



Parent and Sibling Science Support for Latinx Adolescents

Perla Ramos Carranza¹ · Sandra D. Simpkins¹

Received: 8 September 2020 / Accepted: 18 February 2021
© The Author(s), under exclusive licence to Springer Nature B.V. 2021

Abstract

Although previous literature indicates that parents and siblings each provide key support for Latinx adolescents' academic success, most studies have not considered how parents and siblings work as a system to support adolescents in science. Informed by theories on family systems and family influence on youth's achievement and education, this study aimed to (a) identify what Latinx adolescents believed were the most helpful ways that parents and siblings supported them in science, and (b) explore whether family science support varied based on parents' science education. Using a qualitative approach, semi-structured interviews from 90 Latinx adolescents (mean age = 15.54 years; 38% girls; 84% born in the U.S.) were analyzed using inductive and deductive approaches. We found that parents and siblings supported Latinx adolescents in science through various home-based strategies: active engagement (classwork help and monitoring), academic socialization (encouragement, conversations about the future, and advice) and providing resources (material and social resources). Adolescents mentioned their older siblings were particularly helpful in providing class-specific support based on the science classes that they had previously taken. Additionally, our findings suggest that siblings relied more on classwork help from only older siblings in families where parents did not take any high school science classes compared to families where parents took some high school science classes. Overall, this study highlights the complementary science support that parents and siblings provide Latinx adolescents and the valuable role that siblings can play in Latinx families when parents have limited science education.

Keywords Latinx · Adolescents · Parents · Siblings · Academic support · Science

✉ Perla Ramos Carranza
pramosca@uci.edu

¹ 3200 Education Building, School of Education, University of California, Irvine 92697, USA

1 Introduction

In our modern globalization era, scientific literacy and knowledge are critical for individual and societal well-being (Turiman et al. 2012). Thus, it is essential to address the marginalization of certain groups from participating in science education and fields (Allen-Ramdial and Campbell, 2014). Latinxs¹, who are the largest ethnic minority group in the United States, representing 16% of the population, only account for 8% of the science and engineering workforce (National Science Foundation 2019). Throughout their educational trajectories, Latinxs often face several challenges, such as discrimination and under-resourced schools that negatively impact their academic achievement (Conchas 2001; DeGarmo and Martinez 2006; Lopez 2003; Valenzuela 1999). In science for instance, Latinx youth are more likely to be placed in low-academic tracks where they take remedial classes instead of the advanced classes that would enrich their knowledge of science (Gandara 2006; Solorzano and Ornelas 2004; Taningco et al. 2008). High school is an important time to understand the science educational experiences of Latinx youth as adolescents' high school science courses, performance, and beliefs predict whether they pursue science-related college majors and careers (Jiang et al. 2020; Maltese and Tai 2011; Robinson 2003).

In order to address the challenges that Latinx high school students face in their science education, it is important to examine sources of support that help them succeed. For example, parent academic support has been linked to Latinx youth's overall academic motivation and performance and has been found to be a protective factor against discrimination (Altschul 2011; DeGarmo and Martinez 2006; Hsieh et al. 2019; LeFevre and Shaw 2012; Simpkins et al. 2018; Simpkins et al. 2015b). Siblings are also key socializers in the development of youth but their role in providing academic support has been under-researched compared to that of parents (McHale et al. 2012; Puente and Simpkins 2020). As suggested by family systems theory, parent-adolescent and sibling-adolescent processes should be considered simultaneously as they likely influence each other and co-determine adolescent development (Cox and Paley 1997). Scholars suggest that sibling academic support is especially important among Latinx families when parents are unfamiliar with the American education system (Azmitia et al. 1996; Sanchez et al. 2006). When applied to specific subjects like science, parents' level of science education may influence the science support they provide their children as well as the science support siblings provide. Thus, this study adds to the existing literature by examining (a) what Latinx adolescents believe are the most helpful strategies that parents and siblings use to support them in science, and (b) whether parent and sibling science support varied depending on the parents' level of science education.

