This suggests that these processes work similarly for Latinx adolescents in science, which was previously an untested assumption due to the few studies on these processes for Latinx adolescents. These findings provide further insight into what these positive family science processes look like specifically for Latinx adolescents using a large sample of Latinx families.

One finding that did not align with our hypothesis was that parent science support was not significantly associated with adolescent boys' science intrinsic value, though it was positively predictive of adolescent girls' science intrinsic value. It is possible that parent support was not a consistent predictor of intrinsic value compared to utility value due to the types of discussions parents may have with their adolescent. As utility intervention studies have indicated (Harackiewicz et al., 2012), parents may help develop adolescents' utility value but intrinsic value may be more difficult to develop if adolescents are not interested in the subject and have interests in other domains (Jacobs et al., 2005). For example, Jacobs and colleagues (2005) highlight how girls had strong ability self-concepts in math but were not interested in this domain. In regard to why parent support predicted science intrinsic value for girls and not boys, scholars have noted that women and girls face discrimination and barriers due to gender dynamics within science (Rodriguez & Blaney, 2020). For Latina girls, there is also an added layer of discrimination due to their race/ethnicity, with scholars emphasizing the lack of sense of belonging they face related to both their race/ethnicity and gender (Johnson, 2011; Rodriguez & Blaney, 2020). For Latino boys, they do not experience this "double bind" (Johnson, 2011), but they generally may experience more barriers within school settings (e.g., criminalization) more broadly and not just science (Musto, 2019). Thus, parent science support may work as a protective factor for the development of interest in science for Latina girls but not for Latino boys. Parent support may be more impactful for Latino boys' general academic motivation. Also, part of our findings suggested that girls were more likely to have higher STEM occupational expectations, which may indicate that parent support is more influential since Latina girls may already be thinking of careers in science. Studies should further examine qualitatively why parent science support may yield greater science interest among Latina girls but not for Latino boys.

Aligned with our hypothesis, having greater science utility value was associated with being more likely to having a STEM occupational expectation among Latinx adolescents. This supports studies that have shown that adolescents who think science is or will be useful for their goals, such as career goals, is associated with individuals' choices and STEM career expectations (Hidi & Renninger, 2006; Jiang et al., 2020). For example, Jiang and colleagues (2020) using the full sample of the High School Longitudinal Study found support for adolescents' science subjective task value in high school being related to their STEM college major choice years later. The current findings further underscore the strong association between science utility value and occupational expectations among Latinx adolescents as well and aligns with prior research on other racial/ethnic groups that find associations between their subjective task value and career expectations (Banerjee et al., 2018; Hiller & Kitsantas, 2014; Jiang et al., 2020). However, this association was not present for science intrinsic value among Latinx adolescents, which contrasts other studies on White populations (Banerjee et al., 2018; Hiller & Kitsantas, 2014). This difference by racial/ethnic group confirms that findings from one group should not be generalized to another. Further, this finding emphasizes the need to continue to study not only relations between overall subjective task value and outcomes, but also the unique contributions of each type of subjective task value. As our study indicates, science intrinsic value alone was not indicative of career expectations that Latinx adolescents had.

Differences Based on Adolescent Gender

Results indicated that there were no significant differences by gender for adolescents' science utility value or how much parent science support they received. Also, there was only a trend level significance for STEM occupational expectations where Latina girls were more likely to have STEM occupational expectations compared to Latino boys. Our findings highlight that for Latinxs there is no difference between boys and girls in terms of how useful they find science overall though other research suggests Latina girls to have lower science utility value of specific science disciplines, namely physics but not for biology or chemistry (Simpkins et al., 2015). To our knowledge, these findings further expand the large gap in the literature regarding within-group variability of marginalized racial/ethnic groups since most studies have focused on examining mean-level differences of motivational beliefs by racial/ethnic groups and by gender among White adolescents (Andersen & Ward, 2013). The current study's nonsignificant findings indicate that Latinx girls and boys were more similar rather than different, which align with Hyde's (2005) gender similarities hypothesis. Hyde (2005) posited that contrary to popular beliefs about gender, boys and girls may actually be more similar rather than different on psychological variables and that boys and girls perform similarly in science (Hyde & Linn, 2006). The gender similarities hypothesis may potentially extend to motivational beliefs, such as science utility value.

Pertaining to parent science support, the current study findings diverge from other findings based on White adolescents where parent support is typically greater for boys compared to girls (Fredricks et al., 2005; Simpkins et al., 2015; Simpkins et al., 2010). Among Latinx families, parents tend to have high educational expectations of their children regardless of gender (Cabrera & Padilla, 2004; Luna & Martinez, 2013; Sanchez et al., 2006; Suizzo & Stapleton, 2007). Moreover, qualitative studies have indicated that within the domain of science, Latinx parents engage in many supportive behaviors (Soto-Lara & Simpkins, 2020; Ramoz Carranza & Simpkins, 2021). Due to the high expectations that are also noted in these qualitative studies, Latinx parents may not engage in gendered socialization practices present for other populations when it comes to science. Overall, our study further contributes by testing whether these supportive behaviors differed by adolescent gender.

Our final finding when examining mean-level differences by gender was that Latina girls were more likely to expect having a STEM occupation compared to Latino boys. From the literature, it is known that both Latina girls and Latino boys face significant barriers and challenges when pursuing science, such as negative stereotypes based on their race/ethnicity (Beasley & Fischer, 2012; Strayhorn et al., 2013). However, this finding may be indicative of the growing resources and support for a larger representation of underrepresented minorities and women in STEM that may be pushing Latina girls towards pursuing STEM careers. An additional area for exploration would be whether occupational expectations differ by the type of science field among Latina girls and Latino boys. Studies have indicated that women and underrepresented minority populations are more likely to show an interest towards careers that are interpersonal in nature (Boucher et al., 2017; Eccles, 1994; Diekman et al., 2017; Harackiewicz et al., 2016). Science fields may vary on this front since some science occupations may be more interpersonal compared to other occupations.

When examining relational differences, we found that the science utility value model did not vary by adolescent gender, which has been noted by a few studies (Hsieh et al., 2019; Simpkins et al., 2018; Simpkins et al., 2015). These findings support those of Simpkins and colleagues' (2018) where they examined relations between parent support and Latinx adolescents' motivational beliefs and also found nonsignificant findings in regard to relational differences by adolescent gender. The current study extends this research since Simpkins and colleagues' (2018) study used a small sample whereas the current study uses a larger, nationally representative dataset.

Differences Based on Parent Education

Regarding mean-level differences by parent education, findings indicated that adolescents' science values and STEM occupational expectations did not differ by parent education. However, parents who had a higher education degree provided more science support than their peers with less education. Contrary to situated expectancy-value theory (Eccles & Wigfield, 2020) and studies on first-generation college students (Chen, 2005; Puente et al., 2021), parent education may not be directly related to Latina girls' and Latino boys' science values and STEM occupational expectations as there may be other factors at play within these processes. Theoretically, there may be indirect associations between parent education and science values and STEM occupational expectations that may be explained by different parent behaviors (e.g., help with homework, engaging in conversations about career expectations) and beliefs (Aschbacher et al., 2010; Eccles, 2005; Ramos Carranza & Simpkins, 2021). For example, studies on parent support for first-generation college students (i.e., students who have parents with a high school degree or less) have noted that regardless of parent education, parents support their adolescent (Nichols & Islas, 2016). As found in this study and in others, parent support has direct associations to adolescent motivational development. Thus, parent education may be indirectly associated with science values and STEM occupational expectations depending on parents' supportive behaviors for example. This may also be true of other factors, such as parent beliefs as outlined by the parent socialization model (Eccles, 1993). Thus, more studies are needed that examine potential mediators of associations between parent education and adolescents' science values.

In addition to mean-level differences, we also examined whether the tested associations differed by parent education. Our findings indicated that the associations for the science intrinsic and science utility value models did not vary by parent education. Although there is limited research on mean-level differences for science motivational beliefs by parent education found in the college generational literature (Allen et al., 2015; Boucher et al., 2017; Chen, 2005; Jiang et al., 2020; Puente et al., 2021), more research is needed at the process-level, especially for underrepresented groups. In one of the only studies that examines process-level differences by college generational status, Jiang and colleagues (2020) did find that associations between motivational beliefs and STEM major varied by whether students were first- or continuing-generation college students. However, this study focused on a diverse racial/ethnic sample that had college-aged adolescents and did not examine within-racial/ethnic group differences. To our knowledge, this would be the first study that examines these processes by parent education for Latinx adolescents in high school. The processes in the current study among Latinx adolescents may not vary by parent education since they may have similar experiences (e.g., negative stereotypes) in science regardless of parent education (Beasley & Fischer, 2012; Grosman & Porche, 2013; McGee, 2016; Strayhorn et al., 2013). Moreover, these findings suggest that Latinx adolescents have similar relations between parent support, adolescent science values, and adolescent STEM occupational expectations regardless of parent education.

Limitations and Future Directions

The current study benefited from many strengths associated with large, national datasets, such as having a large sample size to run complex models and reducing bias through the sample design of the dataset. However, there were also limitations, such as a lack of information on cultural factors and other family members. For example, emerging studies on family support draw attention to the importance of siblings for development, including the development of science motivational beliefs (Cox & Paley, 1997; Puente & Simpkins, 2020; Ramos Carranza & Simpkins, 2021). Future studies should further examine the role of siblings and their characteristics in the development of motivational beliefs of Latinx adolescents, such as examining whether associations differ by whether an older sibling has obtained college degree. Another main limitation was that the dataset did not capture cultural factors associated with Latinx families and barriers that Latinx adolescents may have faced. Theory suggests that culture is present in everyday interactions and developmental processes (Garcia-Coll et al., 1996; Vélez-Agosto et al., 2017), with Latinxs having unique experiences that relate to their development (Raffaelli et al., 2005). Additionally, adolescents of color may experience discrimination and/or racism as well as other barriers related to their social position that influences their development, including their motivational development (Garcia-Coll et al., 1996; Raffaelli et al., 2005). Future studies should incorporate measures of cultural indicators and barriers that are related to developmental processes that are relevant to Latinx families, such as acculturative stress and familism values (Raffaelli et al., 2005). This would lead to more studies exploring within-group variability for important developmental processes among Latinxs.

Conclusion

The current study aimed to address gaps in the literature regarding the processes related to parent support and two key motivational beliefs emphasized as determinants of achievement choices among Latinx adolescents who remain an underrepresented group in science. We further address the gap in the literature on within-group variability by examining whether there were mean-level and process-level differences of these associations by adolescent gender and parent education, which have been tied to many of the study constructs. Our findings indicated that parent science support was predictive of adolescents' science utility value and girls' science intrinsic value, but not boys' science intrinsic value. Additionally, girls' and boys' science intrinsic value were not invariant. This crucial finding emphasizes a need to investigate further what differences there are for girls' and boys' science intrinsic value. Additionally, only science utility value was predictive of adolescents' STEM occupational expectations. Significant findings related to mean-level differences were that Latina girls were more likely to have a STEM occupational expectation than Latino boys and that parents with a higher education gave greater support in science. Finally, the tested processes did not vary by adolescent gender nor parent education. Overall, the current study findings contribute to the literature on what these processes look like for an underrepresented population in science, which differ from prior studies on mainly White adolescents. These findings further inform what constructs and processes are related to STEM occupational expectations, which is related to later persistence.

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Table 1.1
Descriptive Statistics of Study Variables

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Science intrinsic (11th grade)	1									
2. Science utility (11th grade)	.43***	1								
3. Parent science support	.10***	.14***	1							
4. STEM occ. expectations	.08***	.15***	.11***	1						
5. Parent higher education	.03	.04*	.20***	.04	1					
6. Female	-.02	.01	.01	.17***	.03	1				
7. GPA (9th grade)	.10***	.16***	.22***	.15***	.21***	.16***	1			
8. U.S. born (adolescent)	-.05*	-.05**	.01	-.01	.04*	.02	.02	1		
9. Family income[a]	.01	.00	.21***	.04	.43***	.02	.28***	.15***	1	
10. Family language[b]	.01	.02	-.03	.02	-.16***	-.03	-.08***	-.26***	-.24***	1
M/ %	2.81	3.01	3.34	36%	34%	49%	2.35	81%	3.18	72%
(SE)	.04	.04	.14	–	–	–	.05	–	.10	–
Skewness	.04	.04	.35	.89	.36	-.02	-.40	-1.62	1.72	-.66
Kurtosis	-.32	-.39	2.19	1.78	1.13	1.00	2.51	3.62	6.12	1.43
% Missing	2.79	3.49	6%	9%	0%	0%	9%	17%	26%	30%

Note. [a]Family income was parent-reported and referred to the total family income from all sources when adolescents were in 9th grade (1 = Family income less than or equal to $15,000 to 13 = Family income > $235,000). [b]In 9th grade, parents reported if there was a language other than English regularly spoken in the home (0 = *No*, 1 = *Yes*). Frequencies in the table are weighted.
* $p < 0.05$. ** $p < 0.01$. * $p < 0.001$.
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, First Year Follow-Up.

Table 1.2

Descriptive Statistics of Participants in the Analytic and Excluded Samples

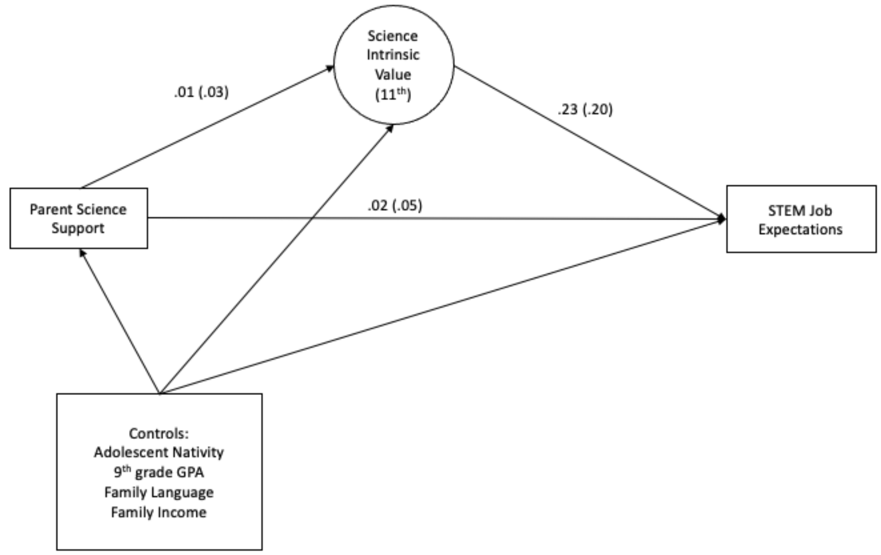
	Analytic Sample			Excluded Sample				
	N	*M* (SE)/%	Min/ Max	N	*M* (SE)/%	Min/ Max	*t*-test or Chi-square test[1]	Effect size
Study variables								
Science intrinsic (11th grade)	3,060	2.81 (.04)	1/4	910	2.80 (.12)	1/4	.53	.09[a]
Science utility (11th grade)	3,060	3.01 (.04)	1/4	910	2.99 (.15)	1/4	1.35	.20[a]
Parent science support	3,050	3.34 (.14)	0/9	950	3.57 (.31)	0/9	8.69***	.36[a]
Parent higher education	3,060	34%	0/1	260	37%	0/1	4.97*	-.04[b]
STEM occ. expectations	2,770	36%	0/1	660	34%	0/1	4.06*	-.03[b]
Covariates								
Female	3,060	49%	0/1	950	46%	0/1	5.41*	-.04[b]
GPA (9th grade)	2,970	2.35 (.05)	0/4	940	2.10 (.19)	0/4	11.30***	.51[a]
U.S. born (adolescent)	2,540	81%	0/1	520	73%	0/1	4.67*	-.04[b]
Family income	3,060	3.18 (.10)	1/13	950	3.32 (.35)	1/13	4.58***	.23[a]
Family language	2,150	72%	0/1	420	84%	0/1	1.49	.02[b]

Note. Frequencies displayed are weighted for both samples. Comparisons were made between the Latinx analytic sample and the Latinx excluded sample. Latinx students who did not have 11th grade intrinsic and utility values or who did not have parent education information were excluded from the analytic sample (n = 950). [a]Indicates Cohen's d was used for measuring effect size among independent sample *t*-tests for continuous variables. Standard interpretation: small effect: .20, moderate effect: .50, large effect: .80. [b]Indicates Cramer's V was used for measuring effect size among Chi-square tests for dichotomous variables. Standard interpretation: small effect: .10, moderate effect: .30, large effect: .50.

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

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, First Year Follow-Up.

A. Boys



B. Girls

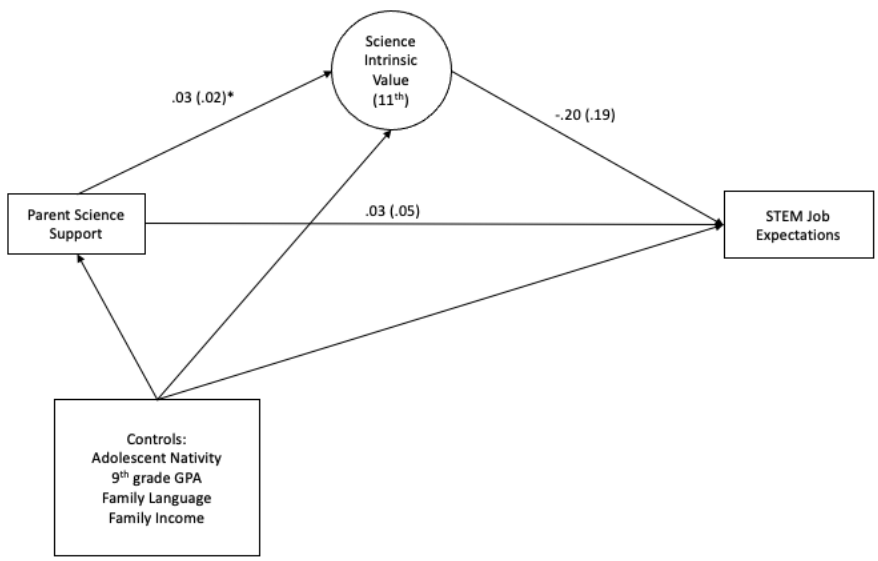


Figure 1.1. Science intrinsic value models for boys and girls. **p* < .05, ***p* < .01, ****p* < .001.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, High School Longitudinal Study of 2009 (HSLS:09), Base Year, First Year Follow-Up.

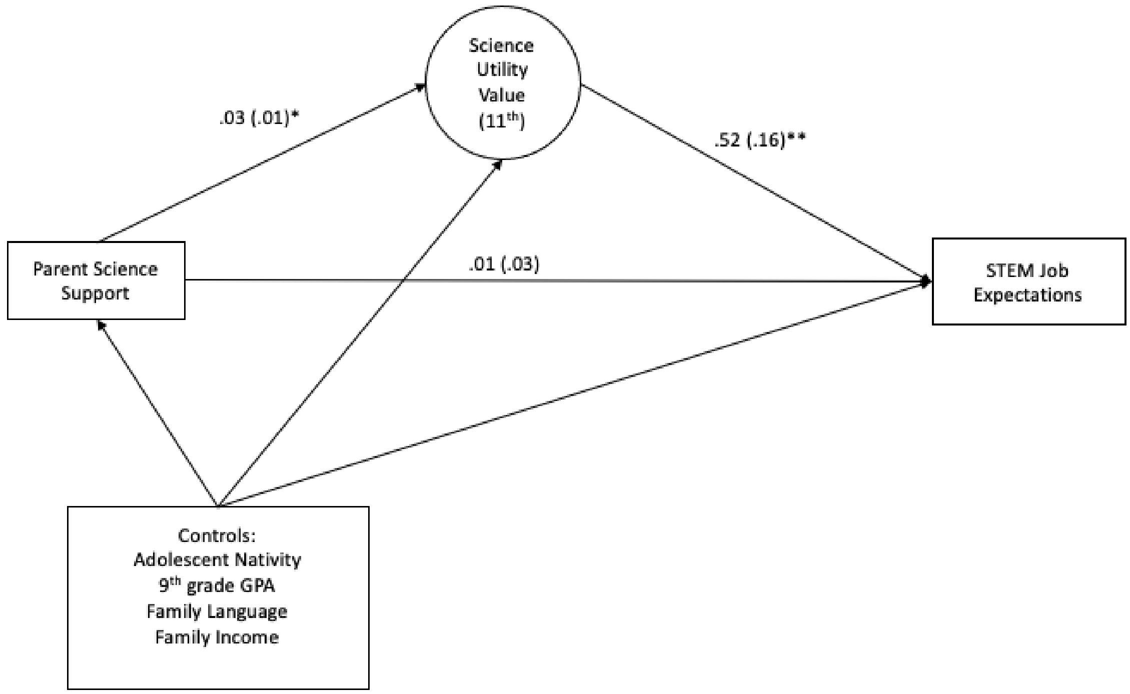


Figure 1.2. Science utility value model. *p < .05, **p < .01, ***p < .001.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, High School Longitudinal Study of 2009 (HSLS:09), Base Year, First Year Follow-Up.

Supplementary Materials

Table 1.S1

Comparisons between Families with and without Missing Data Among the Analytic Sample

	Complete Data Sample			Missing Data Sample			*t*-test or Chi-square test	Effect size
	N	*M* (SE)/%	Min/ Max	N	*M* (SE)/%	Min/ Max		
Study variables								
Science intrinsic (11th grade)	1,870	2.84 (.04)	1/4	1,190	2.69 (.09)	1/4	2.64**	.10[a]
Science utility (11th grade)	1,870	3.05 (.04)	1/4	1,190	2.88 (.06)	1/4	3.11**	.12[a]
Parent science support	1,870	3.60 (.13)	0/9	1,190	2.17 (.35)	0/9	30.63***	1.20[a]
Parent higher education	1,870	37%	0/1	1,190	25%	0/1	14.32***	-.07[b]
STEM occ. expectations	1,870	34%	0/1	900	45%	0/1	2.88	-.03[b]
Covariates								
Female	1,870	47%	0/1	1,190	55%	0/1	1.85	-.02[b]
GPA (9th grade)	1,870	2.36 (.06)	0/4	1,100	2.22 (.11)	0/4	7.59***	.31[a]
U.S. born (adolescent)	1,870	83%	0/1	670	70%	0/1	.18	-.01[b]
Family income	1,870	3.22 (.12)	1/13	1,190	2.98 (.21)	1/13	1.20	.07[a]
Family language	1,870	70%	0/1	280	80%	0/1	5.12*	.05[b]

Note. Frequencies displayed are weighted for both samples. [a]Indicates Cohen's d was used for measuring effect size among independent sample *t*-tests for continuous variables. Standard interpretation: small effect: .20, moderate effect: .50, large effect: .80. [b]Indicates Cramer's V was used for measuring effect size among Chi-square tests for dichotomous variables. Standard interpretation: small effect: .10, moderate effect: .30, large effect: .50.
*$p < .05$, **$p < .01$, ***$p < .001$.
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, First Year Follow-Up.

