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RESEARCH ARTICLE

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Longitudinal associations between Latine parents' support and their adolescents' science motivation and STEM career expectations

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Abstract

Introduction: Parents' science support and adolescents' motivational beliefs are associated with adolescents' expectations for their future occupations; however, these associations have been mostly investigated among White, middle-class samples. Framed by situated expectancy-value theory, the current study investigated: (1) the associations between parents' science support in 9th grade and Latine adolescents' science intrinsic value, utility value, and STEM career expectations in 11th grade, and (2) whether these indicators and the relations among them differed by adolescents' gender and parents' education.

Methods: Study participants included Latine adolescents ($n = 3060$; $M_{age} = 14.4$ years old; 49% female) in the United States from the High School Longitudinal Study of 2009.

Results: Analyses revealed a significant, positive association between parents' science support and Latine adolescents' science utility value. Additionally, there was a significant, positive association between parents' science support and Latinas' science intrinsic value, but not for Latinos' science intrinsic value. Latine adolescents' science utility value, but not their science intrinsic value, predicted their concurrent STEM career expectations. Though there were no significant mean level differences in adolescents' science utility value or parents' science support based on adolescents' gender, the measure of adolescents' science intrinsic value varied across girls and boys. Finally, adolescents whose parents had a college degree received greater science support from parents compared to adolescents whose parents had less education than a college degree.

Conclusion: Findings suggest parents' science support and adolescents' intrinsic and utility values have potential associations with Latine adolescents' STEM career expectations near the end of high school.

KEYWORDS

intrinsic values, Latine adolescents, parent support, science motivation, utility values

1 | INTRODUCTION

Limited diversity within science, including racial/ethnic diversity, is a barrier to further innovation and advancement of society. Having a diverse workforce in science affords greater growth in innovation that not only contributes to the global economy (Hong & Page, 2004) but also innovation that reflects and represents the diverse communities within the United States. Occupations that fall within science, technology, engineering, and math (STEM) fields also often require highly skilled workers who have higher salaries compared to other fields (National Center for Science and Engineering Statistics NCSES, 2023). Thus, addressing inequities within STEM fields directly relates to social mobility issues when marginalized groups, including those marginalized because of their race/ethnicity, are met with challenges and barriers when pursuing science careers. Among the Latine[1] population, more Latine adolescents majored in science than in previous years; however, they continue to be underrepresented in STEM occupations. Specifically, Latine individuals represent 19% of the US population, but only 15% of the STEM workforce (National Science Foundation, 2021; U.S. Census Bureau, 2023). Despite this persistent inequity, little is known about the factors that help support Latine adolescents' pursuit of STEM occupations (Starr et al., 2022). Studies on White adolescents suggest that their motivational beliefs and support from parents during high school are related to whether they want to pursue a STEM career (Cox, 2010; Harackiewicz et al., 2012). Scholars argue that studying the development of motivation in relation to family support is instrumental for Latine adolescents who often mention their families are a source of unwavering strength given the marginalization they typically face at school (Puente & Simpkins, 2020).

Most of the prior research on Latine individuals in STEM has largely focused on between-group ethnic/racial differences, with many of these studies focusing on the lower STEM motivational beliefs and achievement of Latine individuals compared to White and Asian individuals (e.g., Andersen & Ward, 2013; Aschbacher et al., 2010). However, these findings and perspectives provide a limited view of Latine adolescents. Latine individuals are quite diverse due to their intersectional identities and varied background characteristics (Causadias et al., 2018). For instance, adolescents' gender and parents' level of education are likely to explain differences among Latine adolescents. The sciences are gender-stereotyped domains and may lead to differences in Latine parents' science support and Latine adolescents' science motivation and STEM career expectations (Starr, 2018). Moreover, whether students' parents earned a college degree is important to consider as first-generation college students (i.e., students' whose parents do not have a college degree) accounted for 44% of the Latine college student population in 2019 (Excelencia in Education, 2019) and is a population that continues to be marginalized in STEM (Chen, 2005; National Science Board, 2018). Thus, the current study aims to investigate: (1) the associations between Latine parents' science support in 9th grade and adolescents' science values (i.e., intrinsic and utility values) in 11th grade (2) the associations between adolescents' science values and their STEM career expectations in 11th grade, and (3) whether these indicators and the relations among them differ by parents' level of education or adolescents' gender.

1.1 | Adolescents' subjective task values

Adolescence is a critical developmental period for individuals' career expectations, with adolescents gaining greater autonomy and choosing whether to enroll in upper-level science courses or not (Eccles et al., 1993; 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 developing strong task value beliefs (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).

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). In a quasi-experimental study among a largely White population, 8th grade adolescents' motivational beliefs were related to career planning (Hiller & Kitsantas, 2014). Relatedly, Banerjee and colleagues (2018) used qualitative data from a larger 20-year longitudinal study and found further evidence of this link between motivational beliefs and career planning among White women in their mid-30s and 40s who mentioned their interest and their perceived value of STEM were related to their career aspirations. 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 White adolescents (Rozek et al., 2015). Though some research on science intrinsic and utility values is based on nationally representative samples that include some Latine adolescents (Andersen & Ward, 2013; Tai et al., 2006), scholars have noted that research conducted among White families and adolescents is sometimes erroneously generalized to all racial/ethnic groups despite the evidence that Latine families and adolescents have differing experiences within the USA (Grau et al., 2009; Raffaelli et al., 2005).