¹ Latinx refers to people of Latin American origin or descent, such as Mexican descent. Latinx was used over Latino/a because it is a gender-neutral and gender-inclusive term as opposed to Latino/a, in which the gender binary is implicit.

1.1 Parent Science Support

The previous literature concerning family influences on youth's academic outcomes has largely focused on parents. Eccles' (1993) parent socialization model, Hill and Tyson's (2009) academic socialization model, and Epstein's (2010) school, family, and community partnership model, are common, traditional frameworks of parent influences on youth's academic outcomes (e.g., academic motivational beliefs, achievement). Each framework argues that parents influence their children's motivational beliefs and achievement through a variety of strategies (Eccles 1993; Eccles and Harold 1996; Epstein 2010; Hill and Tyson 2009). These models typically include aspects of school-based involvement (e.g., attending parent-teacher conferences), home-based involvement (e.g., helping with homework, providing resources), and academic socialization (e.g., conveying messages about their beliefs and expectations, providing advice, conveying the value of education, encouragement).

Although Latinx parents face several challenges to their school-based involvement, such as language barriers and inflexible working hours, they are involved in a variety of home-based and academic socialization strategies that positively relate to their children's academic outcomes (Altschul 2011; Ceballo et al. 2014; Mena 2011; Zarate 2007). Two home-based strategies that have been well-documented within the Latinx parent involvement literature are monitoring (e.g., ensuring that homework is done) and provision of educational resources (e.g., providing a space for working at home, buying materials for school projects, paying for afterschool science programs or summer science camps; Altschul 2011; Auerbach 2007; Azmitia et al. 1996; Delgado-Gaitan 1992; Goldsmith and Kurpius 2018; Mena 2011). In addition, Latinx parents' academic socialization, such as having conversations about careers and college, has been associated with their children's positive academic engagement and achievement (Carranza et al. 2009; Ceballo et al. 2014; Rivas-Drake and Marchand 2016). Latinx parents may also engage in academic socialization by capitalizing on their unique sociocultural knowledge and experience. For example, parents may use *consejos* (advice and stories) about their struggles in low-paying jobs to emphasize the value of education and motivate their children to remain in school (Auerbach 2007; Delgado-Gaitan 1994; Stanton-Salazar 2001). Most of this literature on Latinx families, however, has focused on academics overall and more work is needed to understand how Latinx families support students in specific subjects.

The literature that has been conducted on Science, Technology, Engineering, and Mathematics (STEM) education highlights the important role of parent involvement for youth's science identity, achievement, and motivation, including those who are Latinx (Archer et al. 2012; Šimunović and Babarović 2020; for studies focused on Latinx youth see Kang et al. 2019; Navarro et al. 2007; Simpkins et al. 2018; Simpkins et al. 2015b). For example, Latinx and White adolescents' reports of their parents' coactivity, positivity, and school-based behaviors was associated with adolescents' motivational beliefs in biology, chemistry, and physics (Simpkins et al. 2015b). Another study showed that parents' provision of science opportunities at home contributed to the development of a science identity for Latina middle schoolers (Kang et al. 2019). Overall, the few studies that have been conducted suggest

that parents are key socializers in the science education of Latinx students. However, there have not been many studies that consider the role of Latinx parents' socio-cultural knowledge (e.g., *consejos*). The literature on parent math support provides some insight on this as some studies have found that Mexican immigrant mothers use their experience from their schooling in Mexico to help their children solve math homework problems in ways that differ from how they are taught in U.S. schools (Civil 1998; Civil and Bernier 2006; Flores 2017). Moreover, a recent study conducted by Soto-Lara and Simpkins (2020) found that Mexican-origin parents provided science support, such as encouragement, that was culturally grounded on the parents' experience. Particularly, parents encouraged their children with phrases embedded with cultural meaning such as "échale ganas" (try harder). Although, this study provided insight into the nontraditional, culturally-grounded forms of science support that Latinx parents provide, a focus of our study is to further consider older siblings as another potential source of science support within the family.