Table 1.S2

Measurement Invariance Tests by Gender and Parent Education

Invariance Model	χ^2	df	*p*	$\Delta\chi^2$	Δdf	*p*	RMSEA	90% CI	CFI	ΔCFI	TLI/NNFI	SRMR
Gender Invariance (Intrinsic & Utility Values)												
Configural	22.61	16	.12	—	—	—	.016	.000; .031	.986	—	.974	.044
Weak	50.84	22	.001	28.23	6	< .001	.029	.019; .040	.939	.046	.917	.127
Partial Weak[a]	28.25	19	.08	5.64	3	.13	.018	.000; .031	.981	.005	.969	.075
Partial Weak (one item constrained)[b]	31.91	20	.04	3.66	1	.06	.020	.003; .032	.975	.006	.962	.090
Partial Strong	40.61	24	.02	8.70	4	.07	.021	.009; .032	.965	.010	.956	.084
Parent Education Invariance (Intrinsic & Utility Values)												
Configural	24.21	16	.09	—	—	—	.018	.000; .032	.981	—	.965	.043
Weak	29.54	22	.13	5.30	6	.51	.015	.000; .028	.983	.002	.976	.065
Strong	33.67	28	.21	4.13	6	.66	.012	.000; .024	.987	.004	.986	.069

Note. [a]The partial weak model constrained the loadings for science utility value and freely estimated the loadings for science intrinsic value. [b]Because the partial weak model achieved partial weak invariance, each loading was tested to see which items could be constrained and still maintain partial weak invariance. The item that referred to whether they found science boring (i.e., “9th grader thinks fall 2009 science course is boring”) was the only loading that could be constrained to meet partial weak invariance.

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, First Year Follow-Up.

Table 1.S3

Structural Equation Model Results of Science Intrinsic Models

Science Intrinsic Value Model (Girls)			
Main Relations	B	SE	*p*
Parent science support → Science intrinsic value	.03*	.02	.04
Science intrinsic value → STEM occupational expectations	-.20	.19	.29
Parent science support → STEM occupational expectations (Direct Effect)	.03	.05	.61
Indirect Effect	-.01	.02	.42
Controls			
Family income → Science intrinsic value	-.02	.01	.16
9th grade GPA → Science intrinsic value	-.03	.05	.52
Adolescent nativity → Science intrinsic value	-.05	.08	.56
Family language → Science intrinsic value	.01	.07	.86
Family income → STEM occupational expectations	.06	.04	.13
9th grade GPA → STEM occupational expectations	.22*	.10	.03
Adolescent nativity → STEM occupational expectations	-.50	.28	.07
Family language → STEM occupational expectations	.14	.20	.48
Family income → Parent science support	.06	.07	.37
9th grade GPA → Parent science support	.64**	.22	.004
Adolescent nativity → Parent science support	-.35	.45	.44
Family language → Parent science support	.21	.33	.53

Science Intrinsic Value Model (Boys)			
Main Relations	B	SE	*p*
Parent science support → Science intrinsic value	.01	.03	.69
Science intrinsic value → STEM occupational expectations	.23	.20	.25
Parent science support → STEM occupational expectations (Direct Effect)	.02	.05	.72
Indirect Effect	.003	.01	.66
Controls			
Family income → Science intrinsic value	-.02	.02	.45
9th grade GPA → Science intrinsic value	.04	.08	.60
Adolescent nativity → Science intrinsic value	-.24	.14	.08
Family language → Science intrinsic value	-.01	.14	.94
Family income → STEM occupational expectations	-.02	.04	.68
9th grade GPA → STEM occupational expectations	-.10	.13	.44
Adolescent nativity → STEM occupational expectations	-.08	.28	.76
Family language → STEM occupational expectations	.30	.24	.22
Family income → Parent science support	.11	.06	.08
9th grade GPA → Parent science support	.30	.17	.07

Adolescent nativity → Parent science support	-.70	.42	.09
Family language → Parent science support	-.54	.36	.13

Note. *p < .05, **p < .01, ***p < .001.
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, First Year Follow-Up.

Table 1.S4

Structural Equation Model Results of Science Utility Model

Main Relations	B	SE	*p*
Parent science support → Science utility value	.03*	.01	.03
Science utility value → STEM occupational expectations	.52**	.16	.001
Parent science support → STEM occupational expectations (Direct Effect)	.01	.03	.89
Indirect Effect			
Controls			
Family income → Science utility value	-.02	.01	.08
9th grade GPA → Science utility value	.02	.04	.64
Adolescent nativity → Science utility value	-.09	.09	.29
Family language → Science utility value	-.00	.05	.95
Family income → STEM occupational expectations	.03	.03	.29
9th grade GPA → STEM occupational expectations	.09	.10	.39
Adolescent nativity → STEM occupational expectations	-.28	.21	.18
Family language → STEM occupational expectations	.19	.18	.29
Family income → Parent science support	.08	.05	.07
9th grade GPA → Parent science support	.46***	.12	< .001
Adolescent nativity → Parent science support	-.56	.32	.08
Family language → Parent science support	-.19	.24	.44

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

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, First Year Follow-Up.

Table 1.S5

Regression Results for Examining Mean-Level Differences by Adolescent Gender

Predictor	Utility Value β (SE)	Parent Science Support β (SE)	STEM Occupational Expectations β (SE)
Constant	3.10*** (.13)	2.64*** (.54)	-1.10 (.66)
9th grade GPA	.04 (.05)	.41*** (.11)	.10 (.16)
Family income	-.02 (.01)	.10 (.06)	.01 (.05)
Family language	.02 (.07)	-.19 (.22)	.32 (.32)
Adolescent nativity (U.S. born)	-.10 (.08)	-.38 (.33)	-.38 (.35)
Female	-.06 (.07)	.06 (.25)	.55 (.28)$^{+}$
Observations	2,620	2,620	2,560
F	F(1, 289) = .57	F(1, 289) = .07	F(5, 276) = 1.21

Note. $^{+}p < .10$, $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

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, First Year Follow-Up.

Table 1.S6

Regression Results for Examining Mean-Level Differences by Parent Education

Predictor	Utility Value β (SE)	Intrinsic Value (Girls) β (SE)	Intrinsic Value (Boys) β (SE)	Parent Science Support β (SE)	STEM Occupational Expectations β (SE)
Constant	3.08*** (.13)	2.89*** (.18)	3.01*** (.26)	2.62*** (.57)	-.89 (.64)
9th grade GPA	.03 (.05)	-.02 (.07)	.07 (.08)	.38** (.11)	.17 (.17)
Family income	-.02 (.01)	.00 (.02)	-.02 (.02)	.06 (.07)	.02 (.06)
Family language	.02 (.07)	.05 (.11)	-.05 (.16)	-.13 (.22)	.25 (.33)
Adolescent nativity (U.S. born)	-.10 (.08)	-.03 (.10)	-.31* (.12)	-.37 (.32)	-.40 (.35)
Parent education (college degree or more)	-.01 (.07)	-.14 (.13)	.03 (.13)	.55* (.23)	-.19 (.28)
Observations	2, 620	1, 170	1,140	2,620	2,560
F	F(1, 289) = .01	F(1, 144) = 1.24	F(1, 166) = .05	F(1, 289) = 5.47*	F(5, 276) = .73

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

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, First Year Follow-Up.

Appendix A

Measures:

Construct: Parent Science Support
Measurement Information: 9 dichotomous items (0 = *No*, 1 = *Yes*)
Adolescent-reported: What are the reasons you plan to take more science courses during high school? 1. Plans to take more science courses because parents want him/her to Since the beginning of the last school year, which of the following people have you talked with about which science courses to take this year? 2. 9^{th} grader talked to mother about science courses to take in 2009-2010 3. 9^{th} grader talked to father about science courses to take in 2009-2010 *Parent-reported:* During the last 12 months, which of the following activities have you or another family member done with [your 9^{th} grader]? 4. Went to science or engineering museum with 9^{th} grader in the last year 5. Worked or played on computer with 9^{th} grader in the last year 6. Built or fixed something with 9^{th} grader in the last year During the last 12 months, which of the following activities have you or another family member done with [your 9^{th} grader]? 7. Discussed a program or article about math, science, or technology 8. Attended a school science fair with 9^{th} grader in the last year 9. Helped 9^{th} grader with a school science fair project in the last year
Alpha: .60

Construct: Adolescent Science Motivational Beliefs
Measurement Information: Items measured on a 1 to 4 scale that will be reverse coded; 1 = *Strongly Agree;* 4 = *Strongly Disagree*
Science Intrinsic Value at 11^{th} Grade (adolescent-reported): 1. 9^{th} grader is enjoying fall 2009 science course (*reverse-coded*) 2. 9^{th} grader thinks fall 2009 science course is a waste of time 3. 9^{th} grader thinks fall 2009 science course is boring *Science Utility Value at 11^{th} Grade (adolescent-reported):* 1. 9^{th} grader thinks fall 2009 science course is useful for everyday life 2. 9^{th} grader thinks fall 2009 science course is useful for college 3. 9^{th} grader thinks fall 2009 science course is useful for future career
Alphas: Science Intrinsic Value at 11^{th} grade: .79 Science Utility Value at 11^{th} grade: .83

Construct: STEM occupational expectations in 11^{th} Grade
Measurement Information: Open ended responses coded by NCES
Item (adolescent-reported): As things stand now, what is the job or occupation that you expect or plan to have at age 30?
Alphas: N/A

Construct: Adolescent Gender
Measurement Information: This item was dummy coded into the variable Female (1 = *Female*; 0 = *Male*) based on the original item (below)
Item: What is your sex? (1 = *Male*, 2 = *Female*)
Alphas: N/A

Construct: Parent Education
Measurement Information:
Parent Higher Education Item (parent-reported): Composite variable indicating the highest level of education achieved by either parent 1 or parent 2 using the following scale: 1 = Less than high school 2 = High school diploma or GED or alternative HS credential 3 = Certificate/diploma from school providing occupational training 4 = Associate's degree 5 = Bachelor's degree 6 = Master's degree 7 = Ph.D./M.D/Law/other high level professional degree
Alphas: N/A

Construct: Covariates
Measurement Information: N/A
Nativity Items: 1. Was [your 9^{th} grader] born in the United States, in Puerto Rico, or another U.S. territory, or in another country? (*parent-reported*) 2. Were you born in the United States, Puerto Rico or another U.S. territory, or another country? Applies to second follow-up respondents for whom country of birth is not available from previous data collections. (*adolescent-reported*) *Family Language Item (parent-reported):* Is any language other than English regularly spoken in your home? (yes, no) *Family Income Item (parent-reported):*

Composite variable that is categorical which indicates the sample member’s family income from all sources in 2008 using the following scale: 1 = Less than or equal to $15,000 2 = > $15,000 and <= $35,000 3 = > $35,000 and <= $55,000 4 = > $55,000 and <= $75,000 5 = > $75,000 and <= $95,000 6 = > $95,000 and <= $115,000 7 = > $115,000 and <= $135,000 8 = > $135,000 and <= $155,000 9 = > $155,000 and <= $175,000 10 = > $175,000 and <= $195,000 11 = > $195,000 and <= $215,000 12 = > $215,000 and <= $235,000 13 = > $235,000
Alphas: N/A

CHAPTER 2

Latinx Family Support in Science and its Links to Adolescents' Science Intrinsic and Utility Values

Abstract

Latinxs remain largely underrepresented in the sciences despite attempts to increase access and diversity. The current study aimed to address: (1) what factors predict parent and older sibling science support and the extent to which they are related and (2) associations between parent and older sibling science support and adolescent science motivational beliefs. The longitudinal study was based on 104 Latinx adolescents (M_{age} = 14.5; 40% Female) and their families. Findings indicated that parents' and siblings' familism values and parent education were unrelated to the amount of science support provided. Adolescents who thought their parents provided greater support also thought their siblings provided greater support, with parents providing greater science support compared to siblings. Lastly, parent and sibling science support were positively associated with adolescents' science utility value. These results begin to underscore how parents and older siblings both play an important role in the development of adolescents' motivational beliefs.

Keywords: Parent support, sibling support, Latinx adolescents, science motivation

Latinx Family Support in Science and its Links to Adolescents' Science Intrinsic and Utility Values

Science continues to be a field that is markedly composed of White and Asian individuals whereas other populations, such as Latinx individuals, continue to be underrepresented (Beasly & Fischer, 2012; Hazari et al., 2013; National Science Board, 2018; Rochin & Mello, 2007). Research indicates that Latinxs face various structural barriers and challenges in science, including discrimination, stereotype threat, and microaggressions (Andersen & Ward, 2013; Beasley & Fischer, 2012; Strayhorn et al., 2013). Having strong motivational beliefs can serve as a protective factor where adolescents who have greater interest in science (i.e., intrinsic value) and who find it valuable (i.e., utility value), for example, have positive science outcomes, such as greater persistence (Andersen & Ward, 2013; Eccles & Wigfield, 2020; Hulleman & Harackiewicz, 2009; Wang & Degol, 2013).

Adolescents' motivational beliefs are fostered by the support that families give (Hsieh et al., 2019; Puente & Simpkins, 2020; Simpkins et al., 2015a). Although family systems theory argues that multiple, dependent family relationships (e.g., parent-child, sibling-child) influence adolescents' adjustment, which in this case is their science motivation (Cox & Pailey, 1997), most research has only examined parent-child relationships, and typically among White families. Family processes among White families, however, do not always generalize to other populations (Grau et al., 2009). Although research among Latinx families has grown in recent years, gaps remain, especially when examining positive family processes that support adolescent science motivational beliefs with consideration of cultural processes (Grau et al., 2009). The existing research on Latinx family academic support has often been examined qualitatively and notes the importance of both parents and siblings (Alfaro & Umaña-Taylor, 2010; Ceballo et al., 2014).

The current study extends this literature by examining: (a) the relations between adolescents' perceptions of parent and sibling science support, (b) the extent to which parent and sibling familism values and parent education predict their science support, and (c) the extent to which adolescents' perceptions of parent and sibling science support in 9th grade predict two key adolescent science motivational beliefs (i.e., intrinsic and utility values) when adolescents are in 10th grade, including identifying the types of support that are most significant in this association.

Adolescents' Science Intrinsic and Utility Values and Family Support

Situated expectancy-value theory describes the underlying processes associated with achievement-related choices and motivational beliefs, heavily acknowledging that individuals are situated within contexts that shape these processes (Eccles & Wigfield, 2020). It is a widely utilized framework when studying adolescent motivational beliefs in a variety of domains (e.g., music, sports, reading; Jacobs & Eccles, 2000; Simpkins et al., 2012; Simpkins et al., 2015a). Subjective task value beliefs, which include intrinsic and utility values, are theorized as central determinants of individuals' achievement-related choices and persistence. Intrinsic values are defined as how much an individual enjoys or is interested in the subject at hand whereas utility values are defined as the level of usefulness that individuals believe a subject has for their lives and future (Eccles & Wigfield, 2020). Intrinsic and utility values are both related to positive adolescent science outcomes, including taking more advanced science courses and science persistence (Hecht et al., 2019; Hulleman & Harackiewicz, 2009; Wigfield et al., 2017; Tai et al., 2006).

Situated expectancy-value theory argues that families, and parents in particular, are one of the central socializers of adolescents' subjective task values (Eccles & Wigfield, 2020). The parent socialization model, which is a model nested within the situated expectancy-value theory, further states that adolescents' perceptions of parents' behaviors foster the development of adolescents' motivational beliefs (Eccles & Wigfield, 2020; Fredricks et al., 2005). Various types of parent support are associated with adolescents' motivational beliefs, including coactivity (e.g., conversations), positivity (e.g., verbal encouragement), and school-focused supports (e.g., homework checks) (Fredricks et al., 2005; Simpkins et al., 2015a). Although parents' actual support is important, the situated expectancy-value theory argues that adolescents are active agents in their development and interpret their surroundings and experiences; as such, adolescents' interpretation or perceptions of their parents' support, rather than parents' actual support or intensions, are what influences adolescents. Although this theory focuses on parenting processes, it also argues that perceived support from other socializers, such as siblings, impact adolescents' motivational beliefs in a similar fashion. However, the extent this theory applies to siblings has rarely been tested.

As suggested by family systems theory (Cox & Paley, 1997; Cox, 2010), sibling support can complement parent support. Specifically, older siblings who have experience with K-12 and higher education in the U.S. can provide support by passing down advice and information to their younger siblings that help them overcome challenges. Cooper and colleagues (1999) describe the complementary ways that parents and siblings support Latinx adolescents where parents often give moral guidance, which iterates the importance of a good moral and academic education, whereas siblings often act as role models, tutors, and offer emotional support. Similarly, Azmitia and colleagues (1996) found that, compared to White families, Mexican American older siblings increasingly helped with homework as their younger siblings reached adolescence. These findings emphasize how families work together and are dependent upon one another for the development and socialization of each family member, such as adolescents (Cox & Paley, 1997).

Most of the research on Latinx family support has focused on parent support rather than sibling support with even less research on both parent *and* sibling support. Latinx parents engage in a range of supportive behaviors (Auerbach, 2007; Hill & Tyson, 2009; Soto-Lara & Simpkins, 2020) that predict positive academic outcomes in adolescence (Delgado Bernal, 2001; Simpkins et al., 2015b). Additionally, Latinx older sibling support is related to general academic motivation and access to higher education (Azmitia et al., 2009). For example, Alfaro and Umaña-Taylor (2010) found direct positive associations between sibling academic support and general academic motivation. These associations are further evidenced in the qualitative literature. Carolan-Silva and Reyes (2013) found that older siblings who were in college often advised their younger siblings on how to prepare for college, including discussing the high school courses they should take. Though sibling support has been less conceptualized, qualitative studies note similar types of parent and sibling support-related behaviors, such as homework help and coactivity (e.g., Ramos Carranza & Simpkins, 2021). Unfortunately, this literature on Latinx siblings' support of adolescents' general academic outcomes provides little insight into the extent siblings help adolescents in science as the level of parent support and the correlates of that support among White families varied significantly by domain (Simpkins et al., 2015a).

The limited, but emerging work focusing on Latinx family support in science suggests parent and sibling support is typically positively associated with adolescents' science subjective task values (Hsieh et al., 2019; Puente & Simpkins, 2020; Simpkins et al., 2015b). For example, Hsieh and colleagues (2019) found that overall science support from multiple socializers, including parents, teachers, siblings, positively predicted adolescents' science motivational beliefs. In another study, Simpkins and colleagues (2020) identified that home-based support, which was a combination of parent and sibling support, predicted adolescents' 10th grade science self-concepts. However, those examples combined parent and sibling support into an overall indicator, and other studies described earlier examined only parents or siblings in different studies. Thus, this literature does not address the tenets of family systems theory (Cox & Paley, 1997), including the relations between parent and sibling support and the extent to which support from siblings might predict adolescents' science motivation above and beyond parents. If the support is complementary as scholars have argued (Ramos Carranza & Simpkins, 2021), then they should each uniquely predict adolescents' science motivational beliefs.

Moreover, less is known about the associations between specific types of Latinx family supports and adolescents' science intrinsic and utility values. In addition to understanding processes related to overall support, exploring which specific types of support are related to stronger science intrinsic and utility values is vital for applied efforts to build on Latinx family strengths. Qualitatively, Ramos Carranza and Simpkins (2021) found that siblings played a larger role in helping with their younger high school siblings' science homework than parents. Meanwhile, both parents and siblings often engaged in academic socialization strategies and provided resources (e.g., social resources, science materials) to high school adolescents in science. As highlighted by this study, more research is needed on the types of supports that both parents and siblings provide.

Predictors of Family Support

As argued by situated expectancy-value theory, these family and individual processes are influenced by the cultural milieu, which includes cultural processes (e.g., cultural stereotypes) and family demographics (Eccles & Wigfield, 2020). Scholars note that among Latinx families, some of the central cultural aspects to consider include strong cultural values, such as familism values, as well as parents' educational levels (Raffaelli et al., 2005).

Familism

Familism values are a marker for enculturation and refer to the extent to which family is an important aspect of one's identity (Knight et al., 2009; Umaña-Taylor et al., 2009). One central dimension of familism values is prioritizing family and supporting family members (Azmitia et al., 2009). Familism values are related to stronger family relationships with greater warmth (Delgado et al., 2011; Stein et al., 2014); yet few studies have examined the extent to which a family member's familism values predict their level of support. In a study on older sibling support in science, Puente and Simpkins (2020) found that older siblings with stronger familism values gave more support compared to those with weaker familism values. Additionally, familism values were a moderator of the relations between siblings' support and adolescent science motivation. Overall, given the strong links between familism values and family bonds, we hypothesized that family members with strong familism values would provide more support compared to family members with lower familism values.

Parent Education

Eccles (2005) argued that parent education has a significant influence on adolescents' beliefs and behaviors, which, in turn, shape their motivational beliefs. Aligned with these theoretical expectations, scholars have found that students with parents who have college education benefit from getting specific advice and feedback from their parents whereas students with parents who do not have college education are given more general support, such as encouragement (Nichols & Islas, 2016). In fact, in one study with an ethnically diverse sample, parent-adolescent conversations on college topics were more helpful among those whose parents had college experience versus not (Palbusa & Gauvain, 2017). Similarly, Nichols and Islas (2016) also found quantitatively that all adolescents viewed their parents' support as foundational for their college journey, but there were differences in the types of support parents were able to offer, which also might have implications for siblings' support. Older siblings in families where parents do not have college experience may serve as a resource by providing more specific supports to complement their parents' support. This is expressed in a few studies where siblings served as a source of social capital for their younger siblings by providing help on college-related topics (González et al., 2003; Ceja, 2006). The overall literature thus indicates that support from parents and siblings may vary depending on parents' educational levels.