[1]Latine reflects current conversations regarding inclusive terminology and has been adopted across varying fields that have US samples. For a historical review on the terminology regarding Hispanic versus Latino/a versus Latinx/es within the USA, please see Soto-Luna (2023).

1.2 | Parents' science support

According to theory, socialization processes shape individuals' development (Eccles, 2005; Garcia-Coll et al., 1996), 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) influence adolescents' motivational development in that same domain (Eccles, 2005; Fredricks & Eccles, 2005). Thus, parents' academic support during key transitions, such as the transition to high school in 9th grade, would then theoretically be related to later motivational beliefs in the final years of high school as adolescents make plans for their future. Additionally, many of the studies situated within these frameworks note positive associations between parents' supportive behaviors (e.g., visiting science museums together, having conversations about the future; Eccles, 1993; Hill & Tyson, 2009), and adolescents' 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 Latine families, with some qualitative studies highlighting the variety of supportive behaviors that Latine parents engage in, such as helping with homework and having conversations about the future with their adolescents (Ramos Carranza & Simpkins, 2021; Soto-Lara & Simpkins, 2020). Given the centrality of family in Latine cultural values (Stein et al., 2014; Updegraff et al., 2005), we expected parents' science support to be associated with Latine adolescents' motivational beliefs as researchers have found in preliminary work with Latine adolescents (Simpkins et al., 2015).

1.3 | Differences among Latine adolescents in these processes

Situated expectancy-value theory argues that researchers need to consider child and family characteristics to identify *for whom* parents' science support 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 Latine adolescents (e.g., differences by adolescent gender and parent education). 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 individuals' persistence in science due to barriers that girls and first-generation college students face within STEM fields (Leaper & Starr, 2019; Puente et al., 2021).

Historically, boys have been stereotyped to be scientists resulting in girls facing more barriers and discrimination (Leaper & Starr, 2019; Miller et al., 2018). This holds true among Latines, where Latinas face not only discrimination due to their race/ethnicity but also their gender within science fields (Camacho & Lord, 2013). Gender differences among adolescents' motivational beliefs, however, may vary by racial/ethnic group, as noted by a few emerging studies using adolescent samples that find gender differences among some racial/ethnic groups but not others (e.g., Hsieh et al., 2021; Puente et al., 2021). Among Latine adolescents, Simpkins and colleagues (2015) found that Latinas had lower science utility value than Latinos in physics but not in biology or chemistry. More research is needed to test whether gender differences emerge for overall science intrinsic and utility values as well. Other research focuses on gender differences in parents' support, with most studies focusing on White adolescents (Fredricks & Eccles, 2005; Simpkins et al., 2010). The current research suggests that parents' support and beliefs are generally greater for boys than girls in both math and science (see Wang & Degol, 2013 and Starr et al., 2022). More work needs to be done on whether these findings are similar or different among Latine families. Lastly, in regard to STEM career expectations, studies have shown that existing marginalized populations within STEM, including adolescent females and individuals from a low socioeconomic class, are less likely to be interested in a STEM career compared to dominant groups, such as males or those coming from a higher socioeconomic status (Mau & Li, 2018; Saw et al., 2018).

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

Theoretically, parents' characteristics, such as their level of education, should also be related to adolescents' science intrinsic, utility values, and career expectations (Eccles, 2005). Several scholars have focused specifically on parents' educational backgrounds, with many emphasizing how having at least one parent with a college degree (i.e., an associate's or higher) gives adolescents greater social and cultural capital that is then related to higher academic achievement and overcoming challenges (Engle, 2007; Gibbons & Borders, 2010). In some studies with adolescent samples, parents with college degrees are better able to help adolescents with homework, engage in conversations about career aspirations, and also use connections to further adolescents' educational goals (Aschbacher et al., 2010; Ramos Carranza & Simpkins, 2021).

Studies examining interest in and expectations for a STEM career also suggest that those coming from a higher socioeconomic status are more likely to be interested in a STEM career compared to those coming from a lower income background (Mau & Li, 2018; Saw et al., 2018). Due to the large portion of Latine adolescents whose parents have less than a college degree (Postsecondary National Policy Institute, 2020), this remains an important family characteristic to study when testing the correlates of adolescents' science motivation and career expectations.

First-generation college students (i.e., students whose parents have less than a college degree) are underrepresented in science college majors and tend to have lower motivational beliefs compared to continuing-generation college students whose parents have college degrees (Chen, 2005; Puente et al., 2021). Science intrinsic value is also 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 the differences evident in college are also prevalent in high school. The few studies on college generational status and science motivational beliefs using the HSLS data set find that first-generation college students have lower motivational beliefs in high school, including subjective task values, compared to their continuing-generation college counterparts (Jiang et al., 2020; Snodgrass Rangel et al., 2020). However, these studies collapsed all racial/ethnic groups; to our knowledge, no study has examined these science process-level differences by parent education among Latine adolescents.

1.4 | Current study

Several gaps remain in our understanding of normative developmental processes concerning Latine adolescents' science motivational beliefs and parent processes. We hypothesized that parents who gave greater science support in 9th grade would be related to stronger science intrinsic and utility values in 11th grade for Latine adolescents. We also expected Latine adolescents' 11th grade science values to positively predict their 11th grade STEM career expectations. Lastly, these science-related indicators and associations could differ by adolescents' gender (Leaper & Starr, 2019) as well as by parents' educational levels (Engle, 2007; Gibbons & Borders, 2010). For our last research aim, we hypothesized that female adolescents and, separately, adolescents whose parents had less than a college degree would have a lower probability of having a STEM career expectation, lower science intrinsic and utility values, as well as lower parent support compared to male adolescents and those with parents with college degrees, respectively. Also, we expected the relations between parents' support, adolescents' science values, and STEM career expectations would be stronger for males and stronger for adolescents who have parents with college degrees compared to their peers.