1.2 Family Systems Theory and Sibling Science Support

According to family systems theory, a family functions as a system where members are interdependent and mutually influence each other (Cox and Paley 1997, 2003; Cox 2010). In line with this theory, the role of parents and siblings should be considered in conjunction when looking at the role of the family in adolescents' academic outcomes. Siblings may be particularly relevant in Latinx families given the importance of family in Latinx culture (Updegraff et al. 2005). Moreover, Latinx siblings spend more of their non-school hours with each other than with their parents or peers (Updegraff et al. 2006). In immigrant families, older siblings have prominent roles as cultural brokers of American mainstream culture (McGuire and Shanahan 2010; Updegraff and Umaña-Taylor 2015; Updegraff et al. 2010).

The few studies that have considered Latinx siblings' influences have found that they are an important source of motivation and academic support, including for STEM-specific subjects (Alfaro and Umaña-Taylor 2010; Azmitia et al. 1996; Azmitia et al. 2009; Hurtado-Ortiz and Gauvain 2007; Puente and Simpkins 2020; Sanchez et al. 2006; Simpkins et al. 2019). Aligned with family systems theory, previous studies found that older siblings' support in classwork became instrumental as their younger siblings reached middle school in Mexican-descent families where parents did not obtain a middle and high school education (Azmitia et al. 1996; Hurtado-Ortiz and Gauvain 2007; Sanchez et al. 2006). Thus, academic support from older siblings may be especially valuable when parents have limited experience with and knowledge of the American school system.

Taken together, previous research suggests that both parents and siblings are key sources of support for Latinx adolescents' science education. To this end, Simpkins et al. (2019) found that science support from both parents and siblings together positively predicted the science self-concept of Latinx adolescents. However, this study combined parent and sibling support as a global family indicator and did not address the extent to which parent or sibling support accounted for these patterns nor the intricate dynamics theorized in family systems theory. To our knowledge, the extent

to which parents and siblings provide similar or complementary types of support has not been tested. Such information is vital to understand positive supports for Latinx youth's pursuit of STEM, and to design programs and curriculum that make a difference.

1.3 Family Science Support and Parents' Science Education

The Eccles' parent socialization model posits that parent education influences the support parents provide their children in achievement-related domains, including academics (Eccles 1993, 2005). Specifically, parents' educational experiences influence their skills, values, and knowledge, which parents draw on to provide support. Emerging literature suggests that parents' knowledge of science developed from their educational and occupational experiences contributes to their children's science interest and aspirations through parents' support (Archer et al. 2012; Chakraverty and Tai 2013; Dabney et al. 2013; Dewitt et al. 2016). For example, in a study conducted by Dabney et al. (2016), parents with higher levels of education were more likely to encourage their children's science interest. Moreover, parents with science occupations have the funds of knowledge to discuss the value of science and promote their children's interest in pursuing science careers (Archer et al. 2012). In summary, the parent socialization model (Eccles 2005) and the literature on the role of science education on parent science support suggests that the science knowledge and resources parents developed through their science education shapes the science support they provide their adolescents.

When considering Latinx parent science education, it is important to consider that Latinx parents have either attended school in the U.S. where they have been largely marginalized from accessing science education or attended schools outside of the U.S. (Flores 2011; Gandara 2006; Taningco et al. 2008; Zarate 2007). One consequence is that some Latinx parents may not have access to the information on the U.S. mainstream conceptions of scientific literacy that may be helpful for supporting their children in science. In addition, adolescents' science high school coursework also may surpass their parents' level of education in science. Under such circumstances, Latinx parents may engage less in practices directly related to their adolescent's schoolwork, but provide more of indirect guidance through monitoring, encouragement, and advice (Auerbach 2007; Azmitia et al. 1996; Sanchez et al. 2006). Thus, adolescence, particularly in high school, may be a key turning point in which some Latinx parents adapt their support based on their educational background. Overall, we argue that Latinx parents' varying levels of science education will be related to how they support their adolescents in science.