Current Study

More research is needed on perceived parent and sibling science support among Latinx families, as well as the extent to which they are related and predict adolescents' science outcomes. Due to the qualitative findings on Latinx families, our first hypothesis was that higher parent science support would be related to higher older sibling science support in 9th grade. Under the second research aim, we hypothesized that parents' and siblings' familism values would positively predict the science support they each provided adolescents. On the other hand, we expected adolescents with at least one parent who has some college education to receive more support from parents compared to adolescents that have parents with a high school education or less. We also expected that students with parents who have a high school degree or less would receive more support from their siblings compared to students with parents who have some college education. For our final research aim, based on situated expectancy-value theory and positive associations found between family supports and adolescent science motivational beliefs (Eccles & Wigfield, 2020; Hsieh et al., 2019; Puente & Simpkins, 2020; Simpkins et al., 2015b), we hypothesized that greater parent and older sibling science support in 9th grade would be related to greater science intrinsic and utility values in 10th grade. Additionally, under this aim we explore what types of support among parents and separately siblings (i.e., positivity, school-focused, and coactivity) predicted adolescent science intrinsic and utility values to help inform families on best practices when supporting their adolescents.

Method

Participants

A total of 104 Latinx adolescents along with their parent and an older sibling or cousin were recruited from three public high schools in a large southwestern metropolitan city in the United States. Participants and their family members were part of a larger longitudinal study, with the current study focusing on surveys collected when adolescents were in 9th (2012-2013 school year) and 10th grade (2013-2014 school year). The three selected schools served a large number of Latinx students (23% - 48%) and represented a range of graduation rates (80% - 93%) and science achievement levels (29%-60%).

Latinx adolescents were on average 14.5 years old in 9th grade, around 40% were female, and 86% were born in the United States. Parent reports indicated that all adolescents were of a Latinx background, with most being of Mexican-origin (89%), which is representative of the area. Of the older sibling/cousin sample, 86% were older siblings of the adolescent and the remaining were older cousins who were close to the adolescent. Older cousins were recruited if an older sibling was not able to be recruited (e.g., adolescent didn't have an older sibling). Prior research utilizing this dataset found no differences among older siblings and cousins (Puente & Simpkins, 2020) and have noted the similar peer-like relationships that cousins and siblings have within families (Johnson et al., 2016). Older siblings/cousins were on average 18 years old, 50% were female, and 82% were born in the United States. All older siblings or cousins (except one) had experience with at least one year of science courses in high school though five participants were missing this information. Family annual incomes, on average, were between $30,000 and $49,000. Over half of mothers (i.e., 62%) reported being married. On average, 55% of mothers and 74% of their spouses had a high school degree or less. In terms of nativity, the majority of parents reported being born outside of the U.S. (67% mothers; 70% spouses), namely in Mexico.

Procedures

The current study utilizes data collected from the surveys administered to high school adolescents and their family members (i.e., older sibling and parent). Each participant provided assent or consent. To ensure accurate data collection and participant comfort, participants had the option of filling out the surveys in English or Spanish in their homes or at the university campus of the PI. In 9^{th} grade, all but one Latinx adolescent and three older siblings completed the surveys in English whereas 45 parents filled out surveys in English and 59 parents completed them in Spanish. Spanish-fluent research assistants translated the surveys using forward-translation and panel/group method approaches in order to ensure accuracy of the translations (Knight et al., 2009). Each participant was compensated $50 due to the extensive procedures, which were approved by IRB.

Measures

Parent and Older Sibling Science Support in 9th Grade

Adolescents reported how often their parents and separately their older sibling provided a variety of science-related supports through 23 items (1 = *Never*, 3 = *Sometimes*, 5 = *Always*; Bouchey & Harter, 2005; Simpkins et al., 2015b). Parent and sibling science support were described in terms of overall science support and in terms of the three subscales. Overall science support was an average of all 23 items for parents (α = .94) and older siblings (α = .95) separately. The three subscales included positivity, school-focused involvement, and co-activity (Simpkins et al., 2015b; Simpkins et al., 2018). Positivity items (7 items; parents $\alpha = .91$; siblings $\alpha = .92$) reflected verbal encouragement, such as praising adolescents' work and helping them feel better when they struggled in science (e.g., "How often do you praise teen for their schoolwork in science?"). School-focused items (6 items; parents $\alpha = .80$; siblings $\alpha = .88$) included checking homework, providing study spaces, and encouraging adolescents to seek help (e.g., "How often do you check or ask if teen's science homework is complete?"). Lastly, coactivity items (9 items; parents $\alpha = .86$; siblings $\alpha = .87$) referred to activities that adolescents did with their families, including science conversations, discussing science careers, and participating in activities together (e.g., "How often do you take teen to a science museum, zoo or event?"). The overall scale and three subscales in prior studies have shown good reliability (Simpkins et al., 2015b), strong criterion and face validity (Bouchey & Harter, 2005; Jacobs et al., 2002; Puente & Simpkins, 2020) as well as strong measurement invariance across Latinx and White male and female high school students (Simpkins et al., 2015b).

Adolescent Intrinsic and Utility Values in 10th Grade

Adolescents' science intrinsic and utility values in 10th grade were measured with existing scales that were adapted to refer to chemistry, physics, and biology (Eccles et al., 1993; Jacobs et al., 2002). Science intrinsic values included two items assessing their interest in each of the three subjects (e.g., "How much do you like [chemistry/physics/biology]?"; 1 = *A little*, 4 = *Neither boring nor interesting*, 7 = *Very interesting*), which were averaged to create a composite score. Reliability for the 6-item science intrinsic values scale was high ($\alpha = .89$). Similarly, science utility values, which referred to the importance they placed on science, was averaged to create an overall composite score ($\alpha = .96$; 9 items; e.g., "Compared to other subjects, how important is it to be good at [chemistry/physics/biology]?"; 1 = *Not at all important,* 4 = *Somewhat important*, 7 = *Very important*). Higher scores indicated greater science intrinsic and utility values. Simpkins and colleagues (2015b) found strong measurement invariance across Latinx and White male and female high school student values. Prior studies have also noted that these scales have strong face, convergent, and discriminate validity (Jacobs et al., 2002; Simpkins et al., 2018; Simpkins et al., 2015b)

Parent and Sibling Familism Values

Parent and sibling familism values referred to the extent to which they had close family relationships that were integral to their identity and choices (e.g., "Older kids should take care of and be role models for their younger brothers and sisters"). For parents and siblings separately, familism was measured by a composite score using the 15-item scale and was reported by parents and siblings (Parent α = .88, Sibling α = .90; 1 = *Not at all,* 3 = *Somewhat*, 5 = *Completely*) created by Knight and colleagues (2010). This scale demonstrated strong construct validity and reliability when examining the strength of the scale on studies using samples of Mexican American families (see Knight et al., 2010).

Parent Education

Both parents' education was available as reported by the primary parent when the adolescent was in 9th grade. From this information, a dichotomous variable (0 = *parents with some college*; 1 = *parents with high school degree or less*) was created to distinguish between adolescents whose parents had a high school degree or less (n = 55) and adolescents who had at least one parent with some college education or more (n = 49).

Controls

Adolescents' gender, adolescents' science grade in 9th grade, and dichotomous codes for the schools were included as controls. Adolescents' gender was adolescent-reported and was measured dichotomously (1 = *Female*, 0 = *Male*). Adolescents' science grade in 9th grade was adolescent-reported and was asked in terms of letter grade. The original coding (1 = *A*, 5 = *E or F*) was reverse coded to reflect low to high grades (1 = *E or F*, 5 = *A*). Schools B and C were included as controls with School A as the reference group to account for between-school variation (McNeish & Stapleton, 2016; O'Dwyer & Parker, 2014). Additionally, parents' combined highest level of education was included as a control for analyses that did not examine parent education in regards to college experience. A variable was created that represented the highest level of education completed by both parents (i.e., parent highest education). This was measured on a 6-point Likert scale (1 = *Less than high school*, 6 = *More than a B.A.*).

Data Analysis Plan

All analyses were conducted in Stata 14.2. For the first hypothesis, we expected that adolescent-reported parent and older sibling science support would be positively correlated, such that higher parent support would be related to higher older sibling support in 9th grade. We also expected parents to give more support than older siblings. To address our hypotheses, we estimated bivariate correlations. We also estimated a dependent t-test to assess mean-level differences between parent and older sibling support.

Second, we hypothesized that parent and sibling familism values would be positively associated with greater parent and sibling science support. We also hypothesized that Latinx adolescents would receive greater sibling support if they had parents who did not have any college education compared to adolescents with at least one parent with some college education, and that the opposite would be true for parent support. To address these hypotheses, we estimated two hierarchical regressions with one model having parent support as the outcome and a separate model for sibling support as the outcome. Each hierarchical regression had first the controls in one model, followed by a model with controls and either familism values for the respective socializer or parent education as the predictor.

Lastly, we hypothesized that greater overall parent and older sibling support in science in 9th grade would be related to greater science intrinsic and utility values in 10th grade, with follow up analyses examining the correlates of the three specific types of support. To address this research aim, we estimated two hierarchical regressions with the controls entered into the first model. In the second model, parent support and the controls were entered as the predictors. In the third model, sibling support and the controls were entered as the predictors. In the fourth model, both parent and sibling support along with the controls were entered as predictors. Finally, we re-estimated these models as follow up analyses in order to test the extent to which the three specific types of parent and sibling support predicted science values separately.

Missing Data

Attrition is highly common in longitudinal studies. Among the analytic sample, when adolescents were in 10th grade, 93 adolescents, 89 siblings, and 94 parents completed questionnaires. For the current study, no participants were excluded, and missing data was handled through multiple imputation (Enders, 2010). Auxiliary variables used to estimate missing data included variables that were related to the study variables, such as adolescent-reported science self-concept in 10th grade, and cognitive, behavioral, and emotional engagement in science. Comparisons between those with missing data (n = 12) and complete data (n = 92) were made on the study variables (e.g., overall adolescent-reported sibling support) as well as on controls. These comparisons revealed no significant differences (see Table 2.S1).

Results

Descriptive Statistics

As shown in Table 2.1, adolescents thought parents, on average, sometimes gave science support to adolescents (M = 2.68, SD = .75) whereas siblings rarely gave science support to adolescents in 9th grade on average (M = 2.04, SD = .75). Adolescents, on average, thought science was somewhat interesting (M = 4.55, SD = 1.16) and had some utility (M = 4.67, SD = 1.19). Bivariate correlations revealed moderate positive associations between adolescents' perceptions of overall sibling science support and their science utility values (r = .33, p < .01). This association was also found for adolescents' perception of overall parent science support and their science utility values (r = .32, p < .01). Moreover, there were strong, positive associations between science intrinsic and utility values (r = .77, p < .001).

Parent and Sibling Science Support

Our first hypothesis was that parent and older sibling support in science would be positively related, where siblings would give greater science support if parents also gave greater science support. The bivariate correlation (r = .63, p < .001) supported our hypothesis since there was a positive association between parent and older sibling support in science (see Table 2.1). We also expected parents to give greater support compared to siblings. In support of our hypothesis, mean-level differences in parent and sibling science support revealed that adolescents thought parents provided more support in science compared to siblings (t[103] = 10.14, p < .001).

Predictors of Parent and Sibling Science Support

Our second hypothesis was that parent and sibling familism values would positively predict the support adolescents thought they provided in science (see Table 2.2). Findings revealed that parents' familism values did not predict adolescents' perceptions of parent support (ß = .20, SE = .15, t = 1.34, p = .18). Older siblings' familism values also did not predict adolescent-reported older siblings' science support (ß = .09, SE = .14, t = .63, p = .53). We also expected that adolescents would report greater sibling support if they had parents who had a high school degree or less compared to adolescents who had at least one parent with some college education, and that the opposite would be true for parent support. Contrary to our hypothesis, parents' level of education was unrelated to the support that parents (ß = .02, SE = .16, t = .15, p = .88) and older siblings gave in science (ß = .21, SE = .16, t = 1.35, p = .18).

Parent and Sibling Science Support as Predictors of Adolescent Science Values

Our final hypothesis was that adolescents' perceptions of overall parent and older sibling support in science in 9th grade would be positively related to their science intrinsic and utility values in 10th grade, with follow up analyses examining the correlates of the three specific types of support (see Table 2.3). Contrary to our hypothesis, adolescents' perceptions of parent science support and sibling science support in 9th grade were not related to adolescents' 10th grade science intrinsic values (parents: ß = .28, SE = .17, t = 1.68, p = .10; siblings: ß = .25, SE = .16, t = 1.53, p = .13). Our hypothesis was partially supported for science utility values, where sibling support (ß = .51, SE = .16, t = 3.20, p = .002) and parent support (ß = .61, SE = .16, t = 3.86, p < .001) were positively related to adolescents' 10th grade science utility values with parent support still being significant when controlling for sibling support (ß = .48, SE = .21, t = 2.26, p = .03). This finding highlights those adolescents who felt they had greater science support from their older siblings and parents in 9th grade would later have greater science utility values when they were in 10th grade.

We also examined the three distinct types of support during follow-up analyses (see Table 2.S2 & 2.S3). Descriptives for the different types of support as well as comparisons between parent and sibling types of support are included in Table 2.S2. Main analyses revealed that there was a trend for sibling positivity (ß = .27, SE = .14, t = 1.99, p = .05) and coactivity (ß = .35, SE = .18, t = 1.91, p = .06) to positively predict adolescents' science intrinsic values (see Table 2.S3). For adolescents' science utility values, sibling positivity (ß = .43, SE = .14, t = 3.18, p = .002), school-focused (ß = .31, SE = .12, t = 2.47, p = .02), and coactivity (ß = .59, SE = .18, t = 3.28, p = .001) all positively predicted adolescent science utility values. Findings revealed similar patterns among parents for both adolescent science intrinsic and utility values. For parents, findings showed that there were trends for positivity (ß = .26, SE = .14, t = 1.86, p = .07) and coactivity (ß = .30, SE = .17, t = 1.77, p = .08) to positively predict adolescent science intrinsic values (see Table 2.S4). Like older sibling support, parent positivity (ß = .49, SE = .13, t = 3.60, p = .001), school-focused (ß = .41, SE = .14, t = 2.89, p = .01), and coactivity behaviors (ß = .64, SE = .16, t = 3.92, $p < .001$) positively predicted adolescent science utility values.

Discussion

Latinx families are a source of strength and support for high school adolescents' science intrinsic and utility values, which can help promote their persistence in a field where they often face challenges and barriers. Though much of the existing work points to these challenges and barriers for Latinx individuals in science (Andersen & Ward, 2013; Beasley & Fischer, 2012; Strayhorn et al., 2013), limited research focuses on sources of strength and positive supports that help promote persistence and motivation in science, such as positive family supports. Although most existing research has focused on parent support, these findings suggest parents are only one of source of strength within Latinx families and that the field needs to seriously consider the potential of older siblings as they are a central socializer in adolescents' lives (Cox & Paley, 1997; Eccles & Wigfield, 2020; Ramos Carranza & Simpkins, 2021). In various qualitative studies that examine the perceptions of adolescents, Latinx parents and older siblings often engage in various support-related behaviors to assist adolescents in their general education (Carolan-Silva & Reyes, 2013) as well as in science (Ramos Carranza & Simpkins, 2021; Soto-Lara & Simpkins, 2020). Although there are some studies that examine parent and sibling support quantitatively, most examine these among White families and do not examine these processes among Latinx families. These studies typically also examine parent *or* sibling support but not in conjunction. Due to these limitations in the literature, the present study investigated adolescents' perceptions of parent *and* sibling science support while also considering family characteristics (e.g., parent education and familism) and the relations to Latinx adolescents' science intrinsic and utility values.

Variability in Parent and Sibling Science Support

An important aim of the current study was to understand the extent to which parent and older sibling support were related to each other and to their corresponding familism values and parent education. According to the literature, parents and siblings engage in some overlapping and some unique support-related behaviors (Azmitia et al., 1996; Cooper et al.,1999; Carolan-Silva & Reyes, 2013). Scholars have also emphasized the complementary ways in which parents and siblings support younger adolescents, with parents relying on older siblings to help with things such as homework (Azmitia et al., 1996; Azmitia et al., 2009). In support of our hypothesis and family systems theory, our findings indicated that parent and sibling support in science were significantly related, with greater parent support related to greater sibling support. We also found that when comparing levels of support, parents gave greater support in science compared to siblings. These findings indicate that although parents and siblings are working together to support adolescents, parents may still be the main source of support as they are able to engage in certain supports that are more relevant to the typical managerial role parents have within families, such as taking adolescents to science museums and providing study spaces as measured by our support scale. Meanwhile, siblings may fulfill a supplementary role where they help their younger siblings in aspects that parents are not able to.

The roles of parents and siblings in supporting adolescents was further investigated by testing whether socializers' familism values predicted their support adolescents felt they provided. Both siblings' and parents' familism values were unrelated to the support they gave in science. In other words, parents and siblings provided support regardless of their familism values. Parent support of their children's academic pursuits is one of the central indicators of parenting in the literature and a central aspect of parents' role in supporting their children (Bradley, 2019; Halgunseth, 2019). In contrast, older siblings share a peer relationship with their younger siblings, but also serve as role models and sources of support, especially among immigrant families (Cooper et al., 1999; Grau et al., 2009). Because providing support for adolescents' academic outcomes is one of parents' central responsibilities (Bradley, 2019) and older siblings are often recruited to help their younger siblings among Latinx families (Azmitia et al., 1996; Valenzuela, 1999), familism may be unrelated to how adolescents perceive the support they receive from them. Additionally, scholars have noted that parents with strong familism values have better communication and relationships with their children (Fuligni et al., 1999; Stein et al., 2014), which prompt greater parent support. Among siblings, they note that older siblings with higher familism values have stronger, closer relationships with their younger siblings (Fuligni et al., 1999; Killoren et al., 2016; Updegraff et al., 2005). Thus, parents' and siblings' familism may relate more to the quality of interactions (i.e., better relationships) with adolescents rather than how much support they give.

Contrary to our hypothesis, parent education was not predictive of either parent or sibling support in science. Although some of the literature indicates that continuing-generation college students have access to more resources and networks, scholars have also found that supports are not significantly different among parents (Nichols & Islas, 2016; Palbusa & Gauvain, 2017). Thus, the non-significant findings may indicate that families with parents who did not go to college provide statistically similar levels of science support compared to families who do have parents that have college education. However, scholars have also found that the types of supports among families may differ between parents with and without higher education among college-related topics (Nichols & Islas, 2016; Palbusa & Gauvain, 2017; Ramos Carranza & Simpkins, 2021). Thus, parent education may be more critical for family college-related supports compared to science support in high school. A better indicator to test may thus be parent science education or capital. Overall, these findings are encouraging as it counters any deficit-based narratives and stereotypes of Latinx families giving less support or being uninvolved in their adolescents' education (Hernandez et al., 2016).

Family Support and Adolescent Science Values

Partially aligned with some studies on associations between parent support and adolescent motivation (Fredricks et al., 2005; Simpkins et al., 2015b), our findings indicated that parent science support was only significantly related to adolescents' science utility value but not science intrinsic value. In other work, parent support has been positively associated with adolescent science motivational beliefs, including intrinsic and utility values (Harackiewicz et al., 2012; Simpkins et al., 2015a; Simpkins et al., 2015b; Simpkins et al., 2020). However, most of these studies have focused on White families or combined parent support with support from other people (Hsieh et al., 2019; Simpkins et al., 2015b). Hsieh and colleagues (2019), for example, found positive associations between 9th grade science support from multiple people (i.e., parents, teachers, siblings, and peers) and most of Latinx adolescents' science motivational beliefs at 9th grade. Contrary to part of our hypothesis, our findings revealed no associations to science intrinsic value when adolescents were in 10th grade, which may be due to a lack of statistical power when testing the one-year lagged relation. Follow up analyses revealed that parents' use of positivity and coactivity was associated with science intrinsic value at the trend level, possibly suggesting that only certain types of support are related to adolescents' science intrinsic value. Regarding science utility value, our findings support the situated expectancy-value theory as we found a strong association between parent science support and adolescents' science utility value (Eccles & Wigfield, 2020).

In partial support of our hypothesis and situated expectancy-value theory, sibling science support was also positively associated with adolescents' science utility value but not science intrinsic value. When examined more closely, there was a trend for sibling positivity and coactivity supports to be positively related to science intrinsic value whereas positivity, school-focused, and coactivity were positively related to science utility value. This supports findings among studies that find older siblings supporting their younger siblings in college and career aspirations (Carolan-Silva & Reyes, 2013; Delgado, 2020). Our findings suggest that older siblings who support their younger siblings in science may communicate the usefulness of science for their future and that some behaviors but not others may also play a role in the development of science intrinsic value. Among low-income, immigrant Latinx families, older siblings often support their younger siblings in ways their parents are not able to (Updegraff et al., 2010; Valenzuela, 1999). Thus, older siblings' support may play a similar role in adolescents' motivational beliefs to parents' support since younger siblings may also rely on the advice of their older siblings in addition to their parents as they begin to think about college and their future. As outlined by family systems theory (Cox & Paley, 1997; Cox, 2010), socializers, such as parents and siblings, work interdependently. Thus, these considerations should be taken into account when theorizing about the ways in which not only socializers' behaviors are individually associated with adolescents' motivational beliefs, but also how socializers interact to support the development of adolescents' motivational beliefs, especially among Latinx families that can draw from certain cultural strengths (e.g., familism).

Limitations and Future Directions

The current study underscores the extent to which family processes can be a source of promoting positive development, with a specific focus on science motivational beliefs, adding to the literature on how to support Latinx adolescents who would like to pursue science but face the many challenges and barriers highlighted in the literature. Despite these contributions, the current study did have some limitations that provide researchers with ideas for future directions. The current study was limited in exploring further within-group processes and other relations since the dataset utilized had a small sample size with most of the population being of Mexican-descent. Future studies should also examine how these processes are presented in other Latinx ethnic groups and aim to have larger sample sizes to be able to perform statistical analyses that require more power, such as structural equation modeling. Investigating these processes across Latinx ethnic groups would allow us to understand the heterogeneity within Latinx populations. Lastly, two main themes across the findings were the similar and complimentary role that parents and siblings may play in regard to the development of science utility value as well as the importance of understanding the quality of interactions among family members. Future research should further explore the role of these family supports through adolescents' perspectives by probing when and why adolescents seek support from each socializer. Relatedly, quality of interactions may give more insight into the role of cultural values, such as familism, in developmental processes. Future studies should examine quality of interactions and relationships and its implications for when support may be more impactful for adolescents' motivational development.