2 | MATERIALS AND METHODS

2.1 | Participants

This study included Latine adolescents and their parents from the High School Longitudinal Study (HSLS) of 2009. 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).[2] This study focuses on the Latine subsample comprised of 4000 adolescents and their parents. From that sample, we excluded Latine adolescents who did not have 11th grade intrinsic and utility values or who did not have parent education information ($n = 950$; see Tables 1 and 2 for descriptive statistics). The final analytic sample had 3060 Latine adolescents and their parents. As shown in Table 2, only three of the 10 comparisons evidenced a small or moderate difference between the analytic sample ($n = 3060$) and the excluded sample ($n = 950$). Specifically, adolescents in the excluded sample had greater parent science support, lower 9th grade GPAs, and a higher family income compared to the final analytic sample. Among the analytic sample ($n = 3060$; 49% female; 81% US born; *M age* = 14.4 years), 34% of adolescents had at least one parent with a college degree (i.e., parents had at least an associate's degree) and the average annual family income was around $55,000. In terms of ethnic heritage, most identified as Mexican, Mexican–American, or Chicano (50%), with the remaining adolescents identifying 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). The analytic sample is representative of the US Latine population, who share similar rates of ethnic heritage, family income, and education levels, according to the Pew Research Center (Krogstad et al., 2023).

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

2.2 | Procedures

All procedures abided by ethical guidelines. The original study was reviewed and approved by the federal Office of Management and Budget, and informed consent/assent was obtained from all participants. For a list of items for each measure, see Supporting Information.

2.3 | Measures

2.3.1 | Adolescents' 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 value. Science intrinsic value in 11th grade was measured using three items (α = .79) that indicated whether adolescents experienced enjoyment, boredom, and if they believed their science course was a waste of time or not. Science utility value in 11th grade referred to how useful adolescents believed science was for their future and was 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). When necessary, items were reverse coded so higher scores indicated stronger science intrinsic and utility values (1 = *Strongly Disagree* to 4 = *Strongly Agree*).

2.3.2 | Adolescents' STEM career expectations in 11th grade

Adolescents reported the job they expected or planned to have at age 30. Adolescents were coded as having a STEM career 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 Center for Science and Engineering Statistics NCSES, 2023; National Science Board, 2018). These occupations included those needing a college degree or higher as well as occupations that did not require a college degree, as both types of occupations are part of the US STEM workforce (National Center for Science and Engineering Statistics NCSES, 2023).

2.3.3 | Parents' science support in 9th grade

In 9th grade, parents and adolescents reported on nine different types of science-related support provided by parents, such as engaging in science activities together (e.g., visiting a science museum). These items cover a range of behaviors parents use to support adolescents academically, with many of the items relating to home-based involvement strategies and academic socialization, as shown in previous research (Fredricks & Eccles, 2005; Hill & Tyson, 2009). Though the nine items cover a range of behaviors, they were summed because, according to situated expectancy-value theory, although any one parent might not engage in all of these various types of support, they are all theorized to have similar impacts on adolescents' motivational beliefs (Hsieh & Simpkins, 2022). Bradley (2004) named such indicators as cause indicators because even though the behaviors might be different, they are all theoretically expected to cause or influence the same outcome in adolescents. Scholars have used cause indicators with the Home Observation Measurement of the Environment to assess the family environment and risk scales (Bradley, 2004). Higher scores on the indicator note the adolescent receives more science support from parents.

2.3.4 | Adolescents' 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*).

2.3.5 | Parents' college education

Parents' college 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). Adolescents were divided into two categories: those with at least one parent who had a college degree and those whose parents who had less than a college degree (0 = *Parents had less than a college degree*, 1 = *At least one parent had a college degree or higher*).

2.3.6 | Covariates

Adolescents' GPA in 9th grade, adolescents' nativity, family income, and family language 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) as well as their associations found in prior literature to parents' support, adolescents' motivational beliefs, and adolescents' STEM career expectations (Davis-Kean, 2005; Koenka et al., 2021; Mau & Li, 2018; Urdan et al., 2007). Adolescents' nativity referred to whether the adolescent was US or foreign-born (0 = *Foreign-born*, 1 = *US born*). Due to the historical background behind Puerto Rico and the identification of Puerto Ricans, those who were born in Puerto Rico were also considered foreign-born despite their US citizen status (Duany, 2003; Rivera Ramos, 2001). Adolescents' GPA at 9th grade referred to a composite GPA based on all of the courses that adolescents had taken throughout 9th grade (0–4.0 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*).

2.4 | Data analysis plan

The current study examined associations between parents' science support, adolescents' science utility and intrinsic values, adolescents' STEM career expectations, as well as how these indicators and associations varied by parents' education and separately adolescents' gender (see Figures 1 and 2). 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 data set, strata, primary sampling units, and weights were utilized to account for nonresponse and to reduce bias. 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 < 0.08, an RMSEA < 0.05, and a CFI/TLI > 0.90 (Hu & Bentler, 1999).