Because families function as systems where members mutually influence each other, parents' science education may not only influence parent academic support but also the academic support that siblings provide (Cox and Paley 1997). For instance, Latinx parents who have more limited science education may strategically leverage resources through their social network of family, friends, and community members to support their adolescents in science (Delgado-Gaitan 1992; Soto-Lara and Simpkins 2020). Particularly, older siblings in Latinx families where parents are

unfamiliar with the U.S. education system may provide access to knowledge and resources obtained through their experience with science in the U.S. education system (Azmitia et al. 1996; Hurtado-Ortiz and Gauvain 2007; Sanchez et al. 2006). To further understand these familial processes, this study examined the extent to which parent and sibling science support for Latinx adolescents varied based on parents' science education.

1.4 Current Study

Given the challenges that Latinxs face in their science education and the important role of families in the educational trajectories of Latinxs, this study aimed to fill in the gap in the literature by considering the science support for Latinx adolescents from both parents and siblings. Informed by the literature on family involvement in youth's education, influences on youth's academic outcomes and family systems theory, a qualitative approach was used to analyze the semi-structured interviews of Latinx adolescents to answer the following research questions:

1. What do Latinx adolescents believe were the most important ways their parents and siblings supported them in science?
2. Did science support from parents and siblings vary based on parents' science education?

2 Method

2.1 Participants

Participants were part of a larger, mixed-methods study that focused on the role of family support on Latinx adolescents' science motivational beliefs and outcomes. Recruitment was conducted in three ethnically diverse public high schools near a large southwestern metropolitan city in the United States. Each school was purposely selected because they had a large Latinx student population (23–48%) and varied on achievement and demographics (17–63% eligible for free or reduced lunch). A total of 104 9th grade Latinx adolescents who had an eligible parent and older sibling, or cousin were recruited into the study. Each member of the family was compensated with \$50 for participating in the larger study, which included surveys, observational tasks, and interviews.

This study derives its analysis from semi-structured qualitative interviews that were conducted with 90 adolescents from the original sample when they were in 10th grade (see Table 1). Eleven families from the original sample did not participate in the interviews and three additional families were excluded from those that participated in the interviews because the interviews were incomplete. We used chi-square tests and *t*-tests to compare the families included in this study and participants not included based on adolescents' age, gender, and science ability; parents' age, income, and science education; and siblings' age. All comparisons were not

Table 1 Adolescent, parent and sibling demographic characteristics

	Adolescent	Parent	Sibling
Age (mean in years)	15.54	42.12	19.06
<i>Gender</i>			
Female	38%	92%	51%
Male	62%	8%	49%
<i>Nativity</i>			
Born in the U.S	84%	31%	81%
Born outside U.S. *	16%	69%	19%
<i>Education</i>			
HS graduation or less	—	57%	87%**
Some college or more	—	43%	13%
Total (N)	90	90	90

Note *Most adolescents, parents and siblings born outside U.S. were born in Mexico, except for 4 parents (3 born in El Salvador and 1 in Guatemala). **Of these, 62% were enrolled in high school at the time

statistically significant (Cohens $d=0.07$ to 0.18 , $phi=0.01$ to 0.13). One non-significant effect had a small effect size; adolescents in the study had, on average, a higher science ability as rated by teachers than adolescents who were dropped (Cohens $d=0.26$). The adolescent respondents in our study were mostly born in the U.S. (84%), had an average age of 15.54 years, and were 62% boys. The older sibling or cousin respondents (87% siblings) were mostly born in the U.S. (81%), were on average 19.06 years old, and 51% were girls. Most parent respondents were mothers (92%), were born outside the U.S. (69%), and had an average age of 42.12 years. Aside from three parents, the majority of the adolescents, siblings, and parents born outside the U.S. were born in Mexico. The median household income was \$30,000 to \$39,000, 57% of parents had a high school degree or less, and two-thirds of adolescents lived in a 2-parent household (66%).