Conclusion

The current study emphasizes the predictors of parent and older sibling support and the ways in which parent and older sibling support in science are similarly associated with adolescent science values. Our findings indicated that parent and older sibling support in science were related, with parents giving greater support compared to siblings, and that parents' and siblings' familism values were unrelated to their support in science. Also, parent and sibling support was unrelated to adolescents' science intrinsic value whereas their support was positively predictive of only adolescents' science utility value. Our study begins to uncover relations of support among two key socializers, what predicts socializers' supports, and which supports are related to greater science values. Overall, these findings may inform interventions focused on fostering motivation among adolescents and on providing resources for families with children and adolescents by highlighting the important role older siblings play in addition to parents for the development of adolescents' science motivational beliefs.

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Table 2.1

Pairwise Correlational Statistics of Study Variables

	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Parent support (9th)	1								
2. Sibling support (9th)	.63***	1							
3. Science intrinsic value (10th)	.16	.17	1						
4. Science utility value (10th)	.32**	.33**	.77***	1					
5. Parent familism (9th)	.05	.06	.02	.09	1				
6. Sibling familism (9th)	.13	.07	-.02	.05	.22*	1			
7. Parent education (HS or less)	-.02	.11	.11	.17	.30**	.10	1		
8. Female (adolescent)	-.11	-.01	-.23*	-.02	.19^{+}	.06	.11	1	
9. Science grade (9th)	.16	.01	-.05	-.13	-.18^{+}	-.05	-.06	-.02	1
M/ %	2.68	2.04	4.55	4.67	4.32	4.18	53%	40%	4.18
(SD)	.75	.75	(1.16)	(1.19)	(.53)	(.55)	–	–	(.53)
Skewness	.33	.77	-.64	-.30	-1.08	-.43	-.12	.39	-.39
Kurtosis	2.64	3.48	3.74	3.24	3.78	2.66	1.01	1.15	2.35
% Missing	0%	0%	11%	11%	0%	0%	0%	0%	0%

Note. $^{+}p < .10$. $^{*}p < 0.05$. $^{**}p < 0.01$. $^{*}p < 0.001$.

Table 2.2
Hierarchical Regression Analyses of Predictors of Parent and Sibling Support

	Parent Support (9th grade)			Sibling Support (9th grade)		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
	β	β	β	β	β	β
Predictor	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)
Constant	2.24***	1.25	2.36***	2.24***	1.86**	1.92***
	(.32)	(.81)	(.30)	(.32)	(.68)	(.30)
Parent highest education	.05	.07	–	-.07	-.07	–
	(.05)	(.05)	–	(.05)	(.05)	–
Science grade (9th)	.11	.12	.11	.01	.01	.01
	(.07)	(.07)	(.07)	(.07)	(.07)	(.07)
Adolescent female	-.10	-.13	-.14	-.05	-.05	-.03
	(.16)	(.16)	(.15)	(.16)	(.16)	(.16)
School B	-.31	-.29	-.32	-.23	-.23	-.24
	(.22)	(.22)	(.22)	(.23)	(.23)	(.23)
School C	-.07	-.06	-.02	.07	.08	.06
	(.18)	(.18)	(.18)	(.19)	(.19)	(.18)
Parent familism values (9th)		.20				
		(.15)				
Sibling familism values (9th)					.09	
					(.14)	
Parent education (HS or less)			.02			.21
			(.16)			(.16)
Observations	104	104	104	104	104	104
R^2	.07	.08	.06	.03	.03	.03

Note. Standard errors in parentheses. Beta coefficients are standardized.
^{+}p<.10. * p<0.05. ** p<0.01. *** p<0.001.

Table 2.3

Hierarchical Regression Analyses of Predictors on 10th Grade Science Motivational Beliefs

	Intrinsic Value				Utility Value			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Predictor	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)
Constant	5.15***	4.52***	4.60***	4.43***	5.69***	4.32***	4.55***	4.17***
	(.51)	(.63)	(.62)	(.65)	(.53)	(.60)	(.61)	(.62)
Parent highest education	-.09	-.10	-.07	-.09	-.18*	-.21*	$-.15^{+}$	-.19*
	(.08)	(.08)	(.08)	(.09)	(.09)	(.08)	(.08)	(.08)
Science grade (9th)	-.05	-.08	-.05	-.07	-.12	-.18	-.12	-.17
	(.12)	(.12)	(.11)	(.12)	(.12)	(.11)	(.11)	(.11)
Adolescent female	$-.55^{+}$	$-.52^{+}$	$-.54^{+}$	$-.52^{+}$	-.22	-.16	-.20	-.16
	(.28)	(.28)	(.28)	(.28)	(.28)	(.27)	(.27)	(.27)
School B	-.04	.05	.02	.06	-.09	.10	.03	.11
	(.38)	(.38)	(.38)	(.38)	(.39)	(.37)	(.38)	(.37)
School C	.26	.28	.24	.27	.30	.34	.27	.32
	(.31)	(.31)	(.31)	(.31)	(.31)	(.29)	(.30)	(.29)
Overall parent support (9th)		.28		.21		.61***		.48*
		(.17)		(.23)		(.16)		(.21)
Overall sibling support (9th)			.25	.11			.51**	.20
			(.16)	(.21)			(.16)	(.21)
Observations	104	104	104	104	104	104	104	104
R^2	.06	.09	.09	.10	.07	.20	.17	.21

Note. Standard errors in parentheses. Beta coefficients are standardized.

$^{+}p<.10$. * $p<0.05$. ** $p<0.01$. *** $p<0.001$.

Supplementary Materials

Table 2.S1

Comparisons Between the Complete and Missing Samples

	Complete Data			Missing Data			*t*-test or Chi-square test[1]	Effect size
	N	*M* (SD)/%	Min/Max	N	*M* (SD)/%	Min/Max		
Study variables								
Sibling support (9th)	92	2.07 (.77)	1/5	12	1.78 (.74)	1/5	1.25	.39[a]
Parent support (9th)	92	2.69 (.75)	1/5	12	2.59 (.78)	1/5	.41	.13[a]
Science intrinsic (10th)	92	4.55 (1.16)	1/7	12	–	–	–	–
Science utility (10th)	92	4.69 (1.18)	1/7	12	–	–	–	–
Female (adolescent)	92	40%	0/1	12	42%	0/1	.01	.01[b]
Familism (parent)	92	4.33 (.50)	1/5	12	4.24 (.76)	1/5	.53	.16[a]
Familism (sibling)	92	4.18 (.54)	1/5	12	4.15 (.65)	1/5	.17	.05[a]
Parent education (HS or less)	92	53%	0/1	12	50%	0/1	.05	-.02[b]
Controls								
Science grade (9th)	92	3.62 (1.08)	1/5	12	3.82 (.40)	1/5	-.60	-.19[a]
Parent highest education	92	3.15 (1.55)	1/6	12	3.25 (1.91)	1/6	-.20	-.06[a]

Note. [1]Comparisons were made between the Latinx analytic sample and the excluded sample. [a]Indicates Cohen's d was used for measuring effect size among independent sample *t*-tests for continuous variables. Standard interpretation: small effect: .20, moderate effect: .50, large effect: .80. [b]Indicates Cramer's V was used for measuring effect size among Chi-square tests for dichotomous variables. Standard interpretation: small effect: .10, moderate effect: .30, large effect: .50. *$p < .05$, **$p < .01$, ***$p < .001$.

Table 2.S2
Comparisons Between Types of Support Among Parents and Siblings

	1.	2.	3.	4.	5.	6.
1. School-focused support (parent)	1					
2. Positivity (parent)	.77***	1				
3. Coactivity (parent)	.74***	.79***	1			
4. School-focused support (sibling)	.52***	.43***	.43***	1		
5. Positivity (sibling)	.54***	.67***	.56***	.79***	1	
6. Coactivity (sibling)	.47****	.51***	.61***	.75***	.79***	1

	Parent *M* (SD)	Sibling *M* (SD)	*t* (103)	Cohen's *d*[a]
Comparisons				
School-focused support	3.10 (.84)	2.32 (.98)	8.86***	.86
Positivity	2.88 (.94)	2.08 (.90)	10.93***	.87
Coactivity	2.26 (.73)	1.85 (.67)	6.69***	.58

Note. [a]Cohen's d was used for measuring effect size among dependent sample *t*-tests for continuous variables. Standard interpretation: small effect: .20, moderate effect: .50, large effect: .80.
**p* < .05, ***p* < .01, ****p* < .001.

Table 2.S3

Hierarchical Regression Analyses of Types of Sibling Support Predictors on 10th Grade Science Motivational Beliefs

	Intrinsic Value				Utility Value			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Predictor	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)
Constant	5.15***	4.65***	4.97***	4.44***	5.69***	4.87***	4.79***	4.47***
	(.51)	(.56)	(.63)	(.63)	(.53)	(.55)	(.63)	(.62)
Parent highest education	-.09	-.08	-.08	-.07	-.18*	-.16+	-.15+	-.15+
	(.08)	(.08)	(.09)	(.08)	(.09)	(.08)	(.09)	(.08)
Science grade (9th)	-.05	-.07	-.04	-.05	-.12	-.16	-.09	-.12
	(.12)	(.11)	(.12)	(.11)	(.12)	(.11)	(.12)	(.11)
Adolescent female	-.55+	-.55+	-.55+	-.53+	-.22	-.21	-.20	-.19
	(.28)	(.28)	(.28)	(.28)	(.28)	(.27)	(.27)	(.27)
School B	-.03	.01	-.02	.07	-.09	-.01	.01	.08
	(.38)	(.38)	(.39)	(.38)	(.39)	(.37)	(.38)	(.38)
School C	.26	.23	.24	.29	.30	.24	.22	.35
	(.31)	(.31)	(.32)	(.31)	(.31)	(.30)	(.31)	(.30)
Positivity		.27+				.43**		
		(.14)				(.14)		
School-focused			.06				.31*	
			(.12)				(.12)	
Coactivity				.35+				.59**
				(.18)				(.18)
Observations	104	104	104	104	104	104	104	104
R^2	.06	.10	.06	.10	.07	.17	.13	.17

Note. Standard errors in parentheses. Beta coefficients are standardized.

$^+p<.10$. * $p<0.05$. ** $p<0.01$. *** $p<0.001$.

Table 2.S4

Hierarchical Regression Analyses of Types of Parent Support Predictors on 10th Grade Science Motivational Beliefs

	Intrinsic Value				Utility Value			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
	β	β	β	β	β	β	β	β
Predictor	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)
Constant	5.15***	4.62***	4.73***	4.56***	5.69***	4.71***	4.52***	4.44***
	(.51)	(.58)	(.67)	(.60)	(.53)	(.56)	(.65)	(.58)
Parent highest education	-.09	-.10	-.10	-.11	-.18*	-.20*	-.20*	-.23**
	(.08)	(.08)	(.09)	(.08)	(.09)	(.08)	(.09)	(.08)
Science grade (9th)	-.05	-.11	-.05	-.06	-.12	-.23*	-.13	-.15
	(.12)	(.12)	(.12)	(.11)	(.12)	(.11)	(.11)	(.11)
Adolescent female	-.55⁺	-.51⁺	-.55⁺	-.52⁺	-.22	-.15	-.21	-.15
	(.28)	(.28)	(.28)	(.28)	(.28)	(.27)	(.27)	(.27)
School B	-.03	.07	.03	.04	-.09	.12	.09	.07
	(.38)	(.38)	(.39)	(.38)	(.39)	(.37)	(.38)	(.37)
School C	.26	.28	.26	.30	.30	.34	.29	.38
	(.31)	(.31)	(.31)	(.31)	(.31)	(.29)	(.30)	(.29)
Positivity		.26⁺				.49**		
		(.14)				(.13)		
School-focused			.15				.41**	
			(.15)				(.14)	
Coactivity				.30⁺				.64***
				(.17)				(.16)
Observations	104	104	104	104	104	104	104	104
R^2	.06	.10	.07	.09	.07	.20	.15	.20

Note. Standard errors in parentheses. Beta coefficients are standardized.

⁺p<.10. * p<0.05. ** p<0.01. *** p<0.001.

Appendix B

Measures:

Construct: Parent and Sibling Support at 9th Grade
Measurement Information: Items measured on a 1 to 5 scale (1 = *Never*, 3 = *Sometimes*, 5 = *Always*)
Parent and Sibling Support Items (parent-reported; sibling-reported): 1. How often do you (and your spouse/partner) buy science supplies, like equipment, books, games, or things to help study? 2. How often do you (and your spouse/partner) help enroll [TEENAGER] in science lessons, workshops, or tutoring programs outside of class? 3. How often do you (and your spouse/partner) tell [TEENAGER] that (he/she) is good at science? 4. How often do you (and your spouse/partner) talk to [TEENAGER] about how things are going in (his/her) science classes? 5. How often do you (and your spouse/partner) give [TEENAGER] rewards for good performance in science? 6. How often do you (and your spouse/partner) make sure [TEENAGER] has a space or time to work on science homework? 7. How often do you (and your spouse/partner) pressure [TEENAGER] to do well in science? 8. How often do you (and your spouse/partner) encourage [TEENAGER] to work with friends or family members who are good at science? 9. How often do you (and your spouse/partner) talk about college majors and careers in science? 10. How often do you (and your spouse/partner) tell [TEENAGER] how important doing well in science will be for (his/her) future? 11. How often do you (and your spouse/partner) check or ask if [TEENAGER]'s science homework is complete? 12. How often do you (and your spouse/partner) help [TEENAGER DO (his/her) science work? 13. How often do you (and your spouse/partner) take [TEENAGER] to a science museum, zoo, or event? 14. How often do you (and your spouse/partner) watch science television shows with [TEENAGER]? 15. How often do you (and your spouse/partner) look at science websites with [TEENAGER]? 16. How often do you (and your spouse/partner) talk about news or current events related to science? 17. How often do you (and your spouse/partner) praise [TEENAGER] for (his/her) school work in science? 18. How often do you (and your spouse/partner) help [TEENAGER] feel better when science is hard? 19. How often do you (and your spouse/partner) like how [TEENAGER] does things in science?

20. How often do you (and your spouse/partner) say nice things about [TEENAGER]'s grades in science?
21. How often do you (and your spouse/partner) like [TEENAGER]'s study habits in science?
22. How often do you (and your spouse/partner) teach [TEENAGER] about things (he/she) needs to know?
23. How often do you (and your spouse/partner) teach [TEENAGER] about things (he/she) wants to know in science?

Alphas:
Parent Support: .94
Sibling Support: .95

Construct: Adolescent Motivational Beliefs at 10th grade

Measurement Information: Items were measured on a 1 to 7 scale, with greater scores reflecting greater intrinsic and utility value.

Science Intrinsic Value (adolescent-reported):

1. I find doing chemistry: (1= *Very boring*, 4= *Neither boring nor interesting*, 7= *Very interesting*)
2. How much do you like chemistry? (1= *A little*, 4= *Somewhat*, 7= *A lot*)
3. I find doing biology: (1= *Very boring*, 4= *Neither boring nor interesting*, 7= *Very interesting*)
4. How much do you like biology? (1= *A little*, 4= *Somewhat*, 7= *A lot*)
5. I find doing physics: (1= *Very boring*, 4= *Neither boring nor interesting*, 7= *Very interesting*)
6. How much do you like physics? (1= *A little*, 4= *Somewhat*, 7= *A lot*)

Science Utility Value (adolescent-reported):

1. For me, being good in chemistry is: (1= *Not at all important*, 4= *Somewhat important*, 7= *Very important*)
2. Compared to other subjects, how important is it to be good at chemistry? (1= *Not at all important*, 4= *Somewhat important*, 7=*Very important*)
3. How useful is what you learn in chemistry? (1= *Not at all useful*, 7= *Very useful*)
4. For me, being good in biology is: (1= *Not at all important*, 4= *Somewhat important*, 7= *Very important*)
5. Compared to other subjects, how important is it to be good at biology? (1= *Not at all important*, 4= *Somewhat important*, 7=*Very important*)
6. How useful is what you learn in biology? (1= *Not at all useful*, 7= *Very useful*)
7. For me, being good in physics is: (1= *Not at all important*, 4= *Somewhat important*, 7= *Very important*)
8. Compared to other subjects, how important is it to be good at physics? (1= *Not at all important*, 4= *Somewhat important*, 7=*Very important*)
9. How useful is what you learn in physics? (1= *Not at all useful*, 7= *Very useful*)

Alphas:
Overall Science Intrinsic Value: .89
Overall Science Utility Value: .96

Construct: Parent and Sibling Familism Values
Measurement Information: Measured on a 1 to 5 Likert Scale (1 = *Not at all*, 3 = *Somewhat*, 5 = *Completely*)
Items: 1. Parents should teach their children that the family always comes first. 2. Children should be taught that it is their duty to care for their parents when their parents get old. 3. Children should always do things to make their parents happy. 4. Family provides a sense of security because they will always be there for you. 5. If a relative is having a hard time financially, one should help them out if possible. 6. When it comes to important decisions, the family should ask for advice from close relatives. 7. It is always important to be united as a family. 8. A person should share their home with relatives if they need a place to stay. 9. It is important to have close relationships with aunts/uncles, grandparents, and cousins. 10. Older kids should take care of and be role models for their younger brothers and sisters. 11. Children should be taught to always be good because they represent the family. 12. Holidays and celebrations are important because the whole family comes together. 13. Parents should be willing to make great sacrifices to make sure their children have a better life. 14. A person should always think about their family when making important decisions. 15. It is important to work hard and do one's best because this work reflect on the family.
Alphas: Parent: .88 Sibling: .90

Construct: Parent Education
Measurement Information:
Parent Education Item: 1. Highest degree parent(s) completed: 1 = Less than high school 2 = Some high school 3 = High school degree 4 = Some college 5 = College degree 6 = Graduate degree or training beyond a college degree
Alphas: N/A

Construct: Controls
Measurement Information:
Parent Education Item: 1. Highest degree parent(s) completed:

1 = Less than high school
2 = Some high school
3 = High school degree
4 = Some college
5 = College degree
6 = Graduate degree or training beyond a college degree

Adolescent Gender (Measured as dichotomous (1 = Female; 0 = Male):
What gender are you?

Science Grade in 9th grade Item (reverse-coded from original):

1. What was your grade in science?
   1 = E or F
   2 = D
   3 = C
   4 = B
   5 = A

Alphas: N/A

CHAPTER 3

Latinx Undergraduate Science Student Perspectives: A Retrospective Analysis of Parent and Sibling Support and Adolescent Science Values in High School

Abstract

Exploring and documenting the experiences of Latinas is necessary to understand the intersectional experiences of a marginalized population within science. In the few studies on Latinx family support, scholars highlight the supporting roles that parents and family members play in helping adolescents navigate their education (Soto-Lara & Simpkins, 2020). Although some studies note how parent support, sibling support, and overall family support are positively related to adolescents' motivational beliefs (Hsieh et al., 2019; Simpkins et al., 2020), less is known about what parents and siblings do similarly or differently in supporting Latinas and their science motivation. Drawing from 14 semi-structured interviews with Latina undergraduate students (6 Mexican, 3 Latina/x, 2 Hispanic, 3 other) who were in their third or fourth year and majoring in a biological or physical science, the current study aims to bridge the gap between the two separate literatures on parent and older sibling academic support and explore the following research questions: (1) What were the similar and unique perceived supports in science from parents and older siblings that Latinas viewed as most essential for their science intrinsic and utility values development in high school? and (2) In what ways, if any, does Latinx parent and sibling support in science differ by family higher education experience and adolescent familism values? The main types of support that emerged for both parents and older siblings were conversations, emotional support, and coactivity. Meanwhile, only parents provided material and general academic supports. Findings also revealed that Latina adolescents with high familism values received greater parent and older sibling science support compared to Latina adolescents with low familism values. Finally, families where parents and siblings had similar levels of education had greater parent science support. In families where only older siblings had higher education experience, older siblings gave equal or greater support compared to parents. Overall, these findings underscore how families serve as a source of motivation for Latinas who have persisted in science.

Keywords: Latinas, science motivation, family support, familism

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Although the number of Latinx college students has increased in recent years, the disparities in STEM for Latinx students are profound and persistent; the numbers are particularly stark for Latinas who only account for 5% of the science occupations (Excelencia in Education, 2019; Fry et al., 2021; Khan et al., 2020). Documenting the experiences of Latinas in science is necessary as they continue to be significantly underrepresented in the sciences and face multiple challenges in pursuing science (Andersen & Ward, 2013; Beasley & Fischer, 2012; Strayhorn et al., 2013), including feeling isolated, a lack of belonging, and having to prove oneself (Contreras et al., 2020; Rodriguez & Blaney, 2020). Understanding their experiences is fundamental for knowing the ways in which society can support Latinas who want to pursue science.

Though much of the literature has focused on the challenges that Latinas face, far less is known about what helps Latinas persist and succeed, including their motivational beliefs which are strongly associated with their academic success and persistence (Eccles & Wigfield, 2020). Families are also a source of strength that Latinx adolescents draw upon to develop their motivational beliefs. Yet, few studies focus on Latinx families and the support that family members provide in science. Even within that limited literature, most studies focus on parents even though siblings also serve as guides and mentors in helping their younger siblings navigate school systems (Azmitia et al., 1996; Azmitia et al., 2009; Carolan-Silva & Reyes, 2013; Valenzuela, 1999). According to family systems theory, the development of family members are interdependent and interconnected, with all family members influencing each other's development (Cox & Paley, 1997). The literature's emphasis on parent-child relationships overlooks the role of other critical family socializers, including older siblings. The current study aims to address these gaps by further understanding the ways in which parents and siblings help support Latina adolescents' science intrinsic and utility values during high school. Lastly, we aim to also understand how family support may differ by two main factors related to these processes, namely (1) family higher education experience and (2) Latina adolescents' familism values.