Before estimating the SEMs to test the hypotheses, measurement invariance of adolescents' intrinsic and utility values was tested to examine if the constructs were similar across gender and parents' education (Bialosiewicz et al., 2013; Little, 2013). Measurement invariance was analyzed among boys and girls and, separately, among adolescents whose parents did or did not have a college 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 Supporting Information S1: Table S1). 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 were different constructs for Latinas and Latinos and could not be compared.

The SEMs were estimated for the analytic sample ($n = 3060$) to address our first and second research aims related to associations between parents' support, adolescents' science values, and adolescents' STEM career expectations (see Figure 1). Covariates in every model included adolescents' nativity, adolescents' GPA in 9th grade, family language, and family income. These covariates were used to predict all study variables. Parents' science support at 9th grade was an observed variable. Adolescents' science intrinsic and utility values at 9th grade were latent variables each composed of the three items outlined in the measures. Two separate models were estimated; one model included adolescents' science intrinsic value, and the other model included science utility value. Within these models, the associations between parents' science support, adolescents' science intrinsic or utility value, and adolescents' STEM career expectations were examined. Direct and indirect effects from parents' science support to adolescents' STEM career expectations via their science intrinsic or utility value were also estimated.

The third research aim was to understand the extent to which the means and processes differed by (a) adolescents' gender and (b) parents' education. Because strong invariance was not achieved for adolescents' 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., parents' education) followed by a Wald test for all continuous study variables (i.e., science intrinsic value, science utility value, and parents' science support) and estimating a logistic regression with controls and the variable of interest for STEM career expectations.

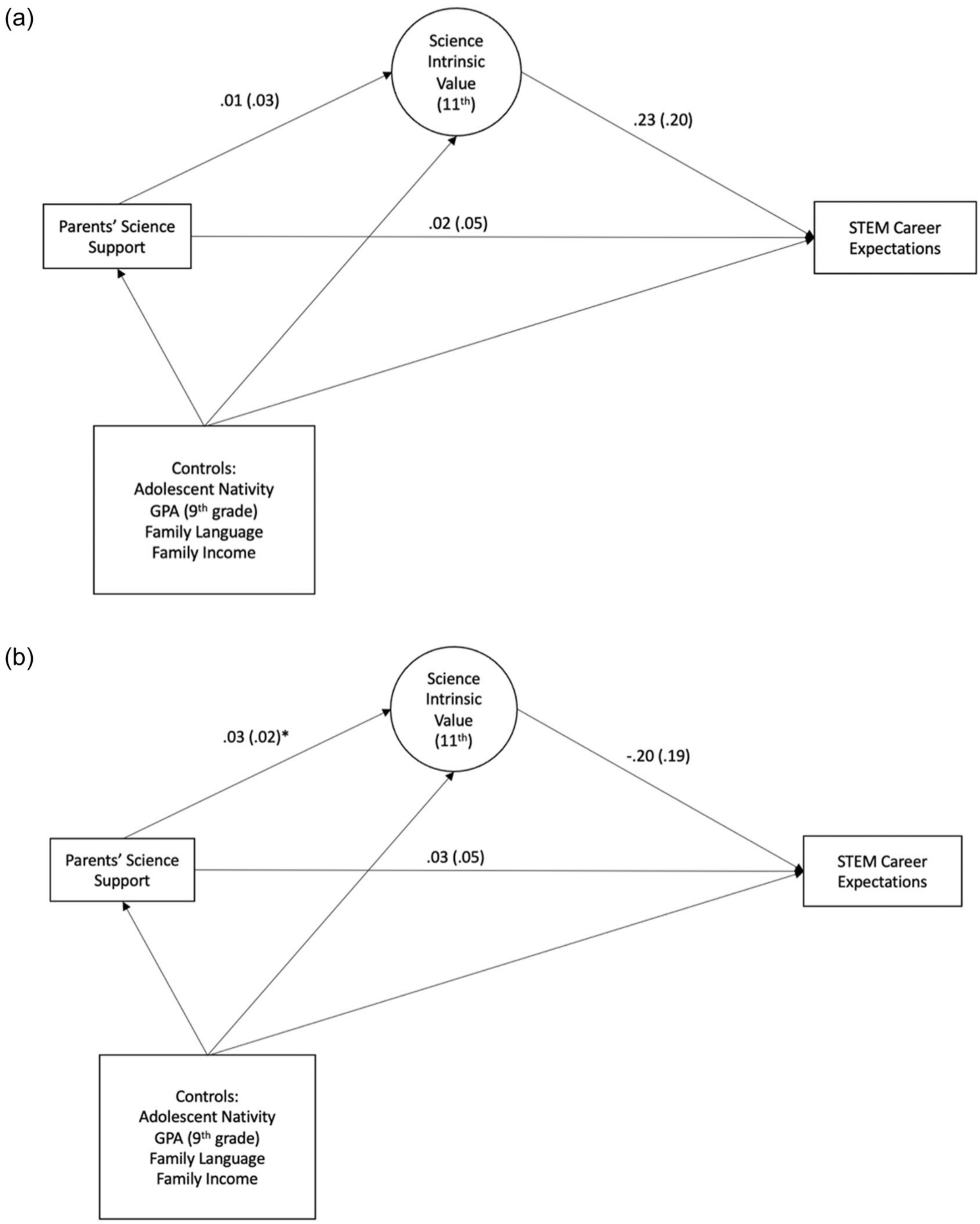

FIGURE 1 Science intrinsic value models for boys and girls. *Note*: Unstandardized estimates are presented along with the standard error in parenthesis. $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$. *Source*: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, High School Longitudinal Study of 2009 (HSLS:09), Base Year, First Year Follow-Up. (a) Boys. (b) Girls.