2.2 Interview Procedures

Aligned with the Institutional Review Board (IRB) guidelines for recruitment, families were recruited when the adolescents were 9th graders (2012–2013 academic year). Each family member provided consent or assent at the outset of the study. The families were interviewed when the adolescent was in 10th grade in their homes or at the university based on their choice. This study focused on the adolescent interviews to gain insight to their unique perspective on the most helpful science support they received from their parents and older sibling in the study. The script of the interviews was semi-structured with open-ended questions that allowed for probing to obtain in-depth responses. The questions from the script captured adolescent's motivation and interest in science and the support they received from their parents and siblings, and were based on the existing literature (e.g., Eccles 1993; Hill and Tyson 2009; Simpkins et al. 2015a, 2015b). Data from the interview questions were analyzed but the majority of

the data were drawn from the following two questions, which were asked separately for parents and siblings: (a) “What do you think are the two most important things your (parents do/sibling does) to help you in science?”, and (b) “Do you think your (parents do/sibling does) the same things or different things to help you in science compared to other classes or other subjects?” These specific questions elicited responses on what adolescents perceived to be the most important ways their parents and siblings supported them in science.

Bilingual research assistants from diverse ethnic backgrounds and education levels (e.g., undergraduates and graduates) attended mandatory training sessions where they became familiar with the interview script and practiced interview skills, including probing techniques. In order to obtain detailed responses from participants, interviewers used both standard probes (e.g., “why is that?”) and personalized probes tailored to participants’ specific experiences. Moreover, weekly meetings were held amongst the data collection team to debrief and discuss any issues or concerns with the interviews. Most of the interviews with adolescents were conducted in English, except for one adolescent who was interviewed in Spanish. Interviewers audiotaped and transcribed verbatim the interviews. After an initial transcription, secondary checks were conducted, which consisted of a second transcriber checking the work of the first transcriber. In order to ensure accuracy and cultural meaning of the one Spanish interview, a six-step process was conducted (Simpkins et al. 2011).

2.3 Researcher Positionality

As researchers, it is important to acknowledge and discuss how our experiences, perspectives, and biases may function during the research process (Goldberg and Allen 2015; Hill et al. 2005). As a first-generation Mexican immigrant raised in California, the first author was aware of her own and her family’s experience within the American education system during her analysis of the adolescent interviews. Thus, her unique cultural insight often guided the interpretation of the findings. The second author, who was the principal investigator of the overall research project, was involved throughout the coding and analyses of the interviews. She is a White woman raised in California, whose family has been in the U.S. for more than three generations. She has previously conducted research on the role of family involvement on the academic motivation, performance, and choices of Latinx youth. Additionally, a research team composed of graduate students and post-doctoral scholars from diverse ethnic backgrounds also participated in the analysis process. Discussions with the second author and the research team as well as the consideration of prior literature allowed the first author to account for potential biases and obtain a comprehensive and thorough understanding of the responses from the Latinx adolescents.

2.4 Coding and Analyses

In order to identify patterns in the data, coding analysis was conducted using Microsoft Excel spreadsheets, in which both deductive and inductive approaches were applied during multiple stages (Saldaña 2016). In the first stage of coding, a

subsample of 15 transcripts were read in their entirety by the first author to identify the questions that would elicit responses pertaining to science support from parents and siblings and to get a sense of the preliminary patterns in the data. A preliminary coding framework was established based on the first stage of coding in which codes were identified using in-vivo (i.e., verbatim words or phrases from transcripts) and descriptive (i.e., words or phrases that summarize a topic) techniques (Saldaña 2016). Following an inductive approach, codes that reoccurred in the data were selected and reviewed during consensus between the first and second authors. Additionally, a deductive approach was applied when each author considered prior literature on the academic support of parents and siblings to refine the codes.