Theoretical Frameworks

Three main complementary theoretical frameworks were utilized to ground the current study: (1) situated expectancy-value theory, (2) family systems theory, and (3) the Latino youth development model. These three theoretical frameworks were selected as they provide unique, complementary perspectives, which have not been examined in combination in prior work on STEM. Utilizing multiple theoretical frameworks and synthesizing their complementary information in this way has been coined theory bridging (Leaper, 2011; Starr et al., in press). Theory bridging allows researchers to situate their work within multiple, appropriate frameworks with the goal of providing a more comprehensive understanding of the relevant processes. Thus in the current study, we bridge theories that include motivational, familial, and cultural aspects as we expect these processes matter in describing Latinx family motivational processes.

Situated expectancy-value theory specifically outlines how various family, individual, and contextual factors are associated with individuals' intrinsic and utility values in domains including science (Eccles & Wigfield, 2020). Eccles and Wigfield (2020) define intrinsic value as the interest that people have towards a domain whereas utility value is related to how useful and valuable people view a domain for their future goals, such as career goals. Studies have indicated that although a person's perceived competence and self-efficacy plays a role in persistence and choices, utility and intrinsic values are stronger determinants of what careers people pursue (Eccles, 1994; Harackiewicz et al., 2016). For example, although women and underrepresented populations may perform well and may be confident in their abilities in certain science fields, they may be drawn to other careers based on their interests (Boucher et al., 2017; Eccles, 1994; Diekman et al., 2017; Harackiewicz et al., 2016; Smith et al., 2014). Thus, examining the development of these values regarding the domain of science is an important step in understanding what helps promote science persistence among Latinas. Further, adolescence and the high school years in particular are foundational for the development of interests, identity, and career expectations as students begin to prepare for the future, such as deciding on whether to take advanced courses in preparation for careers they will pursue in college (Education Commission of the States, 2019; Hecht et al., 2019; Hulleman & Harackiewicz, 2009; Osborne & Jones, 2011). Thus, our main focus is examining the family factors that support high school adolescents' intrinsic and utility values.

One of the main contextual factors that is described by situated expectancy-value theory as being central to the development of these values is support by family members. Specifically, the parent socialization model is a subtheory nested within situated expectancy-value theory and describes what parent support-related behaviors are important determinants of youth's subjective task values (Eccles, 1993; Eccles & Wigfield, 2020). This theory argues that, in addition to other experiences and factors, adolescents are more likely to be interested in science and find it more useful when family socializers provide science-related support. Science-related support is defined broadly and typically relates to both home and school involvement. Examples include having science conversations, engaging in science activities together, and provision of science-related materials and opportunities. Though situated expectancy-value theory and its subtheory focuses on parents, other theories suggest we need to also consider the support of other family members.

Extending situated expectancy-value theory, we draw upon family systems theory to delve more deeply into the possible role of older siblings for adolescents' motivational beliefs and the ways in which older siblings and parents uniquely and collectively support development (Cox & Paley, 1997; Cox, 2010). More specifically, family systems theory emphasizes the interdependence of individuals' development and their relationships with key family members, which include those within and outside of the nuclear family unit (e.g., aunts, uncles, siblings, parents, etc.). Despite its emphasis on the importance of studying different family members, the majority of studies have focused on examining the potential implications of parent-adolescent relationships for adolescents' motivational beliefs. However, as Cox (2010) notes, older siblings also influence the family context and their younger siblings' development, with Latinx siblings often serving as role models or assisting with younger siblings (Azmitia et al., 1996; Cooper et al., 1999). In accordance with family systems theory, sibling support, its associations with adolescents' motivational development, and links to parental support should therefore be examined.

Finally, we relied on the Latino youth development model to help elucidate the role of families and cultural processes in the development of Latinas' science intrinsic and utility values (Raffaelli et al., 2005). Despite culture being present in micro, meso and macrosystems (Vélez-Agosto et al., 2017), culture is largely absent from many developmental perspectives and models (Garcia-Coll et al., 1996; Raffaelli et al., 2005; Soto-Lara & Simpkins, 2020). The Latino youth development model (Raffaelli et al., 2005) thus brings a necessary cultural perspective onto the development of Latinx youth and adolescents. It aims to address within-group differences among

Latinx families and evaluate normative development of Latinx youth. The main factors outlined that are associated with the development of Latinx youth include child characteristics, family characteristics, and cultural factors. According to the Latino youth development model, family characteristics (e.g., parents' and older siblings' educational levels) and child characteristics (e.g., gender, cultural values) play a role in Latinx adolescents' development. Therefore, in the current study, we focus on family education and familism values to understand how these family and adolescent characteristics relate to the development of Latinas' science values.

Family Supports in Science and Latinas' Science Intrinsic and Utility Values

Prior studies have emphasized the positive relations between parents' socialization practices and youth's subjective task values in different domains, including music, sports, and math (Jacobs & Eccles, 2000; Simpkins et al., 2012; Simpkins et al., 2015a), with researchers beginning to examine these relations among the domain of science and math (Hsieh et al., 2019). These relations have also begun to be studied among Latinx families, where Latinx parent support has been associated with positive science motivational beliefs (Simpkins et al., 2018; Simpkins et al., 2015b) and academic achievement (Altschul, 2011) among high school students. Though the existing research on normative positive motivational development in Latinx families is limited, including domains with significant ethnic disparities like science, even fewer studies have examined the potential positive influence of older siblings. Among Latinx families, older siblings often serve as role models (Cooper et al., 1999), help their younger siblings with homework (Azmitia et al., 1996; Valenzuela, 1999), and serve as cultural brokers for parents who may not be as familiar with the U.S. educational system (Cooper et al., 1999). Despite their positive and influential role within Latinx families, there are very few studies that examine older sibling support, and even less that examine them jointly with parents as recommended by family systems theory.

The literature has only recently begun to establish the connections between Latinx family support and adolescents' science motivational beliefs. Taking a culturally grounded approach to development with qualitative interview data, Soto-Lara and Simpkins (2020) found that Mexican-descent parents used both traditional (e.g., homework help, provision of materials) and nontraditional (e.g., *consejos, dar ánimo*) forms of support related to science. These findings align with studies on school more generally where Latinx parent support includes school and home involvement as well as academic socialization behaviors (Azmitia et al., 1996; Altschul, 2011; Hill & Tyson, 2009) in addition to providing other forms of culture-specific support to promote both academic and moral education (e.g., *consejos;* Alfaro et al., 2014; Auerbach, 2007; Soto-Lara & Simpkins, 2020). In one of the only studies that examine parent and sibling support in science collectively, Ramos Carranza and Simpkins (2021) found that parents and siblings both engaged in similar forms of support in science (e.g., classwork help, monitoring, academic socialization, and providing resources), but that siblings were also able to provide unique support if they had taken similar science classes as siblings could leverage their experiences to provide classwork help, advice, and material resources. Most other studies examine these types of family supports separately (Altschul, 2011; Puente & Simpkins, 2020; Soto-Lara & Simpkins, 2020) instead of jointly despite studies highlighting the ways in which Latinx parents may bring in siblings to help promote the academic success and motivation of younger children and adolescents (Alfaro & Umaña-Taylor, 2010; Azmitia et al., 2009). As family systems theory (Cox, 2010; Cox & Paley, 1997) and the Latino youth development model (Raffaelli et al., 2005) suggest, the development of individuals within Latinx families is interconnected and studying family supports jointly would further inform how Latinx families work together to support adolescents.

Family Support by Family Educational Experience and Adolescent Familism Values

The support-related behaviors that parents and older siblings engage in within Latinx families may vary based on family and adolescent characteristics as argued by situated expectancy-value theory (Eccles & Wigfield, 2020) and the Latino youth development model (Raffaelli et al., 2005). The current study focuses on two characteristics: family higher education experience and adolescents' level of familism values.

Family Higher Education Experience.

The literature generally highlights how parents and siblings may provide different forms of support depending on their level of educational and experience with the U.S. educational system (Aschbacher et al., 2010; Davis-Kean, 2005; Jabbar et al., 2019; Sheldon, 2002). For example, Hurtado-Ortiz and Gauvain (2007) emphasized that Mexican American parents with a high school education or less were able to provide some types of support, such as encouraging their adolescent, but not other types of support, such as helping with homework. Although less is known about older siblings' education experience and its relation to sibling support and adolescent values, some scholars have noted that siblings who have higher educational experience are better positioned to provide specific types of academic support, such as giving advice about college applications, and may supplement in areas where parents are not able to offer specific forms of academic support due to limited education experience (Carolan-Silva & Reyes, 2013; Hurtado-Ortiz & Gauvain, 2007). Carolan-Silva and Reyes (2013), for example, reported that older siblings in college would use their higher education experience to advise their younger siblings in things such as selecting their high school courses that would better prepare them later on. Additionally, both parents and siblings with higher education experience were able to help adolescents more often with homework, engage in conversations about career aspirations, and use connections to further educational goals (Aschbacher et al., 2010; DePlanty et al., 2007; Ramos Carranza & Simpkins, 2021; Sheldon, 2002). However, a main gap in the literature that remains is considering both parents and older siblings' education jointly rather than separately as family systems theory suggests. For example, Latinx older siblings may provide more and unique types of support compared to parents if parents did not attend a university in the US, but the older sibling did. More research is needed to understand the types of support parents and siblings provide based on parents' and siblings' higher education.

Adolescent Familism Values

According to the Latino youth development model (Raffaelli et al., 2005), cultural factors, such as familism values, are related to Latinx individuals' psychological development, such as motivational beliefs. Familism values refer to how family is an important aspect of one's identity and is considered a marker for enculturation (Umaña-Taylor et al., 2009). Adolescents who have stronger cultural values aligned with their family's culture of origin or who have stronger ethnic identities also tend to have greater family support (Alfaro & Umaña-Taylor, 2010; Luna & Martinez, 2013). Familism values are often examined as a correlate of family relationships, with stronger familism values related to closer, warmer parent (Fuligni et al., 1999; Stein et al., 2014) and sibling (Fuligni et al., 1999; Killoren et al., 2016; Updegraff et al., 2005) relationships. Despite its potential association to family support, few studies examine how familism values is related to the types of support that family members provide. Adolescents who have stronger familism values may have closer relationships with their parents and older siblings, and may also receive more or unique forms of support compared to adolescents who have weaker familism values. In a study on Latinx parent support, Simpkins and colleagues (2018) found that parent support was more strongly associated with high school adolescents' science values when adolescents endorsed higher familism values compared to their peers. The current study aims to explore the ways in which this cultural factor may result in different forms of family support.

Current Study

Due to the limited research on parent and sibling support in science, the current study aims to address the following research questions using a qualitative approach:

Research Question 1: What were the similar and unique perceived supports in science from parents and older siblings that Latinas viewed as most essential for their science intrinsic and utility values development in high school?

Research Question 2: In what ways, if any, does Latinx parent and sibling support in science differ by family higher education experience and adolescent familism values?

Positionality

It is important to acknowledge the positionality and potential biases that we as researchers bring into the research process (Hill et al., 2005). The first author is a first-generation college graduate as well as a first-generation Ph.D. student. She is also a second-generation Latina since her parents immigrated from Honduras in the 1980s and she was born in the United States, specifically in Houston, Texas. Much of her research interests have been shaped by her experiences in college, where she started as a pre-medicine student and switched to the social sciences. The second author is a White female who was raised in California and who comes from a family that has been in the U.S. for more than three generations. Her research expertise focuses on out-of-school activities, family influences on STEM motivation, and the role of cultural processes related to these topics. We acknowledge that we may hold certain biases or thoughts relating to why science seems to be a field that pushes out a lot of underrepresented students and the role that family plays in supporting individuals throughout K-12 education and college. To account for these biases, the first and second author had discussions throughout the entire analytic process, deciding and consolidating codes, categories, and themes derived from inductive and deductive approaches. Additionally, the coding framework and findings were presented and discussed with the larger research team. Any disagreements or new ideas were discussed until consensus was agreed upon.

Method

Research Design and Participants

The participants in the current study were from a large public university in Southern California, which has Hispanic-Serving Institution (HSI) as well as Asian American and Native American-Serving Institution designations. Undergraduate Latina students who were majoring in science and in their third and fourth year in college were purposely selected as the study sample in order to examine Latinas who persisted in science through college. Focusing on this group allowed us to investigate the factors related to parent and sibling support Latinas success in scienc. The current sample includes 14 participants who identified as Latinas (see Table 3.1). Except for one participant, all participants reported their racial/ethnic identity. Participants identified as Mexican (n = 4), Hispanic (n = 3), Latin/x/a (n = 3), or another identification related to a Latin American origin (n = 3) when asked about their race/ethnic identity. Most participants were first-generation college students (79%) and were majoring in a physical (50%) or biological (50%) science. Additionally, most parents had a high school degree or less (64%) whereas most older siblings had some college experience or a higher education degree (71%). Most participants (57%) also reported that their parents had taken some science or STEM-related courses in high school or in college. Regarding siblings, all older siblings had taken science or STEM-related courses in high school and, if applicable, college.

To recruit participants, we used purposive sampling, which refers to selecting participants who meet certain criteria, as well as snowball sampling (Miles et al., 2014). The criteria included: 1) identified as Latina, 2) majoring in either a physical or biological science subject as defined by the National Science Foundation (Trapani & Hale, 2019), 3) was a third- or fourth-year undergraduate student, and 4) had an older sibling. These two science fields were selected due to the opposing gender differences within these science fields, with women being overrepresented in the biological sciences and being underrepresented in the physical sciences (National Science Board, 2018). Moreover, third- and fourth-year students were recruited since they had persisted in science and could reflect on what helped promote their science intrinsic and utility values. We expected these individuals likely had high intrinsic and utility values and could speak to how their parents and siblings supported them in developing those high science values. Recruitment for the current study consisted of asking student and campus organizations, instructors, and staff to send recruitment emails and flyers to undergraduate students in science departments throughout the academic year. Flyers were distributed by organizations via social media and were also posted throughout the campus.

Interview and Survey Procedures

All procedures conducted were IRB-approved. Data procedures included semi-structured interviews and a short survey filled out after the interview. Participants were recruited and interviewed during the 2020-2021 and 2021-2022 academic years. The interview protocol and the survey items are included in Appendix C.

Semi-Structured Interview

The semi-structured interviews took place virtually through Zoom or on the phone during the spring of 2020 through the fall quarter of 2021. The semi-structured interviews were audio or video recorded and were typically 30 minutes to 1 hour long. Once interviews were completed, they were transcribed verbatim by research assistants and the authors. When necessary, interviews were transcribed by the first author if participants used Spanish phrases throughout the interview. The first author is a native Spanish speaker and conducted the interviews, which were offered in English or Spanish. Secondary checks were conducted where the transcriptions were checked by a second transcriber. Any interviews that included Spanish phrases were checked by the first author since research assistants were not bilingual in English and Spanish.

The interview protocol consisted of 11 open-ended questions that had participants recall information and their experiences in high school and early college. There were additional probing questions to obtain richer responses from participants. Interview questions were created based on the literature review and were framed by the situated expectancy-value theory, family systems theory, and the Latino youth development model (Cox & Paley, 1997; Cox, 2010; Eccles & Wigfield, 2020; Raffaelli et al., 2005). The first two questions in the interview protocol (i.e., Warm-up section; see Appendix C) were posed in order to establish rapport and develop participant trust before going into questions related to the study. Section 1 of the interview protocol referred to participants' perceived supports from parents and older siblings (e.g., "Describe the support that you received from your parents in high school, especially in science"). Section 2 of the interview protocol addressed the ways in which parents and older siblings helped them overcome costs and barriers in science in high school and included questions such as "Was there anything that made it challenging to keep going in [science major]?" and "Tell me about how your parents helped you in any way to overcome any challenges you faced in high school and in college." The current study utilizes section 1 of the interview protocol. Adolescent-perceived parent and older sibling support themes were mainly drawn from Q4 (i.e., "What, if any, were the conversations surrounding science and your science major in your family?"), Q5 (i.e., "Describe the support that you received from your parents in high school, especially in science."), and Q6 (i.e., "Describe the support that you received from your older sibling(s) in high school, especially in science.") from section 1 of the interview protocol.

Short Survey

Participants were given a short survey after completing the semi-structured interview. The survey included questions regarding participants' demographic information, including gender, year in college, college major, race/ethnicity, and college generational status. It also asked questions related to participants' family background, including number of siblings, sibling and parent education, STEM education, and occupations (see Appendix C for survey items). It measured familism values with a shortened version of the MACVIS by Knight and colleagues (2010), which is described below. Specific attention was placed on the questions measuring family education and familism values in order to address the second research question. These were used to categorize participants separately by levels of family education and familism values.

Family higher education. A categorical variable was created to measure participants' family education. Due to the capital and resources that come from having even some college experience (Tym et al., 2004), we define those with higher education as having at least some college experience (i.e., taking some college courses, associate degree, etc.). Participants reported on both parents and their older siblings' educational levels. Educational levels were categorized by whether parents and siblings had (a) a high school degree or less, or (b) some college experience or higher education degree (0 = *High school degree or less*, 1 = *Some college or more*). This information was then utilized to create four groups: parents and older siblings with a high school degree or less (n = 1), only siblings with higher education experience (n = 9), only parents with higher education experience (n = 2), and both parents and siblings with higher education experience (n = 2).

Adolescent familism values. Familism values were defined as values relating to family relationships that may be central to individuals' identity and choices (Knight et al., 2010). The scale had a total of 15 items measured on a 5-point Likert scale (α = .92 1 = *Not at all,* 3 = *Somewhat*, 5 = *Completely*) and were related to family relationships and beliefs (e.g., "When it comes to important decisions, the family should ask for advice from close relatives"). This scale has been established by prior studies, which have indicated strong construct validity and reliability (Knight et al., 2010; Puente & Simpkins, 2020).

Coding and Analysis

To reduce our own biases and perceptions, we had a larger research team help with the analytical process of the study. For the data analysis portion, we checked in with team members to go over the codes and categories we distinguished and the interpretation of the findings. Both inductive and deductive approaches were utilized to code the interviews when addressing the first and second research questions (Saldaña, 2013). An inductive approach refers to creating "emergent, data-driven" codes that appear in the data whereas a deductive approach refers to a predetermined code list that is driven by theory or conceptual frameworks (Saldaña, 2013, p. 65). To help with the coding analysis, MAXQDA, a coding software program was used to organize and manage the coding process. Additionally, the coding process involved refining codes and developing a coding framework based on discussions between the first and second author and with lab members.

Initial Coding and Development of the Codebook

To begin the coding process, half of the interviews were read and coded thoroughly and in their entirety. This allowed the first set of codes to be developed that were later refined as other interviews were coded. Analytic memos were also written during this step in order to identify possible codes that were reflected in the data based on a subset of the interviews (Saldaña, 2013). Codes that were generated in this first cycle came from descriptive (i.e., a summarizing word or short phrase) and in-vivo (i.e., a word or phrase used by the participants) coding based on the research questions outlined (Saldaña, 2013). After coding half of the interviews, the first and second author met to discuss codes to reach consensus; these discussions informed the development of a coding framework and codebook that was used to code the remaining interviews. The authors then moved forward with codes that reoccurred in the data and that aligned with the common topics and theoretical frameworks (i.e., family systems theory and SEVT) outlined in the literature review.

Refinement of the Codebook and Themes

The second cycle of coding involved using the coding framework established during the first cycle to go over all interviews and recode where necessary. At this stage of analysis, codes were also further refined based on a deductive approach, where the authors more thoroughly drew upon the literature and theoretical frameworks highlighted in the literature review to inform refinement and creation of any new codes that emerged. The coding framework was again revised based on the iterative cycles of coding that occurred. After these cycles of coding, categories were created based on patterns that were present in the agreed-upon codes and more concrete themes were developed.

Analyzing Themes Across Study RQs

The final step in analyzing the interview data to address the research questions was to identify themes that were present for Research Question 1, namely the types of perceived support from parents and separately older siblings that aided in the development of science values. Each question of the interview protocol specified which family member to discuss and so parent and older sibling support were coded separately. To examine parents and siblings jointly, overlapping themes within each family were identified to highlight what parents and older siblings were doing similarly and uniquely to support adolescents' science motivation.

Because the second research question focused on whether family support varied by levels of family education and adolescent familism values, the coded interviews were categorized into groups to look at these differences for a cross-case analysis (Saldaña, 2013). There were two groups for adolescent familism values: (1) those with high familism values and (2) those with low familism values. For family education, there were four groups: (1) parents and older siblings with a high school degree or less, (2) only siblings with higher education experience, (3) only parents with higher education experience, and (4) both parents and older siblings with higher education experience. Once categorized, the coding framework was utilized to identify themes and categories that were similar or different by family with/without higher education experience and high/low familism separately.

Results

Findings for the first research question are presented below in the first section. The second section outlines results for the second research question that focused on a cross-case analysis. Under the first research question, which aimed to understand the similar and unique supports in science from parents and older siblings, there were various themes that emerged. We first discuss themes and categories that emerged for parents and separately siblings. We then provide findings on the overlapping themes that emerged for parents and older siblings.

Parent and Sibling Support in Science

When asked about the types of parent and sibling science support that played a role in the development of Latinas' science intrinsic and utility values, there were three broad themes that emerged for both parents and siblings: conversations, emotional support, and coactivity (see Table 3.2). Although these forms of support were mentioned for both parents and siblings, sometimes these supports manifested differently. Moreover, two additional main themes emerged only for parents: material support and general academic support. Below we describe each broad theme and provide examples in participants' own words. For patterns of support for each participant, see supplementary Tables 3.S1 and 3.S2.

Conversations

Most Latina students reported that their parents and siblings engaged in a variety of conversations with them that supported the development of their science intrinsic and utility values. Adolescents had conversations with both parents and siblings about science, other education-related topics, careers, college, and challenges in science. These conversations at times served as part of the foundation for their interest and perceived value of science. Monica, an earth systems science major, described how her interests in earth science developed at an early age from conversations with her mom:

> "My interest in learning Earth Sciences developed from a really young age because my mom was raised on a ranch, and so she really enjoyed being in nature and being outside

looking at the trees and the flowers, bugs, birds, all of that. She had a really big interest in it. She told me all the stories of what it was like in their ranch, and it made me very interested in it as well."