To test for differences in the relations by adolescents' gender and by parents' education, the SEM model was re-estimated through multi-group analyses. Specifically, two multi-group models were estimated: (1) a model where the three paths among parents' science support, adolescents' values, and adolescents' STEM career 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 the relations differed across groups (Muthén & Muthén, 2012; Satorra & Bentler, 2001). If the change in Chi-square was statistically significant, we estimated follow-up models to test which specific paths differed by group (Little, 2013). Because adolescents' science intrinsic value did not exhibit strong measurement invariance across gender, only the science utility value model was tested for relational differences by gender. Additionally, relational differences based on parents' education were tested on the science utility value model and the two separate science intrinsic value models estimated for boys and girls.

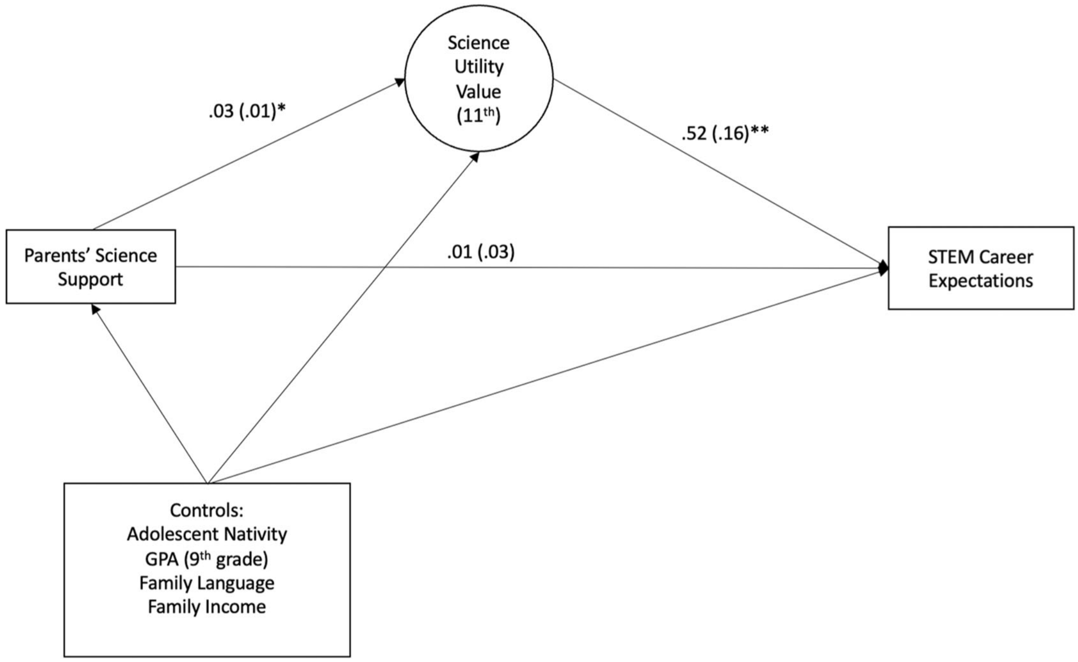

FIGURE 2 Science utility value model. *Note*: Unstandardized estimates are presented along with the standard error in parenthesis. **p* < .05, ***p* < .01, ****p* < .001. *Source*: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, High School Longitudinal Study of 2009 (HSLS:09), Base Year, First Year Follow-Up.

2.4.1 | Missing data

Within the analytic sample, 1870 participants had complete data, whereas 1190 participants had one or more pieces of missing information among the study variables (see Supporting Information S1: Table S2 for comparisons). To address the missing data, full information maximum likelihood was utilized in Mplus, which uses all available data to estimate missing values (Enders, 2010).

3 | RESULTS

3.1 | Descriptive statistics

Latine adolescents in 11th grade, on average, agreed that science had intrinsic and utility value (see Table 1). Moreover, 36% of the 11th grade Latine adolescents expected to have a STEM-related career when they were older. Parents on average engaged in about three science-related supportive behaviors.

There were also several significant associations between the indicators. There were moderate, positive associations between adolescents' science intrinsic and utility values at 11th grade, 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 parents' science support in 9th grade and adolescents' science intrinsic and utility values in 11th grade. Regarding parents' education, parents who had a college degree tended to give greater science support compared to those who did not have a college degree. Lastly, there was a small positive association between adolescents' gender and their STEM career expectations, such that Latinas had higher STEM career expectations compared to Latinos.

3.2 | The associations between parents' science support, and adolescents' science values and STEM career expectations

Two separate models were estimated to test the associations between parents' science support with adolescents' science intrinsic or utility value and STEM career expectations. As shown in Figure 1, both the science intrinsic value models had adequate model fit for boys: χ^2 (12) = 17.10, p = .15, CFI = 0.91, RMSEA = 0.017, SRMR = 0.057; and for girls: χ^2 (12) = 22.89, p = .03, CFI = 0.922, RMSEA = 0.024, SRMR = 0.035. As shown in Figure 2, the science utility value model evidenced excellent

TABLE 1 Descriptive statistics of study variables.

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

[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.

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

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.

model fit, χ^2 (12) = 9.74, $p = .64$, CFI = 1.00, TLI = 1.00, RMSEA = 0.00, SRMR = 0.015. The following control variables were included in all models: adolescents' nativity, adolescents' 9th grade GPA, family language, and family income (see Supporting Information S1: Tables S3 and S4 for more details).