In the second stage of coding, the preliminary coding framework was used to code all adolescent interviews. As the interviews were being coded, the coding framework was further redefined based on the data and discussions between the first and second authors. Moreover, during meetings with the research team we discussed issues, such as collapsing/splitting codes, code definitions, and distinguishing between codes. Throughout the coding process, detailed memos were written that highlighted patterns in the data and documented changes to the coding framework. Categories from the coding framework were developed based on consensus among the authors and the research team, the analytical memos, and the existing literature. For example, the category on conversations about the future was refined based on Hill and Tyson's (2009) and Ceballo et al.'s (2014) work on academic socialization. Furthermore, Delgado-Gaitan's (1992) previous work on Latinx parents' provision of resources was used to define the categories of material and social resources. Lastly, after establishing categories within the coding framework, overarching themes of the science support from parents and siblings were established (see Table 2). There were some codes that appeared within the data and reflected previous literature, such as visiting museums as a common indicator of co-activity (Simpkins et al. 2015b) that were not included in the final coding framework because they appeared infrequently (less than 3 times). More information on these codes is available from the first author.

To capture whether science support from parents and siblings varied based on parents' science education, we conducted a cross-case analysis based on adolescents' responses across three parent science education groups: *high science classes*, *some science classes*, and *no science classes*. As part of the larger study, parents were asked how many years they took science classes in high school (0 years to 4 years) and the specific science subjects they took (e.g., biology, chemistry). Although the larger study included indicators of parents' science coursework in college, we opted to not use their college courses as only five parents majored in science-related careers and only 23 parents took at least one science class in college. We used the number of parents' high school science classes as our measure of science education given its rich variability and because it covered the same age period as their adolescent. The *high science classes* group was composed of families with parents who took three or four science high school classes ($n=29$). The demographic indicators for each of these groups is shown in Table 3. Of the parents in the *high science classes* group, 38% of the parents were U.S. born and 24% were college graduates. Parents in the *some science classes* group included families with parents who.

Table 2 Coding framework for parent and sibling science support

Science support theme	Category	Parent	Sibling
Active engagement	<i>Classwork help</i> ($n=61$) Providing direct support with science classwork activities, such as homework, exams, and projects	$n=36$; "If I'm stuck on a question and they help look through my notes and then help me understand the information that's on my notes."	$n=52$; "He helps me in homework we have, like in vocabulary, since he took that class last year, so he knows what to do."
	<i>Monitoring</i> ($n=42$) Checking-in about adolescent progress in science class (e.g., grades)	$n=38$; "They ask me how I am doing and keep me on task and make sure that I have all my work done."	$n=14$; "She always asks me how my grades are and if I am having trouble in biology so I mean those are probably the two main things, just checking up on me."
	<i>Encouragement</i> ($n=20$) Using supportive and motivating messages	$n=16$; "They always encourage me to get good grades and try to get straight A's every year."	$n=4$; "He encourages me to keep my grades up."
Academic socialization	<i>Conversations about the Future</i> ($n=8$) Conversing about college and career aspirations	$n=4$; "They talk to me about careers and how science works."	$n=5$; "She just talks to me sometimes about what I want to do later in life and like how I want to get there."
	<i>Advice</i> ($n=10$) Conversing about strategies to perform well in science	$n=5$; "If they see if I have a bad grade they are like 'oh you need to stay after school or something, you need to make up the work.'"	$n=5$; "He just tells me what he did in high school and what I can do. The things he did, like how he did it-to make it easier on me."
	<i>Material resources</i> ($n=19$) Providing supplies for science class, such as materials for projects or notes	$n=16$; "When I need something for a project, they are always like there for me, and they always take me to buy something for the project."	$n=4$; "She is a junior, I'm a sophomore, she has like different notes...every time I have homework she lets me use her notes."
Providing resources	<i>Social resources</i> ($n=11$) Connecting adolescents to get help from other social agents	$n=8$; "If I'm having a problem that I can't really qualify with the teacher, like if I don't know how to say it or if I'm having problems on the subject, then I'll have them email them, or set up a little personal meeting... just to get that subject clarified over."	$n=3$; "When he doesn't know he tells me to ask my older brother."