Her early exposure to science through her mother's positive experiences with science and these science conversations led her to develop an early interest in the subject, which she pursued in high school and college. Relatedly, many Latinas noted that their parents could not offer specific help but would engage in conversations with them about what they were learning. Sarah mentioned, "For my parents…we talked about like they can't really help me with my homework. It was just more like engaging in conversation with me and whenever they could so if that was like listening to me talk about definitions and like introducing them to topics. And like that's about the extent of it, but not really like hands-on." Latinas also mentioned how older siblings also discussed science-related topics with them, which often got them more interested in science. Diana mentioned how her brother illuminated her understanding of chemistry by sharing what he was learning in his community college course:

"It was probably my brother to be honest…he used to really, really like chemistry. Also because he was in community college and he took organic chemistry so whatever he learned he basically told me and I end up like bragging to my friends about it…And like in organic chemistry, you always have like an application like…this is like a polymer that you can use to make like this, and so on and so forth…Even like the desk that you have right now is the result of a chemist trying to figure this out. And I'm like wow that's actually pretty cool like everything can be explained by chemistry…So yeah. It's mainly my brother that kind of maintained my interest and he still maintains my interest too because he still loves chemistry…"

Though Latina adolescents had general science conversations with their parents where they shared what they were learning with their parents, for some their older siblings were the ones that imparted knowledge to them and developed both their interest and how useful they thought science was. For Diana, she realized the many applications that chemistry has, which made her more interested in the subject and led her to pursue a chemistry major.

Latina students also mentioned that parents and older siblings had college- and career-related conversations as well as discussions about the challenges they were facing in science, with most of these conversations occurring with siblings rather than parents. These conversations were influential as it gave them a space to talk about challenges and deciding on colleges or career goals. Mirabel, a biological sciences major, described discussing her college goals with her parents:

> "I remember growing up… I told them that I wanted to apply to college and choose biology as my major. They're very supportive and I remember being first gen, they were really like 'Oh, what exactly is our... What classes [do] you take?' So then asking me those questions I would be like … 'oh let me check' and then that's when I would do my research."

In contrast to parents, the conversations that older siblings had regarding college and careers also led to older siblings giving specific feedback and advice, which we refer to as *guided advice.* With all these types of conversations, Latina adolescents mentioned that they were able to receive specific and detailed advice. For example, during challenging times, Latina adolescents mentioned how they would discuss it with their older siblings, and they would provide guided advice. Elizabeth described how she discussed challenges, college, and career topics with her older siblings and the advice she received:

> "Uh, just like the support system like for them, like, I would go more in detail about like 'Oh like this specific thing is bothering me' or, 'I don't know what to do about college' or like 'I don't know how to major in STEM' or like 'How do I prepare for that' or 'What career should I pursue in STEM?' So, I would go more to them for help on that because my sister at the time was already in college. And…in my senior year when I was making my decision, she was already in college and my brother had also been in college, so I kind of relied on them for more like, career and academic help and more my parents for like emotional support."

Elizabeth's older siblings were able to provide her with specific advice on challenges as well as college topics due to their experience. Other Latina adolescents also mentioned how their older siblings would give them guided advice on courses they were struggling with and pointed out ways they could overcome challenges, which helped them move forward with pursuing science and further develop their interest. This differed from parents who did not provide detailed advice and often provided words of encouragement and other types of general support.

For only parents, Latinas had conversations with their parents regarding their parents' educational expectations, which further pushed them to find domains that they were interested in. Mirabel stated:

> "They like even in high school when I [would] tell them about my classes, like a difficult test for me. They would give me space and be like 'okay yeah let's study and like school first' so they also were a big part of like how I wanted to succeed academically because they would emphasize how important like school was and how it's important for us to go to college."

These educational expectations often related to parents' expectations for Latina adolescents to get good grades, graduate high school, and pursue a college degree, which aligns with Latinx parents' educational expectations for their children (Cross et al., 2019). Overall, conversations served as an important type of support as it helped Latinas to develop their interests and value of science, leading them to later pursue a science major and career.

Emotional Support

Another main source of support for the development of science intrinsic and utility values was the emotional support that parents and siblings provided, especially when Latinas faced challenges in science both in high school and in college. The main type of emotional support that Latinas mentioned for both parents and siblings was encouragement, which they described as positive messages to keep pushing forward and pursue their interest in science. Caroline, an ecology and evolutionary biology major, said the following about her mom: "Yeah I mean, my mom always encouraged me to pursue whatever major I wanted to, and she knew I really liked biology, so she was always encouraging." When discussing the support of their older siblings, Latina adolescents mentioned that they too gave them encouragement that helped them to further their interest in science and created deeper understanding of the value of science. For example, Caroline recalled that her older brother motivated her to "keep going": "But it's more like what he said to me that was encouraging that helped me keep going even when I thought I couldn't." Alexandra, an applied physics major, also discussed the similarity between her parents and her older sibling, stating: "I think similarities were that they were always encouraging. They never told me, 'Maybe you should rethink that idea.' They knew that this is a subject that I enjoyed. [They never tried] to talk to me out of it." When faced with challenges in science, these words of encouragement allowed Latina students to continue to pursue their interest and develop their value of science despite the challenges. Encouragement has also been cited in other studies on parent support of Latinx adolescents (Soto-Lara & Simpkins, 2020; Ramos Carranza & Simpkins, 2021), and, as evidenced here, has been an important source of motivation for both Latina girls and Latino boys to continue pursuing their interests despite challenges they may face.

For only parents, Latinas also mentioned autonomy support, which referred to instances when parents vocalized their support for whatever career or goals their daughters wanted to pursue. For example, Sophia, a biological science major, mentioned:

> “My parents didn't go to college, so they really didn't know…what to expect and how it would work. So I guess I kind of like guided them in the way of what [biology] would be like. And like what classes, I would take, and then they really saw …how much workload and everything there was. But yeah, my mom was like supportive of me taking [biology]…At one point I was thinking about grad school, but I wasn't too sure, but then she was like ‘Oh well, like whatever you want, as long as like you know what you're going to do and have it kind of figured out.’ Then she'd be supportive with it.”

Like Sophia, many others also noted how their parents supported any endeavors or interests they developed early on in high school. This support for their autonomy allowed them to further pursue and develop their interest in science by engaging in conversations with their parents about what they were learning and future goals they had. Moreover, this type of support relates to the autonomy that adolescents seek at this age (Eccles et al., 1997). Eccles and colleagues (1997) describe the importance of supporting adolescents’ autonomy as it becomes a developmental need as adolescents continue to explore their interests and begin to mold their identities. When parents were supportive of Latina students' autonomy regarding their interest, they were able to further pursue their interest and engage with the subject.

Finally, one type of emotional support that differed from parents that Latina adolescents mentioned was that their older siblings, but not parents, were understanding of challenges and career aspirations they had. Alexandra mentioned how unlike her parents, her sister would be more understanding of things she would face in the future: "I would say for my sister, it was, I guess, understanding that it would be difficult, far more difficult in college than it was in high school." Although Latina adolescents spoke with their parents about struggles as well, they seemed to have a deeper connection with older siblings since they were knowledgeable of the science curriculum and field. Mirabel shared:

> "Yeah, so I think they understand it more in college in general, like how it works. But they also like took science classes, so when I would tell them like 'Oh yeah my science professors are different from my GE professors.' And they would be like 'Oh yeah like science professors are more like lecture heavy' and my exams are more like specific compared to like a general GE class…So they would understand when I would talk about things like 'Oh my science class is different compared to my other classes.'"

Overall, siblings were able to offer emotional support by communicating their understanding of what Latina adolescents were undergoing, which supported their drive to continue pursuing their science interest.

Coactivity

Coactivity has been defined in the literature as activities that family members and youth do together, such as going to science museums and working on homework together (Eccles, 1993; Simpkins et al., 2015b). The two most common types of coactivity that parents and siblings and Latina adolescents engaged in were working on classwork assignments together and engaging in other science-related activities, such as watching documentaries or working on school science-related projects. Often, Latina adolescents noted that among their parents, their dads would engage in activities with them, as represented by the following quotes:

> "I think helping my dad work on the car. So it's something we can do every every weekend and even though it's not necessarily science, like the, like the process involved reminds me a lot about like what scientists like, and so I think those like really helpful." – Gabby

> "Then my dad would just be a handyman, this is not directly science, but there's this annual thing called the Catapult Competition and we had to build a catapult. Then I know nothing about construction, but my dad's a carpenter, so I was like, "Pa, please help." Then he would teach me like you're using the drill wrong and this bolt will give you better support than this one and stuff that. He would always just be in hand like you need to drive to this location to get this resource for this project and stuff that." – Iris

> "I'm having to think back because, like, I thought Chemistry was like cool I guess like growing up, because my dad really likes those documentaries about like astrophysics and like quantum Chemistry. And he made me watch them too because he thought I would get smarter so." – Diana

In other research, parent support, including coactivity, has often focused on mother-reported data even though some studies note that mothers' and fathers' supports may have different effects on adolescent outcomes (Alfaro et al., 2006; Kim & Hill. 2015; Plunkett et al., 2008). However, Latinas in this study reported on how their fathers were also involved in supporting their science motivational development, specifically through engaging in activities together. This differs from other themes found since either both parents or the mothers were mentioned when it came to conversations and emotional support. Overall, coactivity with parents was a powerful source of developing Latina adolescents' interest in science.

Like parents, older siblings also engaged in coactivity as a form of support by helping Latina adolescents with science assignments and engaging in science-related activities that were school and non-school related. Most commonly, older siblings would help Latina adolescents with classwork by reviewing assignments, answering questions, and helping with science projects. Claudia remembered her study sessions with her sister: "She kind of also needed a review for the basics when she had assignments for it…It was kind of more like a study session that we would have." Moreover, Mirabel recalled how she would take advantage of her older sister's previous experience with AP biology:

> "Specifically, like my older sister. So when I was taking AP Bio, she had also taken that class, with the same teacher. So if I…asked her like 'Oh, do you still have some of your old notes, or do you still have something that he would show you guys, or just any resources?' She would help me with just gathering more resources for the class. Since she had already taken it beforehand."

In addition to classwork help, Latina adolescents touched on science-related activities they would engage in with their older siblings, including science school projects and other non-school activities. Maritza described how her sister would help her develop her interest in science by taking her to museums even though her sister was not as interested in science as she was:

> "My older sister, she wasn't necessarily as interested. We all love museums and my sister she's seven years older than me so it's quite a big age gap. Because she was quite a bit older, she would get us passes, the annual passes to museums and stuff and she would take us to the museums…She would take us to different museums like aquariums and stuff. Her encouragement in that wasn't necessarily super academic but it was in taking us to these different exhibits and that kind of stuff."

Overall, similar to parents, engaging in activities together helped to further their interest and would help them develop their usefulness of science by being exposed to science through different avenues.

Material Support

Another main source of support specifically from parents was material support. Material support included provision of science materials, providing study spaces, transportation, and food as a source of support. These types of material support were noted to further Latina adolescents' science interests and the value they placed on science since they were able to further engage with science through these supportive behaviors. For example, Maritza emphasized how her dad would provide her and her siblings with materials on subjects they were interested in:

> "…I remember when my dad came home one day and he had brought me this life science book…I don't remember exactly what was in it or what the topic was, but I remember that it had a couple of different pages or the whole book just had a bunch of different diseases or different conditions and stuff that people struggled with. I know that they had a couple of pages on different cancers, they had a couple of pages on diabetes or whatever…He had given it to me and I would just sit there and flip through it. I was in the fifth grade, so I didn't fully understand everything that was in there. I would just sit

> there and stare at it and flip through it and see the things that seemed kind of interesting to me… My dad just [tried] to help blossom that interest by giving me things that intrigued me… My dad had gotten us a telescope when we were kids…my brother was into-- he liked astronomy so he would give both of us things like that to help encourage you a little bit."

Relatedly, parents would offer transportation to obtain materials that their daughters needed for science assignments. Iris, a biological science major, recalled:

> "For the skin cancer science fair project, I asked my dad 'Can we go to Sephora to get some samples of products, foundations that have SPF in it?' He was like, 'Okay.' He was patiently waiting for me throughout the whole thing when I was talking to a Sephora person on the floor. Then my dad was like, he didn't know exactly that I was looking for SPF. I was like, 'I need some foundation for a project.' He started pulling out those random ones. I was like, 'Maybe not that one'..."

An important type of material support in the development of science values was when parents provided their daughters with spaces to fully concentrate for their studies. Caroline, for example, described how her parents would "take action": "But then my parents would also try to take action, helping me study and they would give me the space to study and take me to places, like the library if I wanted to study there." With studying, parents would also try to comfort their daughters as they studied, with Elizabeth mentioning how engaging with food was a source of comfort during a difficult time when studying:

> "…but they were always like, I was really stressed, or something they would be like, 'You know I can't help you because I didn't go to college so like I don't have like the tutoring skills to actually help you with this course, but I'm here to support you. If you

want a break, we can watch a movie.' Or like my dad would always make me food um or my mom would bring me like you know, like little mangoes with chameleon, give it to me as a study snack."

Here, Elizabeth's parents acknowledged they could not help with the content she was studying and struggling with. However, parents like Elizabeth's can provide other means of support by offering a source of comfort via food. Unlike providing study spaces and transportation, this type of support to our knowledge has not been documented in the literature. It can be considered as a nontraditional source of support that Latinx parents may offer. Weller and Turkon (2015) note how Latinx families maintain their heritage culture and connection to the community. For Latina adolescents, food may be a source of connection to their families and parents that motivate them to pursue their interests. Overall, these types of material support are noted to be helpful for Latinas developing their interest and value for science.

General Academic Support

In addition to material support, when asked about the ways that parents supported them in developing science values, Latina adolescents described that they received general support that often related to parental school involvement, checking-in, and connecting adolescents to necessary resources. This became a separate theme since many Latinas mentioned that their parents supported them more generally in their academics rather than specifically in science. Gabby, a chemistry major, for example, shared:

> "My mom specifically she was always like… involved with the high school so when…there are different meetings with parents or different events, fundraising events, she would always help in those. Not so much in the science aspect. Like I don't, like I don't have a vivid moment where they supported me and science."

Similarly, Claudia, a biological science major, stated: “um my mom she just encouraged me in general to continue on to get good grades, so that was pretty much it. She didn't tell me like a specific ‘oh, you have to like this, you have to like that.’ It wasn't like that. She just encouraged me in general, and then I just liked biology just because it just clicked with me, and it was really cool.” This related to parents also generally checking-in on their daughters, often asking about if their homework had been completed or making sure their studies were going well.

General academic support that involves general support, checking-in and connecting adolescents to resources has been largely documented in the literature focused on parent supportive behaviors, with some studies beginning to document these types of support among Latinx parents (Eccles, 2005; Simpkins et al., 2015b; Soto-Lara & Simpkins, 2020). In a qualitative study on Latinx adolescents, Soto-Lara and Simpkins (2020) also emphasized that parents engaged in these types of academic support in the domain of science, with their main findings centering on parental support of schoolwork (e.g., homework help, monitoring, etc.). This is also representative of what Latina adolescents mentioned for developing their interest and value of science.

Family Support by Adolescent Familism Values and Family Higher Education

The second research question was to identify patterns among the themes identified by adolescent familism values and family education. Below, we present the patterns present for both parent and sibling support (see Tables 3.3 & 3.4).

Adolescent Familism Values

Latina adolescents were almost equally split in regard to their level of familism values (high familism: n = 6; low familism: n = 8; see Table 3.3). When examining patters of parent and sibling support by Latina adolescents’ level of familism values, there seemed to be greater mention of parent and older sibling support for Latina adolescents with high familism values compared to Latina adolescents with low familism values. Among parent support themes, Latina adolescents with both high (100%) and low (75%) familism values seemed to have conversations with their parents. The majority within each group also mentioned emotional support (High: 83%; Low: 63%). Within the high familism values group, the majority mentioned coactivity (67%), material (67%) and academic (83%) support. However, of those within the low familism values group, less than half mentioned coactivity (38%) and material (38%) support for the types of support that parents gave in science. For patterns among sibling support, conversations were mentioned by most participants with high familism values (83%) and low (75%) familism values. Moreover, the majority within each group mentioned receiving emotional support (High: 67%; Low: 75%) and coactivity (High: 67%; Low: 50%) types of support from their older sibling.

Family Higher Education

For family education, most Latinas had families where only siblings had higher education compared to the other groups (see Table 3.4). A few patterns emerged, with a main one being that families where an older sibling had higher education gave equal or greater support as parents. Within families where both parents and older siblings had a high school degree or less, parents engaged in conversations, emotional support, material support, and academic support but not coactivity. Meanwhile siblings did not offer science support within this group. Within families where only siblings had higher education, parents mainly engaged in conversations (78%), emotional support (78%), and academic support (67%) while the majority of participants mentioned conversations (89%), emotional support (78%), and coactivity (78%) for older sibling science support. For families who only had parents with a higher education experience, they engaged in mainly conversations, emotional support, and material support while older siblings mainly gave emotional support. However, participants within these families noted that they received all types of support from both parents and siblings. Finally, for families who had both parents and older siblings with higher education experience, parents mainly supported them through conversations, coactivity, and academic support but not emotional or material support. Meanwhile, older siblings mainly supported them through conversations and emotional support but not coactivity.

Discussion

Diversity and equity issues within science have persisted, with underrepresented minorities and women continuing to be stereotyped as less competent in STEM, including science (Beasley & Fischer, 2012; Starr, 2018). Latinas in particular may experience a "double bind" since they may experience both racism and sexism within science (Johnson, 2011). Due to known challenges outlined in the literature (e.g., discrimination, negative stereotyping, etc.), the current study aimed to take a positive youth development perspective by understanding what family supports helped promote Latina adolescents' strong science intrinsic and utility values among a sample who had persisted in science in college. The findings from the current study informed several gaps in the literature, including what specific supports promote Latina adolescents' science values and what parents and older siblings do differently and similarly in science by: (1) examining the ways in which parents and older siblings similarly and uniquely supported Latina adolescents' development of science intrinsic and utility values during high school, which is a foundational time for preparing those that want to persist in science, and (2) identifying patterns of parent and older sibling science support by adolescent familism values and family higher education.

Parent and Sibling Science Support

A main contribution to the literature and larger field was findings that related to what parents and older siblings within the same families were doing differently and similarly in supporting Latina adolescents in science. Themes that emerged for both parents and older siblings included conversations, emotional support, and coactivity. These types of support align with those outlined in the parent socialization model (Eccles, 1993; Eccles & Wigfield, 2020) as well as in the literature on Latinx families (Ramos Carranza & Simpkins, 2021; Soto-Lara & Simpkins, 2020; Simpkins et al., 2015b). These findings further add to the parent socialization model since similar supportive behaviors were also found for older siblings, indicating that this theoretical model may be applicable to processes involving siblings in addition to parents.

Although these themes were common among both parents and older siblings, the ways in which conversations and emotional support manifested differed slightly, with only parents having conversations related to educational expectations and giving autonomy support and only siblings having conversations where they provided detailed guided advice and being understanding of Latina adolescents' experiences with science. Other types of conversations, such as career and college conversations, and emotional support (i.e., encouragement) were similar across parents and older siblings. These findings elaborate on prior studies that have noted the power of conversations within families, including Latinx families (Hill & Tyson, 2009; Suizzo et al., 2016; Tulagan et al., 2022; Soto-Lara & Simpkins, 2020). For example, Tulagan and colleagues found that parent and older sibling school-related conversations were associated with Latinx adolescents' ability self-concepts. Additionally, our findings of how conversations and emotional support manifest differently also supports family systems theory (Cox & Pailey, 1997; Cox, 2010) due to the complementary ways that parents and older siblings support Latina adolescents, which would have been overlooked if they were examined separately.

Additional themes that emerged, but only for parents, were material support and general academic support. These types of support may have only emerged among parents as parents may take on more managerial roles that come with supporting their adolescent in education compared to siblings who have a more peer-like relationship with younger siblings (Bradley, 2019; Grau et al., 2009; Halgunseth, 2019). Moreover, these types of support are often noted to be among parents (Eccles, 1993) whereas other types of support are noted for siblings (e.g., homework help; Azmitia et al., 1996; Valenzuela, 1999). However, these studies mainly examined these types of support for general academics and were not science-specific or do not focus on Latinx families. In sum, our findings emphasize how siblings may play a supplementary role in supporting Latina adolescents in science while parents engage in a wider array of supports due to the responsibilities that come from being a parent.

Family Support by Adolescent Familism Values and Family Higher Education

A second aim of the study was to analyze whether these processes varied by Latina adolescents' familism values. A main pattern that emerged was that both parents and older siblings gave greater support in all types of support for Latina adolescents with high familism values compared to Latina adolescents with low familism values. Moreover, among Latinas with high familism values, conversations seemed to be the most frequently mentioned type of support for both parents and older siblings. These findings may be explained by the studies on Latinx family dynamics and familism values, where Latinx parents and older siblings have better communication and closer relationships with adolescents when adolescents have higher familism values (Fuligni et al., 1999; Stein et al., 2014; Updegraff et al., 2005). These closer family relationships may naturally lead to conversations and emotional support as emphasized in the findings. Moreover, this can apply to both parents and older siblings since they both were evidenced to give greater support.

The second aim of the study was to analyze whether there were any patterns of support by family higher education experience. A main pattern identified was that families where parents and siblings who had similar levels of education or where only parents had higher education experience had greater parent support. Meanwhile, in families where only siblings had higher education experience, siblings would give greater support for some types of support (i.e., conversations and coactivity) and equal levels of support as parents for other types (i.e., emotional support). These different patterns underscore the variability within families when considering the educational levels of multiple family members and not just parents as has previously been tested in the literature (Engle, 2007; Gibbons & Borders, 2010). Focusing on just parent education may underestimate the family resources Latina adolescents can draw upon if other sources are not captured. For example, the majority of the participants were part of families where only older siblings had a higher education experience and siblings in this group gave similar or greater support than parents. This contrasts studies on first-generation college students where they usually focus on parent education as indicators of resources. These findings emphasize that although both Latina adolescents and their older siblings in these families would be considered first-generation college students, younger siblings may draw upon their older siblings' knowledge similar to if their parents had higher education experience. Because older siblings have experience with higher education, they were able to provide advice and engage in college and career related conversations more so than parents (Carolan-Silva & Reyes, 2013). Moreover, they also engaged in more science activities with Latina adolescents since they may have taken similar classes or be familiar with the content (Ramos Carranza & Simpkins, 2021). Overall, these findings emphasize the need to consider multiple family members regarding family education since Latina adolescents can pull support from multiple avenues.