We expected parents' science support to positively predict adolescents' science intrinsic value, which in turn would positively predict their STEM career expectations. The models partially confirmed our first hypothesis for Latinas (Figure 1a), but not for Latinos (Figure 1b). Latinas who had greater science support from parents in 9th grade were likely to have greater science intrinsic value in 11th grade. However, this same association was not statistically significant for Latinos. Both Latinos' and Latinas' science intrinsic value was not significantly associated with their STEM career expectations in 11th grade. Lastly, direct and indirect effects were examined from parents' science support to adolescents' STEM career expectations via science intrinsic value. There was no direct effect or indirect effect present for Latinas (direct effect: B = 0.03, SE = 0.05. $p = .61$; indirect effect: B = −0.01, SE = 0.01, $p = .40$). or for Latinos (direct effect: B = 0.02, SE = 0.05, $p = .72$; indirect effect: B = 0.00, SE = 0.01, $p = .66$).

We also expected parents' science support to positively predict adolescents' science utility value in 11th grade and for science utility value to predict STEM career expectations. Both hypotheses were supported, as shown in Figure 2. Greater parent science support was related to greater adolescent science utility value. Additionally, adolescents with a greater science utility value were more likely to expect to have a STEM career when they were older. Though there was no significant direct effect between parents' science support and adolescent STEM career expectations (B = 0.01, SE = 0.03, $p = .89$), there was a significant indirect effect for parents' science support on adolescents' STEM career expectations through adolescents' science utility value (B = 0.02, SE = 0.01, $p = .01$).

3.3 | Mean-level differences by adolescents' gender and parents' education

The findings indicated that there were no significant gender differences in adolescents' science utility value (B = −0.06, SE = 0.07, $p = .45$) nor parents' science support (B = 0.06, SE = 0.25, $p = .80$) (see Table S5). There was, however, a trend-level difference in adolescents' STEM career expectations by gender (OR = 1.73, B = 0.55, SE = 0.28, $p = .05$), such that the odds of having a STEM job expectation for Latinas is 1.73 times that of Latinos. Thus, Latinas had a higher probability of having a

TABLE 2 Descriptive statistics of participants in the analytic and excluded samples.

	Analytic sample			Excluded sample			t-Test or Chi-square test[1]	Effect size
	N	*M* (SE)/%	Min/max	*N*	*M* (SE)/%	Min/max		
Study variables								
Adolescents' science intrinsic value (11th grade)	3060	2.81 (0.04)	1/4	910	2.80 (0.12)	1/4	.53	0.09[a]
Adolescents' science utility value (11th grade)	3060	3.01 (0.04)	1/4	910	2.99 (0.15)	1/4	1.35	0.20[a]
STEM career expectations (11th grade)	2770	36%	0/1	660	34%	0/1	4.06*	−0.03[b]
Parents' science support (9th grade)	3050	3.34 (0.14)	0/9	950	3.57 (0.31)	0/9	8.69***	0.36[a]
Female (adolescent)	3060	49%	0/1	950	46%	0/1	5.41*	−0.04[b]
Parents had a college degree	3060	34%	0/1	260	37%	0/1	4.97*	−0.04[b]
Covariates								
GPA (9th grade)	2970	2.35 (0.05)	0/4	940	2.10 (0.19)	0/4	11.30***	0.51[a]
US born (adolescent)	2540	81%	0/1	520	73%	0/1	4.67*	−0.04[b]
Family income	3060	3.18 (0.10)	1/13	950	3.32 (0.35)	1/13	4.58***	0.23[a]
Family language	2150	72%	0/1	420	84%	0/1	1.49	0.02[b]

Note: Frequencies displayed are weighted for both samples. Comparisons were made between the Latine analytic sample and the Latine excluded sample. Latine adolescents 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: 0.20, moderate effect: 0.50, large effect: 0.80.

[b]Indicates Cramer's V was used for measuring effect size among Chi-square tests for dichotomous variables. Standard interpretation: small effect: 0.10, moderate effect: 0.30, large effect: 0.50.

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

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.

STEM career expectation compared to Latinos in 11th grade. Mean-level differences in adolescents' science intrinsic value by gender were not tested due to a lack of measurement invariance across girls and boys.

The findings indicated that there were no significant differences in parents' education for adolescents' science utility value (B = −0.01, SE = 0.07, $p = .91$) nor their STEM career expectations (OR = 0.83, B = −0.19, SE = 0.28, $p = .51$) (see Table S6). There were also no significant differences in parents' education for Latinas' (B = −0.14, SE = 0.13, $p = .27$) and Latinos' (B = 0.03, SE = 0.13, $p = .82$) science intrinsic value. However, in support of our hypothesis, adolescents whose parents had a college degree reported greater parent science support than adolescents whose parents had less education than a college degree (B = 0.55, SE = 0.23, $p = .02$).

3.4 | Relational differences by adolescents' gender and parents' education

Due to a lack of measurement invariance in adolescents' science intrinsic value by gender, we examined the differences based on parents' education within Latinos and, separately, within Latinas (as shown in Figure 1a,b). We expected the relations would be stronger for adolescents whose parents had a college degree when compared to their peers. Contrary to our hypothesis, there were no relational differences based on parents' education for Latinos ($\Delta\chi^2$ [3] = 4.38, $p = .22$) or for girls ($\Delta\chi^2$ [3] = 1.86, $p = .60$) based on the nonsignificant chi-square difference tests. Thus, the relations between parents' science support, adolescents' science intrinsic values, and adolescents' STEM career expectations, as shown in Figure 2, did not significantly vary based on parents' education.

Under this research aim, we hypothesized that the relations among the science utility value model shown in Figure 2 would be weaker for Latinas than Latinos, and weaker for adolescents whose parents who did not have a college degree compared to those whose parents had a college 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 based on parents' education ($\Delta\chi^2$ [3] = 3.53, $p = .32$). Thus, the relations between parents' science support, adolescents' science utility value, and adolescents' STEM career expectations did not significantly vary by adolescents' gender nor parents' education.

4 | DISCUSSION

According to the situated expectancy-value theory, individuals' motivational beliefs help determine their choices and eventual persistence in a variety of subjects, including science (Eccles & Wigfield, 2020). Coupled with the importance of adolescence as a period for the development of motivational beliefs and career expectations, we found that greater parents' science support in 9th grade predicted adolescents' 11th grade science utility values for Latinos and Latinas and their intrinsic value for Latinas. Moreover, having greater science utility value was associated with being more likely to have a STEM career expectation among Latine adolescents. Finally, we found that though there were some mean-level differences based on adolescents' gender and parents' level of education (e.g., parents with a college education providing more science support), the relations among these indicators did not vary across groups. Below, we discuss these major findings.

4.1 | Associations between parents' science support and Latine adolescents' science values and STEM career expectations

The study findings largely align with situated expectancy-value theory (Eccles & Wigfield, 2020) and prior studies on mainly White adolescents that find parents' support is related to greater subjective task values (Gottfried et al., 2009; Hsieh et al., 2019). The current findings extend prior work by testing the extent to which similar processes emerge for Latine adolescents, who are often marginalized in science and school more broadly (Beasley & Fischer, 2012; McGee, 2016). Moreover, these findings confirm that parents' support is a source of strength for Latine adolescents and provide further insight into what some of these positive parenting science processes look like specifically for Latine adolescents using a large sample of Latine families.

Though situated expectancy-value theory argues that parents' support should have a similar influence on adolescents' utility and intrinsic values (Eccles & Wigfield, 2020; Eccles, 1993), our findings, as well as the work of other scholars, suggest their influence may be less systematic for adolescents' intrinsic values. Many of the STEM value interventions target changing students' utility value, not their intrinsic value (Harackiewicz et al., 2012). It is unclear if it is more challenging to change students' intrinsic value when they are simply not interested in science, or they are more interested in something else (Jacobs et al., 2005). In our study, we found that parents' science support predicted science intrinsic value for Latinas but not for Latinos. Parents' science support might be more critical for Latinas because they face discrimination and barriers in science due to both their gender and race/ethnicity, which can result in marginalization and a low sense of belonging (Johnson, 2011; Rodriguez & Blaney, 2021). Parents' science support may work as a protective factor for the development of interest in science for Latinas. Alternatively, it is also possible that negative processes that influence boys of color in the classroom are challenging for parents to help overcome (Musto, 2019). More work is needed to examine what might be driving these gender differences, namely if parents are more influential for Latinas or if Latinos are facing too many structural barriers to overcome.

The associations between adolescents' values and their STEM career expectations were also less consistent for Latine adolescents' intrinsic value compared to their utility value. Our findings on the positive associations between adolescents' utility value and their STEM career expectations align with situated expectancy-value theory (Eccles & Wigfield, 2020) and previous research showing that adolescents who think science useful are more likely to expect to achieve a career in STEM (Banerjee et al., 2018; Hidi & Renninger, 2006; Hiller & Kitsantas, 2014; Jiang et al., 2020). The current findings also raise questions about the extent to which intrinsic values are associated with adolescents' STEM career expectations among Latine populations, which is inconsistent with prior work on other racial/ethnic groups. For example, research among White populations suggests that students' science intrinsic values are associated with their STEM career expectations (Banerjee et al., 2018; Hiller & Kitsantas, 2014). One possible explanation could be that interest in science may not be enough for Latine adolescents to continue pursuing STEM since they may be experiencing challenges and barriers (i.e., costs as outlined by situated expectancy-value theory) that White adolescents may not be facing (Garcia Coll et al., 1996). Meanwhile, a greater science utility value may offset the costs associated with pursuing STEM (Eccles & Wigfield, 2020). Overall, this difference by racial/ethnic group confirms that one should not assume the findings from one group can be generalized to other groups. Furthermore, this emphasizes the need to study each subjective task value as they may have different associations.

4.2 | Differences based on adolescents' gender

Situated expectancy-value theory argues that adolescents' gender shapes the individual and parenting processes around science as it is a gender-stereotyped domain (Eccles & Wigfield, 2020). Our results are adding to the growing literature suggesting that there are often mean-level differences based on gender (which we discuss in more detail next), but the associations are similar for boys and girls (Hsieh et al., 2019; Simpkins et al., 2018). For example, Simpkins and colleagues'

(2018) also found that parents' support evidenced similar associations with Latinas' and Latinos' science motivational beliefs. Our findings, however, diverge from the literature in terms of gender differences in the indicators. We mainly found gender similarities, 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.