Limitations and Future Directions

The current study had several notable findings that contribute to the literature on Latinx families. However, there were also a few limitations that can inform future studies and the direction the field should take when considering how to best support Latinas in science. First, the current study only asked about overall parent support and did not specify participants to ask what mothers and fathers did similarly or differently to support them in science. An important finding that emerged in addition to our research aims was that fathers were mainly mentioned for coactivity-related supports. More studies are needed that examine what mothers and fathers do similarly and differently as their support may function differently for the development of adolescent motivational beliefs. Future studies should also examine whether there are gendered dynamics between parents and Latina adolescents based on parents' gender. For example, are fathers serving as a protective factor when they support Latina adolescents in science due to the gendered associations within science? An additional limitation was that the current study did not identify whether there were any patterns related to science field. As shown in recent statistics, science fields vary when it comes to gender diversity. Women are overrepresented in fields such as biology but underrepresented in others, such as engineering and computer science (Crisp & Nora, 2012; Flores, 2011; Hazari et al., 2013; Funk & Parker, 2018; Su & Rounds, 2015). Thus, future studies should examine what helps promote the development of science motivational beliefs by science field, especially as some studies note that women and underrepresented groups are drawn towards fields that are more interpersonal and communal (Boucher et al., 2017; Diekman et al., 2017).

Conclusion

Findings from this study indicated that parents and older siblings provided both similar and unique science-related supports. Latina adolescents frequently mentioned that both parents and older siblings would have conversations with them, offer emotional support, and engage in activities with them. Latina adolescents indicated that parents, but not siblings, also offered material and general academic support that helped them develop their interests and value of science. When examining these themes by adolescent familism values, patterns showed that parents and older siblings gave greater support for Latina adolescents who had higher familism values compared to lower familism values. Also, when exploring patterns across groups for family education, findings revealed that there were specific patterns of support by family educational levels, such as parents but not siblings giving support when both the parent and older sibling did not have higher education experience. These findings underscore the importance of examining both parent and sibling science support within families rather than as separate socializers. As supported by the Latino youth development model (Raffaelli et al., 2005) and the situated expectancy-value theory (Eccles & Wigfield, 2020), taking into account cultural values, family-level and adolescent-level characteristics revealed nuances and within-group differences. Overall, this study begins to unpack key factors related to Latina adolescents' motivational development and highlight families as a vital source of motivation that helped them persist in science.

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Table 3.1

Participant Table with Demographic Information

Pseudonym	College Major	Ethnicity/Race	First-Generation?	Parents' Highest Level of Education	Siblings' Highest Level of Education
Martha	Earth Systems Science (Physical Science)	Mexican	Yes	< High School	Master's Degree
Elena	Applied Physics (Physical Science)	No response	Yes	< High School	Bachelor's Degree
Claudia	Biological Science	Hispanic	Yes	< High School	Bachelor's Degree
Mirabel	Biological Sciences	Mexican	Yes	< High School	Bachelor's Degree
Sophia	Biological Sciences	Hispanic	Yes	< High School	High School Degree
Elizabeth	Neurobiology (Biological Science)	Latinx	No	High School Degree	Bachelor's Degree
Iris	Biological Science	Peruvian	Yes	High School Degree	Associate degree
Alexandra	Applied Physics (Physical Science)	Salvadorian	Yes	High School Degree	Bachelor's Degree
Sarah	Chemistry (Physical Science)	Hispanic and Black	Yes	High School Degree	Bachelor's Degree + currently in graduate school
Gabby	Chemistry (Physical Science)	Mexican	Yes	Some Community College Courses	Some Community College Courses
Diana	Chemistry (Physical Science)	Hispanic	Yes	Some Community College Courses	< High School
Monica	Earth Systems Science (Physical Science)	Hispanic/Mexican	Yes	Associate degree	Associate degree
Maritza	Human Biology (Biological Science)	Latina	No	Bachelor's Degree	High School Degree
Caroline	Ecology and Evolutionary Biology (Biological Science)	Latin	No	Master's Degree or Higher	High School Degree

Table 3.2
Coding Framework for Parent and Sibling Science Support Behaviors

Theme	Categories	Examples
Conversations (Parents: *n* = 11; Siblings: *n* = 12)	*Science conversations (Parents: n = 7; Siblings: n = 5)* Conversations that were specifically related to science.	"With my brother, it was more just random silly facts and just laughing about it and the fun in science, getting to share new information."
	Career-related conversations (Parents: n = 1; Siblings: n = 6) Conversations related to adolescents' career goals and aspirations.	"…in my senior year when I was making my decision, [my sister] was already in college and my brother had also been in college, so I kind of relied on them for more like, career and academic help…"
	College conversations (Parents: n = 3; Siblings: n = 5) Conversations related to college (e.g., majors, college applications, etc.).	"Yeah so I have two older siblings and my oldest sibling, he was in college like during the time that I was in high school…I would see how he went through college and then, when it was time for me to apply, he actually helped me with all my college apps."
	Challenges in science (Parents: n = 2; Siblings: n = 2) Parents and siblings discussed challenges that adolescents were facing in science.	"I think some conversations that I've had with my sister have been more just trying to explain to her my struggles in the science classes and how my struggles now are very different from my struggles in high school."
	Other education-related conversations (Parents: n = 6; Siblings: n = 2) Conversations related to general education (e.g., discussions about school days, etc.)	"I would come home and then my mom or my dad would be like, "What did you do today?" and I'll just rant and then I was like either I hated it or I liked it…"

	Educational Expectations (Parents: n = 6) Conversations that outlined educational expectations parents had.	"She [her mom] always warned me when I was taking on more classes. Just the concern of like are you going to have time to handle your extracurriculars on top of like your homework on like, if you take on this class you still need to maintain that GPA."
	Sharing positive science experiences (Parents: n = 2) Parents shared positive experiences that related to science.	"She [her mom] just made it sound like it was a lot of fun, being outside, and we'd always go on hikes. She would explain to me some of the things behind the things that were occurring out in nature, and I thought that was really interesting."
	Guided advice (Siblings: n = 7) Conversations where siblings gave direct and specific advice.	"…when I was struggling, like in a high school class, they [their older siblings] would tell me like "oh reach out to a teacher like do some Tutoring".
Emotional Support (Parents: *n* = 10; Siblings: *n* = 10)	*Encouragement (Parents: n = 7; Siblings: n = 9)* Parents and siblings provided words of encouragement or positive messages.	"It was just their [her parents] willingness to listen and then always being very encouraging and being, "If that's what you want to do, then that's what you should do," and never making me feel dumb in any way."
	Autonomy support (Parents: n = 8) Parents gave adolescents autonomy on what they wanted to pursue and supported their interests.	"They [her parents] just helped me by supporting me in whatever I decided, like anything within school or outside of school. They just wanted to help me as much as again by encouraging me."
	Understanding (Siblings: n = 3) Siblings were described as understanding of challenges adolescents faced and career aspirations.	"I would say she [her older sister] was mostly just understanding of why I spent so much time on the subject."

Coactivity (Parents: *n* = 7; Siblings: *n* = 8)	*Classwork help (Parents: n = 4; Siblings: n = 8)* Parents would provide help on homework or class projects. Siblings offered classwork help through a variety of behaviors, including reviewing assignments and answering questions.	"Then they [her parents] would always try to help me with science, but it wasn't their strong suit so they couldn't kind of help me with the subject itself. But they would try to. They'd like "you could always talk to me if you need to for like studying." You know how they say talk to someone who doesn't really know the subject?" "Also, he [her older brother] would help me with my homework like every once in a while. So, it was like the organic chemistry portions of like AP chemistry, or even like in college. He helped me with general chemistry and some aspects of like organic chemistry."
	Science-related activities (Parents: n = 7; Siblings: n = 3) Parents and siblings engaged in science-related activities, such as science projects or watching science documentaries.	"…my dad he used to work like, very often. Like he wouldn't come home much, but then whenever he would, he would come home like it would be just me and him watching like documentaries…like Physics or like Quantum Chemistry or things of the sort." "I think one time I mentioned off-hand something about moles because we were listening to science podcasts and then they were— [my brother] put one on about moles and it was like, moles are everywhere."
Material Support (Only Parents: *n* = 7)	*Provision of science materials (n = 4)* Parents provided materials for science classwork.	"I guess it would be just their [her parents] willingness to provide us with the proper materials. Whether it was paying for the science AP tests or making sure that I had little model kits that I could use to look at the right stuff, or books, any books that I needed for that specifically."
	Providing study spaces (n = 3) Parents gave adolescents space to complete classwork and focus on their studies.	"They [her parents] would help [by providing] a study environment. So, if I was doing homework, they would make sure not to have the TV on really loud, or they would

		turn it off. And make sure like oh if there's not enough light in the living room just go to the kitchen or something."
	Transportation (n = 3) Parents provided transportation for adolescents to stores for science materials and school.	"My dad was just more a background supporter really like, "I missed this poster up for this assignment that's due tomorrow, can we just drive to Staples real quick again?" He would be like, "Okay," and stuff like that."
	Food as support (n = 2) Parents provided food as a means of comfort for adolescents.	"If I was in there for a super long time studying, she'd [her mom] come in and bring me tea or bring me something to eat or something so I wouldn't have to step away from it or I didn't want to right in that moment. She was still making sure that I was eating and having was well hydrated and stuff. My dad was pretty much the same way but my dad worked a lot more, so he wasn't really able to do it as much as my mom did."
General Academic Support (Only Parents: *n* = 9)	*General support (n = 4)* Parents provided general support related to academics.	"She [her mom] wouldn't exactly encourage one specific thing. She would just encourage the overall, just academic success. I wouldn't say a specific science that she would encourage."
	School involvement (n = 3) Parents were involved in school activities (e.g., science fairs, school meetings, etc.).	"My parents would try their best to attend the science fairs that I did, or the project-based learning, which was a semester thing where a lot of different doctors or different people from different professions would join in to see our projects."
	Checking-in (n = 3) Parents provided support through homework checks and checking-in on other school-related topics (e.g., grades).	"She [her mom] would sometimes check up on whether or not I did my homework during the time. And she would…make sure I'm okay with continuing on and stuff like that. She would just encourage me to keep pushing forward."

	Connecting to resources (n = 2) Parents connected adolescents to resources through giving advice (e.g., tutoring) or administrative support (e.g., getting adolescent an educational plan).	"The only thing she [her mom] kind of like helped me on was getting a 504 plan, because I have autism. It might've like impacted you know, like my abilities and so on, so my mom helped me get accommodations for that…"

Table 3.3

Frequencies of Parent and Sibling Science Support by Adolescent Familism Values

Level of Adolescent Familism Values	Parent Science Support	Sibling Science Support
High Familism (*n* = 6)	Conversations (100%) Emotional support (83%) Coactivity (67%) Material support (67%) General academic support (83%)	Conversations (83%) Emotional support (67%) Coactivity (67%)
Low Familism (*n* = 8)	Conversations (75%) Emotional support (63%) Coactivity (38%) Material support (38%) General academic support (50%)	Conversations (75%) Emotional support (75%) Coactivity (50%)

Table 3.4

Frequencies of Parent and Sibling Science Support by Family Education

Family Education Group	Parent Science Support	Sibling Science Support
HS degree or less (*n* = 1)	Conversations (100%) Emotional support (100%) Coactivity (0%) Material support (100%) General academic support (100%)	Conversations (0%) Emotional support (0%) Coactivity (0%)
Sibling only (*n* = 9)	Conversations (78%) Emotional support (78%) Coactivity (44%) Material support (44%) General academic support (67%)	Conversations (89%) Emotional support (78%) Coactivity (78%)
Parents only (*n* = 2)	Conversations (100%) Emotional support (100%) Coactivity (50%) Material support (100%) General academic support (50%)	Conversations (50%) Emotional support (100%) Coactivity (50%)
Both (*n* = 2)	Conversations (100%) Emotional support (0%) Coactivity (100%) Material support (0%) General academic support (50%)	Conversations (100%) Emotional support (50%) Coactivity (0%)

Supplementary Materials

Table 3.S1

Theme-Related Patterns of Parent and Sibling Support by Participant

Participant	Parent Science Support	Sibling Science Support	Both
Martha	Emotional support	Conversations	Coactivity
Monica	Coactivity	Emotional support	Conversations
Caroline	Coactivity Material support General academic support		Conversations Emotional support
Elizabeth	Material support General academic support	Coactivity	Conversations Emotional support
Gabby	Coactivity General academic support		Conversations
Elena	General academic support	Conversations Emotional support Coactivity	
Maritza	Material support General academic support	Conversations Coactivity	Emotional support
Claudia	General academic support	Coactivity	Conversations Emotional support
Iris	Emotional support Material support General academic support		Conversations Coactivity
Alexandra	Material support General academic support		Conversations Emotional support
Mirabel	Material support General academic support		Conversations Emotional support Coactivity

Diana	General academic support	Emotional support	Conversations Coactivity
Sophia	Conversations Emotional support Material support General academic support		
Sarah	Conversations General academic support		Emotional support

Table 3.S2

Themes and Categories for Each Participant

Participant	Conversations	Emotional Support	Coactivity	Material Support (only parents)	General Academic Support (only parents)
Martha	<u>*Siblings:*</u> • *Other education-related*	<u>*Parents:*</u> • *Autonomy support*	<u>*Parents:*</u> • *Science-related activities* <u>*Both:*</u> • *Study help*	*No material support*	*No general academic support*
Monica	<u>*Parents:*</u> • *Positive science experience* • *Other education-related* • *Science* <u>*Siblings:*</u> • *Career-related*	<u>*Siblings:*</u> • *Encouragement*	<u>*Parents:*</u> • *Science-related activities*	*No material support*	*No general academic support*
Caroline	<u>*Parents:*</u> • *Educational expectations* <u>*Siblings:*</u> • *College (sibs)* <u>*Both:*</u> • *Other education-related*	<u>*Parents:*</u> • *Autonomy support* <u>*Both:*</u> • *Encouragement*	<u>*Parents:*</u> • *Science-related activities* • *Study help*	• *Providing study spaces* • *Provision of science materials*	• *General support*
Elizabeth	<u>*Parents:*</u> • *Other education-related* • *Science* <u>*Siblings:*</u> • *Guided advice* • *College* • *Career-related* <u>*Both:*</u> • *Challenges in science*	<u>*Parents:*</u> • *Autonomy support* <u>*Both:*</u> • *Encouragement*	<u>*Siblings:*</u> • *Study help*	• *Food as support*	*No genral academic support*
Gabby	<u>*Siblings*</u> • *Guided advice* • *Science* <u>*Both*</u> • *College*	*No emotional support*	<u>*Parents:*</u> • *Science-related activities*	*No material support*	• *General support* • *School involvement*

Elena	*<u>Siblings:</u>* • *Guided advice* • *Science*	*<u>Siblings:</u>* • *Encouragement*	*<u>Siblings:</u>* • *Science-related activities* • *Study help*	*No material support*	• *School involvement*
Maritza	*<u>Siblings:</u>* • *Guided advice* • *Challenges in science*	*<u>Parents:</u>* • *Autonomy support* *<u>Both:</u>* • *Encouragement*	*<u>Siblings:</u>* • *Science-related activities* • *Study help*	• *Food as support* • *Transportation*	*No general academic support*
Claudia	*<u>Parents:</u>* • *Educational expectations* • *Other education-related* *<u>Siblings:</u>* • *Guided advice* • *Career-related*	*<u>Parents:</u>* • *Autonomy support* *<u>Both:</u>* • *Encouragement*	*<u>Siblings:</u>* • *Study help*	*No material support*	• *General support* • *Check-in*
Iris	*<u>Parents:</u>* • *Educational expectations* • *Other education-related* *<u>Both:</u>* • *Science*	*<u>Parents:</u>* • *Encouragement*	*<u>Both:</u>* • *Science-related activities* • *Study help*	• *Transportation* • *Provision of science materials*	• *School involvement*
Alexandra	*<u>Parents:</u>* • *Positive science experience* • *Science* *<u>Siblings:</u>* • *Career-related*	*<u>Parents:</u>* • *Autonomy support* *<u>Siblings:</u>* • *Understanding* *<u>Both:</u>* • *Encouragement*	*No coactivity*	• *Transportation*	*No general academic support*
Mirabel	*<u>Parents:</u>* • *Educational expectations* • *Challenges in science* *<u>Siblings:</u>* • *Guided advice* *<u>Both:</u>* • *College* • *Science*	*<u>Siblings:</u>* • *Understanding* *<u>Both:</u>* • *Encouragement*	*<u>Parents:</u>* • *Science-related activities* *<u>Both:</u>* • *Study help*	• *Providing study spaces* • *Provision of science materials*	• *Connecting to resources*

	• *Career-related*				
Diana	<u>*Siblings:*</u> • *Guided advice* • *College* • *Career-related* <u>*Both:*</u> • *Science*	<u>*Siblings:*</u> • *Encouragement*	<u>*Parents:*</u> • *Science-related activities* <u>*Siblings:*</u> • *Study help*	*No material support*	• *Connecting to resources*
Sophia	<u>*Parents:*</u> • *Education expectations* • *College*	<u>*Parents:*</u> • *Autonomy support*	*No coactivity*	• *Providing study spaces*	• *General support* • *Check-in*
Sarah	<u>*Parents:*</u> • *Educational expectations* • *Other education-related* • *Science*	<u>*Parents:*</u> • *Encouragement* <u>*Siblings:*</u> • *Understanding*	*No coactivity*	*No material support*	• *Check-in*

Appendix C

<u>Semi-Structured Interview:</u>

Introduction: Thank you for taking some time to talk to me today. During this interview, I will be asking several questions about your experiences in high school in regard to science. We'll also discuss a bit about the role that your parents and your older siblings had in regard to these experiences.

And just as a reminder, you don't have to respond to any question that you do not wish to respond to. If at any time you are uncomfortable or would like to stop the interview, just let me know.

I will also be recording our conversation today. Would that be ok with you? [PARTICIPANT CONFIRMS].

Ok, any questions before getting started?

Ok. I am pressing record now. Please accept the recording prompt that pops up on your screen [ZOOM SETTING].

Participant ID: Today is MONTH, DAY, and the interviewer is Kayla Puente. The interviewee is [PSEUDONYM].

Warm-Up

1. Describe yourself in high school. What type of student were you?
2. Thinking back to high school, what were your academic interests?
    a. What subjects did you find interesting?
    b. Why were these subjects interesting?

Section 1

Now I would like you to reflect back on your experiences with science in high school:

1. What did you think of science as a high school student?
    a. Describe one positive moment in science that stands out to you while in high school.
    b. Your major now is [SCIENCE MAJOR]. What did you think of that area as a high school student?
2. When did you first develop an interest in [SCIENCE MAJOR]? What events or experiences did you have in high school that helped you develop an interest in [SCIENCE MAJOR]?
    a. What was interesting about [SCIENCE MAJOR] in high school? What was boring?
    b. What experiences helped you develop your interest in [SCIENCE MAJOR]?
    c. What experiences helped you maintain your interest in [SCIENCE MAJOR]?
    d. Was there anyone who helped you develop and/or maintain your interest in [SCIENCE MAJOR]?

            i. IF THEY DID NOT MENTION PARENTS OR SIBLINGS ASK, Did your parents help you develop and/or maintain your interest in [SCIENCE MAJOR]? IF YES, how?
            ii. Did your older sibling(s) help you develop and/or maintain your interest in [SCIENCE MAJOR]? IF YES, how?

3. How much did you value [SCIENCE MAJOR] in high school? Why was it valuable to you?
    a. What was useful about [SCIENCE MAJOR] in high school? What was not useful?
    b. What experiences helped you develop how useful you thought [SCIENCE MAJOR] was?
    c. What experiences helped you maintain how useful you thought [SCIENCE MAJOR] was?
    d. Was there anyone who helped you develop and/or maintain how much you thought [SCIENCE MAJOR] was useful?
        i. IF THEY DID NOT MENTION PARENTS OR SIBLINGS ASK, Did your parents help you develop and/or maintain your value of [SCIENCE MAJOR]?
        ii. Did your older sibling(s) help you develop and/or maintain how much you thought [SCIENCE MAJOR] was useful? If YES, how?

For the next section, I am interested in learning more about the role your family played in supporting you in science in high school:

4. How did your parents generally support you in high school?
5. How did your siblings generally support you in high school?
6. Describe the support that you received from your parents in high school, specifically in science.
    a. What did they do most often to support you in science?
    b. What did they do that was most helpful?
7. Describe the support that you received from your older sibling(s) in high school, specifically in science.
    a. How was it different or similar to the support your parents gave you in science?
    b. What did they do most often to support you in science?
    c. What did they do that was most helpful?
8. What, if any, were the conversations surrounding science and your science major in your family?
    a. What did you talk about with your older siblings?
    b. What did you talk about with your parents?
    c. What were some similarities and/or differences in the conversations that you had with your older siblings and with your parents?

Section 2

For these next set of questions, we'll continue to talk a little bit about your high school experiences, but we'll mainly be talking now about possible challenges you may have faced in science and the role your family had in helping you overcome those challenges:

9. Sometimes people face challenges in their high school science courses, such as not feeling competent in science. Were there any challenges you faced in science when you were in high school?

[IF NO]: Skip to question 10.
[IF YES]: Describe your some of the challenges you faced in science in high school and how that may be related to your experiences now in college.

a. What are some things from high school that have impacted your experience in science now?
b. Some of the research on STEM usually discusses how there are gender differences in who goes into certain science fields. It also talks about how there are gender stereotypes in regard to STEM. Reflecting on your experiences, do you think your gender play any role in the experiences you mentioned?

10. Sometimes even though people enjoy or have an interest in something, there can be challenges, problems, or difficulties that they encounter that may have them question whether they want to pursue it or not.
    a. Was there anything that challenged you or made it difficult to be interested in [SCIENCE MAJOR] or to pursue [SCIENCE MAJOR]?
    b. Was there anything that made it challenging to keep going in [SCIENCE MAJOR]?
        i. IF THEY DID NOT MENTION CODE-SWITCHING (or related topics) ASK: Codeswitching refers to the act of purposefully modifying one's behavior, in a specific interaction in a foreign setting, to accommodate different cultural norms for appropriate behavior. What role did your identity play when pursuing science? Were you able to be yourself in those spaces?
        ii. IF THEY DID NOT MENTION MICROAGRESSIONS ASK (if participant is comfortable): a microaggression is when there is a subtle comment or action that is discriminatory or stereotypes people. If you are comfortable sharing, did you have any experiences with microaggressions related to science when you were in high school?
        iii. IF THEY DID NOT MENTION GENDER, ASK: Did your gender play a role in challenges you may have experienced in science in high school?
    c. What helped you overcome the challenges that you described?
11. [IF YES TO Q10]: Tell me about how your parents helped you in any way to overcome any challenges you faced in high school.
    c. Now tell me about how your older sibling(s) helped you in any way to overcome any challenges you faced in high school. How was it similar or different than your parents' help?
12. Is there anything else you would like to add about the topics we talked about today?