This work also underscores the importance of testing whether group differences change over time. For example, we found at the trend level that Latinas were more likely to expect having a STEM career compared to Latinos, which was contrary to our hypothesis. Both Latinas and Latinos face significant barriers and challenges when pursuing science, such as negative stereotypes based on their race/ethnicity (Beasley & Fischer, 2012; Strayhorn et al., 2013), and Latinas face additional barriers due to their gender. However, this finding may be indicative of the growing resources and support for underrepresented racial/ethnic minorities and women in STEM that may be supporting Latinas' STEM pursuits. These societal shifts may also play a role in parent socialization processes. Another main finding was that parents of Latinas and Latinos provided similar levels of science support, which diverges from other findings based on White adolescents where parents' support is typically greater for boys compared to girls (Fredricks & Eccles, 2005; Simpkins et al., 2010). Among Latine families, parents tend to have high educational expectations of their children regardless of gender (Cabrera & Padilla, 2004; Suizzo & Stapleton, 2007). Moreover, qualitative studies have indicated that within the domain of science, Latine parents engage in many supportive behaviors (Soto-Lara & Simpkins, 2020; Ramoz Carranza & Simpkins, 2021). Thus, Latine parents may not engage in gendered socialization practices present for other populations when it comes to science, which may be tied to historical shifts. Given numerous interventions and efforts to increase diversity, emerging studies have begun to focus on the potential historical changes regarding gender differences but in math (Rubach et al., 2022). Studies focused on gender differences within science would also be beneficial in underscoring any potential historical changes that have impacted adolescents' science motivational beliefs and parent socialization processes.

4.3 | Differences based on parents' education

Despite various nonsignificant mean-level and relational differences by parents' education in the current study, there are still various insights to consider. Aligned with various studies on parents' support, parents who had a college degree provided more science support than their peers with less education (Aschbacher et al., 2010; Ramos Carranza & Simpkins, 2021). However, contrary to situated expectancy-value theory (Eccles & Wigfield, 2020) and studies on first-generation college students (Chen, 2005; Puente et al., 2021), parents' education was not directly related to Latinas' and Latinos' science values and STEM career expectations. These findings may still point to indirect associations between parents' education and science values and STEM career expectations through parent behaviors (e.g., help with homework, engaging in conversations about career expectations) and beliefs (Eccles, 2005; Ramos Carranza & Simpkins, 2021). For example, studies on parents' support for first-generation college students (i.e., students who have parents with less than a college degree) have noted that regardless of parents' education, parents support their adolescent (Nichols & Islas, 2016). As found in this study and in others, parents' support has direct associations to adolescents' motivational development. Thus, parents' education may be indirectly associated with science values and STEM career 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 parents' education and adolescents' science values.

Differences could also emerge at the relational level. However, our findings indicated that the associations for the science intrinsic and science utility value models did not vary by parents' education. The processes in the current study among Latine adolescents may not vary by parents' education since they may have similar experiences (e.g., negative stereotypes) in science regardless of their parents' education (McGee, 2016; Strayhorn et al., 2013). Moreover, these findings suggest that Latine adolescents have similar relations between parents' support, adolescents' science values, and adolescent STEM career expectations regardless of parents' education.

4.4 | 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 data set. However, there were also limitations. For example, emerging studies on family support draw attention to the importance of siblings for development, including the development of science motivational beliefs (Puente & Simpkins, 2020; Ramos Carranza & Simpkins, 2021). Additionally, although we were able to test predictors of adolescents' STEM career expectations, the indicators provided by this national data set do not provide the opportunity to further explore how marginalized adolescents think about science and how they fit within STEM occupations as described by Gottfredson's theory of circumscription and compromise (Gottfredson, 1981). Lastly, the current study was not able to examine differences in these processes by specific science domains, such as chemistry or physics, but rather focused on the general science domain. Given the different gender compositions by science fields (National Center for Science and Engineering Statistics NCSES, 2023), another area of study would be to re-examine these processes by specific science domains where gender differences may be more likely to emerge.

Another main limitation was that the data set did not capture cultural factors associated with Latine families and barriers that Latine 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) and that 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 strengths and barriers that are related to developmental processes that are relevant to Latine families, such as adolescents' nativity, acculturative stress, and familism values (Raffaelli et al., 2005). Examining adolescents' nativity, in particular, would further unpack the within-group variability among Latines as these processes and measured variables may differ by immigrant versus nonimmigrant experiences, as theorized by scholars that study Latine populations (Raffaelli et al., 2005).

5 | CONCLUSION

Our findings indicated that parents' science support was predictive of Latine adolescents' science utility value for all and science intrinsic value for Latinas but not Latinos. Additionally, only Latine adolescents' science utility value was associated with their STEM career expectations. Significant findings related to mean-level differences were that Latinas were more likely to have a STEM career expectation than Latinos and that parents with a college degree gave greater support in science. Finally, the processes did not vary by adolescents' gender nor parents' education. Overall, the current study findings contribute to the literature on what these processes look like for an underrepresented population in science. These findings further inform what constructs and processes are related to STEM career expectations, which are related to later persistence.

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CONFLICT OF INTEREST STATEMENT

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

DATA AVAILABILITY STATEMENT

The datasets generated and/or analyzed during the current study are available in the IES National Center for Education Statistics repository, https://nces.ed.gov/surveys/hsls09/hsls09_data.asp.

ETHICS STATEMENT

Data examined were from the High School Longitudinal Study (HSLS) data set through an NSF-funded project, which was approved by the Institutional Review Board at the University of California Irvine. The original study was reviewed and approved by the federal Office of Management and Budget (see https://nces.ed.gov/pubs2018/2018140_AppendixesA-F.pdf). Informed consent/assent was obtained from all individual participants included in the study (see Appendix E in https://nces.ed.gov/surveys/hsls09/pdf/2011328_1.pdf).

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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