<u>Short Survey:</u>
Demographic Information:

1. What is your gender?
    a. Female
    b. Male
    c. Other: _______
    d. Would not like to disclose
2. What is your year in college?

a. 1^{st} year
b. 2^{nd} year
c. 3^{rd} year
d. 4^{th} year
e. Other: ________

3. What is your college major? (open-ended)
4. What is your race/ethnicity?
5. A person is considered a first-generation college student if their parents have a high school diploma or less. Are you a first-generation college student?
   a. Yes
   b. No
   c. Other: _______

Family Background:

1. What are your parents' current job(s)? Please distinguish between parent 1 and parent 2 (e.g., Mom: teacher; Dad: construction worker).
2. What is your parent 1's highest level of education?
3. What is your parent 2's highest level of education?
4. Did your parents take science or STEM-related courses? If so, please describe.
5. How many siblings (younger and older) do you have? Please distinguish between younger and older siblings (e.g., younger:1; older: 2).
6. Among your older sibling(s), what is their highest level of education? Please distinguish among siblings.
7. Among your older sibling(s) that went to college, what was their major? Please write n/a if not applicable. Please distinguish among siblings.
8. Did your sibling(s) take science or STEM-related courses? If so, please describe.
9. Among your older sibling(s), what is their current job(s)? Please write N/A if they do not currently have a job. Please distinguish among siblings.

ARSMA-II

Measured on a 1 to 5 Likert scale (1 = *Not at all*, 5 = *Extremely often or almost always*).
Mexican-oriented Items

1. I speak Spanish.
2. I enjoy speaking Spanish.
3. I enjoy watching TV in Spanish.
4. I enjoy watching movies in Spanish.
5. I enjoy reading (e.g., books) in Spanish.
6. I think in Spanish.

MACVIS

Measured on a 1 to 5 Likert scale (1 = *Strongly disagree*, 5 = *Strongly agree*).

16. Parents should teach their children that the family always comes first.
17. Children should be taught that it is their duty to care for their parents when their parents get old.
18. Children should always do things to make their parents happy.
19. Family provides a sense of security because they will always be there for you.
20. If a relative is having a hard time financially, one should help them out if possible.

21. When it comes to important decisions, the family should ask for advice from close relatives.
22. It is always important to be united as a family.
23. A person should share their home with relatives if they need a place to stay.
24. It is important to have close relationships with aunts/uncles, grandparents, and cousins.
25. Older kids should take care of and be role models for their younger brothers and sisters.
26. Children should be taught to always be good because they represent the family.
27. Holidays and celebrations are important because the whole family comes together.
28. Parents should be willing to make great sacrifices to make sure their children have a better life.
29. A person should always think about their family when making important decisions.
30. It is important to work hard and do one's best because this work reflect on the family.

DISCUSSION

In recent years, there has been a push towards making STEM fields more equitable and diverse, as evidenced by the many interventions and resources allocated to supporting underrepresented groups within the sciences (Harackiewicz et al., 2016; Hecht et al., 2019). Despite these efforts, certain groups remain largely underrepresented, including women and Latinx individuals (Khan et al., 2020). Thus, there continues to be a great need to understand how to support those who want to pursue science.

An important indicator of persistence and academic success is an individual's motivational beliefs, with intrinsic and utility values being associated with positive outcomes in science (Eccles & Wigfield, 2020; Hecht et al., 2019; Wigfields & Eccles, 2000). A determinant of these values is the academic support that family members give. Although some of these associations have been established in prior studies, there remain several gaps in the literature. First, few studies have examined motivational and family processes among Latinx families, whom have unique experiences and characteristics from other populations and are one of the main underrepresented populations within science (Khan et al., 2020; Raffaelli et al., 2005). Most studies that do consider Latinxs are those that investigate between racial/ethnic group differences and fail to identify what helps support the success of Latinxs in science. Secondly, most of the literature has focused on parent-child relationships (Cox, 2010). Older siblings also need to be considered as they are another key socializer within families, especially given the influence of family relationships on Latinx adolescents' development (Delgado et al., 2011; Fuligni et al., 1999; Stein et al., 2014). Relatedly, limited studies examine parent and sibling support as a system, as family systems theory would suggest (Cox, 2010). As a result, the dissertation studies addressed each of these gaps in the literature by examining: (1) parent and sibling science support as predictors of adolescents' motivational beliefs, and (2) examining the extent to which these indicators and the relations between them vary by adolescent gender, adolescent familism values, and family education experience. Below, I discuss central findings from across the studies as well as their implications for the field.

Overview of Findings and its Implications

Parent and Sibling Science Support

One central aim of this dissertation was to examine parent and older sibling science support as well as understand the correlates of their support. Across the papers, findings revealed that parent and older sibling science support were related to one another in terms of what types of support they gave and the levels of support they gave. In Paper 3, findings revealed that parent and older sibling support was composed of similar as well as unique types of support. For example, it was found that parents and older siblings had conversations with adolescents, gave emotional support, and engaged in coactivity with adolescents. Additionally, across papers it was found that in general parents gave greater support and engaged in more types of support compared to siblings. However, levels of parent and sibling science support did vary when adolescent familism values and family education were taken into consideration.

The main findings of the dissertation papers are a major contribution to the field since prior studies focus on examining parent and sibling support separately and do not consider how they are related (Cox, 2010). Paper 3 in particular examined what *types* of support Latinas reported that their parents and older siblings engaged in to support their science interest and value in high school. Three main themes emerged for both older siblings and parents: conversations, emotional support, and coactivity. Although these themes were similar across parents and older siblings, conversations and emotional support manifested differently by socializer. Additionally, Latina adolescents mentioned that parents, but not siblings, also engaged in material and general academic support. Some of these types of support have been documented in the literature, such as emotional support and coactivity (Azmitia et al., 1996; Hill & Tyson, 2009; Soto-Lara & Simpkins, 2020). Moreover, Eccles' (1993) parent socialization model also emphasizes some of the types of support that emerged. However, what the parent socialization model and the literature were not able to capture when examining socializers separately were the nuances when socializers are examined within the same families. Types of support varied depending on the socializer and the ways in which they informed one another, which provided evidence of how Latinx families work as a system rather than separately (Cox & Paley, 1997). Overall, a main contribution of these findings is that they confirm that parents and older siblings are similarly and uniquely supporting Latinx adolescents in science.

Another important finding was that even though older siblings gave support in science, parents at times were giving greater science support. So, what does this tell us about parent support during adolescence? As my findings highlight, parents are still playing a large role during adolescence. Although adolescents may experience a need for more autonomy during this time as suggested by stage-environment fit theory (Eccles et al., 1997), adolescents still rely on their parents for certain types of support (e.g., emotional support, material support) and may rely less on other types of support that may be more fitting for older siblings (e.g., homework help). For Latinx families in particular, this highlights that parents' support is important to Latinx adolescents. This aligns with cultural values found among Latinx families where strong family relationships inform Latinx adolescents' decision making and serve as a protective factor (i.e., familism values; Raffaelli et al., 2005; Umaña-Taylor et al., 2009). The Latinx youth development model (Raffaelli et al., 2005) further outlines how the family context is important for adolescents' development.

Older siblings, then, may play a supplementary role where they fulfill certain types of support when parents are not able to. Prior studies identified how older siblings would help with homework and school assignments more so than parents (Ramos Carranza & Simpkins, 2021), for example. However, these findings may also reflect how older sibling support may play a larger role when adolescents begin to apply to colleges and begin their transition after high school (Azmitia et al., 2009; Carolan-Silva & Reyes, 2013). Paper 3, for example, found that a large majority of Latina adolescents went to older siblings for conversations that were more specific to careers and their educational goals while also receiving more specific, detailed guided advice from their older siblings but not their parents. Thus, future studies should explore the role of older sibling support throughout the lifespan since older siblings may be more influential at certain developmental and transitional periods. Moreover, these findings inform components of the situated expectancy-value theory and its subtheory, the parent socialization model (Eccles, 1993). Due to the complementary roles of parents and siblings, the parent socialization model (Eccles, 1993) could be extended to include siblings' (and potentially other family members') supportive behaviors and beliefs in association to adolescents' motivational beliefs. Moreover, the situated expectancy-value theory's socializer's beliefs and behaviors (Eccles & Wigfield, 2020) could also be revised to include how socializers are interdependent.

Associations Between Family Science Support and Adolescents' Science Intrinsic and Utility Values

The second main theme addressed by the dissertation was to understand what associations between family support and adolescents' science intrinsic and utility values looked like for Latinx families. Across the papers, parent and sibling science support was related to the development of Latinx adolescents' science utility value, but not science intrinsic value. These results have various implications for the field. First, these results underscore the need to consider additional socializers in processes related to adolescents' motivational development. In addition to parents, greater older sibling support also led to greater adolescent science utility value. These findings align with situated expectancy-value theory (Eccles & Wigfield, 2020) as well as the parent socialization model (Eccles, 1993; Fredricks et al., 2005) since they both argue that family's supportive behaviors would theoretically be related to achievement motivation. The current studies contribute to the field by examining these processes among older siblings, whom have been understudied in the field especially within the domain of science. Also, this significant association between Latinx family supports and adolescents' science utility value can inform future intervention studies that aim to increase the science utility value of Latinx adolescents. Prior studies have worked on increasing STEM utility value through parents (Harackiewicz et al., 2012; Lee et al., 2020; Rozek et al., 2015). However, no utility intervention to our knowledge has involved other family members, such as siblings. As suggested by family systems theory (Cox & Paley, 1997), the situated expectancy-value theory (Eccles & Wigfield, 2020), and the Latino youth development model (Raffaelli et al., 2005), interventions focused on increasing science utility value should involve multiple family members in Latinx families.

Secondly, associations were mainly found for science utility value and not science intrinsic value, with the exception of parent support predicting girls' science intrinsic value in Paper 1. Drawing from the literature, parent and older sibling support may be associated with utility value but not intrinsic value since adolescents may be more easily taught about the usefulness and value of science for their futures and everyday lives while intrinsic value may be more of an individual decision and preference (Hidi & Renninger, 2006; Renninger et al., 2014). This is also evidenced by the many interventions focused on increasing STEM utility value among underrepresented populations (Hulleman & Harackiewicz, 2009; Rosenzweig & Wigfield, 2016). As Hidi and Renninger (2006) propose, the development of interest involves situational and individual interest. Situational interest refers to an interest that flourishes from being exposed and is then maintained. Individual interest comes after situational interest and refers to individuals selecting to engage in subject out of inherent interest. Thus, future studies should examine what types of support may help with developing both situational and individual interests. It may be that specific types of support, such as conversations and coactivity, but not others are better able to develop science intrinsic value.

Differences in Family Science Support and Associations to Science Values by Adolescent Gender, Adolescent Familism Values and Family Education

A final theme of the dissertation studies was to understand differences in parent and older sibling science support by adolescent gender, adolescent familism values, and family education. Mean-level differences were examined for adolescent gender, adolescent familism values, and family education. Only adolescent gender and parent education were examined at the process-level. Below, I outline the findings and implications for each family-level and adolescent-level indicator.

Few differences were revealed in regard to adolescent gender. First, no mean-level gender differences were found for parent science support, science intrinsic value, nor science utility value. There were also no process-level differences by adolescent gender, suggesting that these processes are functioning similar for boys and girls. Findings on no gender differences among parent support contrast those of studies on White families, which typically find that parents give greater support to boys compared to girls (Eccles & Jacobs, 1986; Frome & Eccles, 1998; Simpkins, Price, & Garcia, 2015; Wang & Degol, 2013). This further emphasizes that generalizations and assumptions should not be made across different racial/ethnic groups since these factors and processes may function differently for Latinx adolescents as suggested by the Latino youth development model (Raffaelli et al., 2005). It may be that among Latinx families, parents support both boys and girls equally since Latinx parents have high educational expectations of their adolescents regardless of gender (Cross et al., 2019). This is further evidenced in Paper 3, where Latina adolescents mentioned the high educational expectations their parents had for them and the many conversations they had with their parents regarding these expectations. Moreover, they often mentioned how their parents would provide autonomy support by encouraging them to pursue whatever field they wanted. One difference that did emerge was that Latina girls were more likely to have STEM occupational expectations compared to boys. This may be due to the many resources, interventions, and programs focused on getting more women and underrepresented minorities into STEM education and fields. Situated expectancy-value theory (Eccles & Wigfield, 2020) also argues that differing experiences within contexts are related to motivational beliefs and choices. This finding creates a further need to explore why Latino boys are less likely to expect an occupation in science.

Regarding mean-level differences by adolescent familism values, Latina adolescents seemed to receive greater parent and older sibling support in comparison to Latina adolescents with lower familism values. This reflects the potential strong family relationships that Latina adolescents who have higher familism values may have with their parents and older siblings as stated in the literature (Fuligni et al., 1999; Stein et al., 2014; Updegraff et al., 2005), which they can then draw upon in supporting their motivational development. Additionally, these findings support the cultural milieu component of the situated expectancy-value theory (Eccles & Wigfield, 2020) and the family context component of the Latino youth development model (Raffaelli et al., 2005) since high endorsement of this cultural value showed stronger family support. Specifically, conversations were higher for both parents and older siblings among Latina adolescents who had high familism values. This finding may underscore the critical role that conversations play within Latinx families and among adolescents who have strong identification with their families. As stated by a few studies that examine this, conversations related to academics, careers, and science is an important type of support that Latinx parents engage in (Tulagan et al., 2022; Ramos Carranza & Simpkins, 2021; Soto-Lara & Simpkins, 2020). Overall, the findings from Paper 3 further contribute to this literature as it specifically addresses how older siblings are also engaging in conversations with their younger siblings but in different ways from parents. These supports from older siblings are emphasized to have more of an impact among Latinas with higher familism values, which may be reflective of how certain types of support may be more impactful depending on the quality of the relationship (Darling & Steinberg, 2017; Updegraff et al., 2005).

Finally, there were some mean-level differences that emerged when examining parent or family education. First, there were mixed findings on whether parent science support differed by parent education. The finding that parent science support is greater when parents have a higher education degree is supported by the situated expectancy-value theory (Eccles & Wigfield, 2020) and the Latino youth development model (Raffaelli et al., 2005) since both argue the need to consider family characteristics when examining development. However, the non-significant association between parent support and parent education may be due to the samples used; Paper 1 used a larger dataset compared to Paper 2, resulting in less power. This calls for more studies that focus on the within-group differences among Latinx families and careful considerations of the characteristics of the sample. Second, family education was also examined and revealed differing levels of support depending on levels of family education. For example, in families where only older siblings had higher education experience, older siblings gave equal or greater support than parents depending on the type of support. Prior studies have mainly focused on parent education, including those on first-generation college students (Engle, 2007; Gibbons & Borders, 2010). The implications for these findings suggest that parent education should not be the only indicator examined among family processes since there are resources and capital that may come from multiple family members who may have higher education. Thus, intervention studies or programs aimed at supporting first-generation college students should consider whether adolescents have an older siblings have higher education since they may draw upon that resource compared to adolescents who have neither parents nor siblings with a higher education. Future studies should test the patterns identified in the dissertation paper quantitatively in order to further explore associations with family education and whether this differs if only parent education is considered.

Limitations and Future Directions

The three dissertation studies drew upon a variety of methodologies to address broadly associations between Latinx parent and sibling science support and science intrinsic and utility values while considering family-level and individual-level characteristics. This close examination of these processes among Latinx families further inform gaps in the literature previously outlined. However, several limitations emerged when synthesizing the three studies. Below, I outline these limitations and offer future directions for scholars to consider when studying Latinx families and adolescent motivational beliefs.

Family Higher Education Experience

Although parent or family education was examined for each of the dissertation papers, a notable limitation that emerged was not being able to fully examine associations between family support and adolescent science values by family education experience for all three papers. Studies have noted the resources and capital that come from parents (Chen, 2005; Engle, 2007; Gibbons & Borders, 2010) and older siblings (Carolan-Silva & Reyes, 2013; Ramos Carranza & Simpkins, 2021) who have higher education experience. However, most studies do not explore composition of family education levels and the potential resources and capital that adolescents can draw upon in addition to parents. Because Papers 1 and 2 had parent education as an indicator due to large amounts of missing sibling data or not enough variability in family education (e.g., small *n* for families where both parents and older siblings have higher education), a main aim of Paper 3 was to study parent and sibling education jointly and identifying patterns of support by family education. From those who participated, most came from families where only older siblings had higher education experience while there were only one or two for all other groups. Despite the small number of participants in certain groups, the qualitative findings from this study, which included greater sibling support among families with only siblings with higher education, begin to uncover important patterns and highlight the value of studying both parent and sibling education jointly rather than separately. As argued by family systems theory (Cox, 2010) and the Latino youth development model (Raffaelli et al., 2005), the family is a complex, integrated whole that needs to be studied as a system with considerations of family-level characteristics.

Examining the Role of Fathers

A significant finding that emerged was how often Latina adolescents mentioned the coactivity-related supports that specifically fathers gave them in Paper 3. This finding further emphasizes the need to consider the role of fathers in the development of science motivational beliefs among Latinx adolescents. In the current dissertation, father support was not explicitly investigated and is thus a limitation of all the dissertation studies. Although parent support is often examined in the literature, parent-reports are often mothers, with few looking at father-reported data (Alfaro et al., 2006; Kim & Hill, 2015; Plunkett et al., 2008). Therefore, most parent support studies have been based off mothers while fathers continue to be understudied, especially within the domain of science. Considering the role gender stereotypes and socialization plays within the sciences and motivation (Ceci & Williams, 2007; Eccles & Wigfield, 2020; Eccles, 2007; Su & Rounds, 2015), studying the ways in which fathers and mothers support their children in science separately and jointly and its association to later science motivational beliefs would be an important area to explore. Similar to studies on sibling relationships based off gender composition (Tucker et al., 1997; Updegraff et al., 2005), future studies could explore parent science support by gender composition of parent-child dyads and test whether science motivational beliefs develop differently. For example, would having fathers of daughters who engage in supportive behaviors in science be associated with their daughters' motivational beliefs? How would this compare to fathers of sons? Also, do mothers and fathers engage in similar supportive behaviors in science? Would this differ by adolescent gender? Overall, more studies are needed that consider the role of fathers' support in positive youth development.

Ethnic Heterogeneity within the Latinx Population

A final limitation was not investigating how these processes and indicators function by Latinx ethnic groups. Paper 1 included a diverse Latinx sample, with most reporting being of Mexican descent. Additionally, Paper 2 also had a majority Mexican descent sample while participants in Paper 3 mainly identified as Mexican, Hispanic, or Latinx. Given the growing diversity within the U.S. Latinx population (Noe-Bustamante, 2019), more studies are needed that examine within-group differences in regard to ethnic differences. According to the Pew Research Center, Venezuelans, Dominicans, and Guatemalans had the most population growth compared to other Latinx immigrant groups (Noe-Bustamante, 2019). Given the unique experiences of immigrant groups, including having negative modes of reception that can further increase challenges and barriers for individuals in subsequent generations (Portes & Rumbaut, 2014), this growing diversity warrants new studies that focus on adolescents and families from different ethnic groups.

The Latino youth development model (Raffaelli et al., 2005) would further inform these studies as it specifies the relevance of differing contexts (e.g., historical context) and family and individual characteristics. Moreover, this theoretical framework also calls for examining cultural factors. In the current dissertation studies, I examined the cultural value of familism due to its importance for family dynamics among Latinx families. An additional cultural factor that is related to family processes and which is outlined by the Latino youth development model as specific to immigrant groups is acculturation. Broadly, acculturation is a process where individuals adapt to the cultural patterns of their host society (Buriel, 1993; Rumbaut, 2011). Acculturation, which usually has language as an indicator, has often been linked to educational outcomes among studies that examine adolescents with differing immigrant generational statuses. For example, Portes & Rumbaut (2014) found that second-generation students who were bilingual experienced greater academic achievement and psychosocial adaptations than those who were English monolinguals. These studies have primarily focused on general academic achievement (Brown & Chu, 2012; Feliciano, 2001; Portes & Rumbaut, 2014; Rodriguez et al., 2009) and so a main gap that remains is how acculturative processes are related to Latinx adolescents' science motivation and achievement. In sum, studying these within-group differences can further illuminate where families and adolescents need the most support.

Conclusion

This dissertation aimed to bridge several gaps in the literature related to parent and older sibling science support, Latinx adolescents' science intrinsic and utility values, and relevant family and adolescent-level indicators. A main finding was that parents and older siblings engaged in similar and unique types of support. Also, to an extent, parents gave greater science support when compared to siblings. Another main finding across the papers was that there were significant associations between parent and older sibling science support and adolescents' science utility value but not science intrinsic value. Moreover, there were strong associations between parent science support, adolescents' science utility value and STEM occupational expectations, further highlighting the impact of parent support on science-related outcomes. In terms of differences by adolescent gender, there were almost no differences in indicators and associations by adolescent gender. In contrast, when examining differences by family education, results revealed that parents with greater education were noted to give greater support across the papers. Finally, there were differences only by adolescent familism values, where Latina girls with higher familism values experienced greater parent and sibling science support.

Overall, the findings from the three dissertation studies begin to inform greater understanding of these processes among a largely underrepresented racial/ethnic group in science through a positive youth development perspective. All three studies examined what helped promote Latinx adolescents' science intrinsic and utility values and relevant cultural and background characteristics. Moreover, these studies advocate for more consideration of the role of other family members in adolescents' development addition to parents, as argued by each of the theoretical frameworks used to frame the studies (Cox, 2010; Eccles & Wigfield, 2020; Raffaelli et al., 2005). In summary, findings from these studies help illustrate how Latinx adolescents draw upon their families as a source of strength and source of motivation for their science beliefs and persistence.

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