Table 3 Adolescent, parent and sibling demographic characteristics between the parents' science education groups

	High science classes	Some science classes	No science classes
<i>Adolescent characteristics</i>			
Age (mean in years)	15.44	15.61	15.57
Female	24%	35%	53%
Born in the U.S	93%	97%	63%
<i>Parent characteristics</i>			
Age	41.44	42.03	41.83
Female	90%	90%	97%
Born in the U.S	38%	52%	3%
Some college or more	72%	58%	0%
<i>Sibling characteristics</i>			
Age	19.03	17.84	19.30
Female	55%	48%	50%
Born in the U.S	79%	100%	63%
Some college or more*	14%	16%	10%
Total families (N)	29	31	30

Note *This percentage calculation includes older siblings who were enrolled in high school at the time (62%)

took one or two high school science classes ($n=31$). In this group, 52% of the parents were U.S. born and 25% were college graduates. Lastly, the *no science classes* group was composed of families where the parents did not take any science classes in high school ($n=30$). From this group, 3% of the parents were U.S. born and none were college graduates. For our analysis we focused on looking at (a) the prevalence of science supports from parents and siblings across groups, and (b) whether the science support from parents and siblings was manifested differently across the groups.

3 Results

3.1 Family Science Support

This first section addresses our first research question about what Latinx adolescents believe are the most important ways their parents and siblings support them in science. Three themes of family science support emerged: active engagement, academic socialization, and providing resources (see Table 2). Below, we describe and distinguish between the themes of science support and the categories within each theme while using interview excerpts and describe any emerging patterns within and across parent and sibling science support.

3.1.1 Active Engagement

The first theme encompassed support in which parents or siblings actively engaged in adolescents' science class and science learning. The two categories that emerged in this theme were *classwork help* and *monitoring*, which reflect home-based involvement strategies defined by traditional models of family influences or involvement (Eccles 1993; Eccles and Harold 1996; Epstein 2010). Classwork help, which was reported by over two-thirds of the adolescents, entailed providing direct support with science classwork activities (e.g., homework, projects). Some of the ways in which adolescents received classwork help from their parents and siblings were through reviewing notes and working together to retrieve information to answer homework questions. For example, Ximena², a 15-year-old girl talked about receiving classwork help from her sister in the following way: "Sometimes she helps me look stuff up if I don't know it on the internet and sometimes she just helps me review my notes." While adolescents talked about classwork help as simple interactions, such as those Ximena described, other adolescents also talked about more elaborate classwork help. Specifically, adolescents described that their parents and siblings taught and explained science to them in a way that helped them understand the material differently than how they learned it at school. For example, Omar, a 16-year-old boy, mentioned that his parents used their knowledge from their schooling in Mexico: "If I don't understand, then I just go to them, because they went to school in Mexico. Like, they taught them some different things, and that'll really help me out too." This experience reflects what Flores (2017) found in her study, in which Mexican American mothers used their knowledge from their schooling in Mexico to teach their children long division and multiplication in a way that was different from American schools. For Omar, his parents' cultural insight from their schooling in Mexico helped him with understanding the material from his science classes.

Although adolescents mentioned classwork help from both parents and siblings, it was more commonly mentioned from siblings than from parents (see Table 2). When talking about the classwork help they received from siblings, adolescents mentioned that their siblings provided classwork help based on what they had learned from having previously taken the same class. As Roberto, a 16-year-old boy, described, his sister's knowledge from having taken the chemistry class with the same teacher as himself helped with understanding the material:

She had the same chemistry teacher that I have when she was in chemistry, so she knows how to tutor me better to understand more. And she's been through the class so she can help me out when I don't get stuff.

Roberto's and other adolescents' accounts from the study emphasize the value of older siblings' unique knowledge from their previous experiences in science classes in providing relevant class-specific support to their younger siblings.

² All participant names are pseudonyms.

The other category within the active engagement theme was monitoring, which, compared to classwork help, reflected a more indirect support of the adolescents' science learning. This support, which adolescents more commonly mentioned from parents than siblings, was characterized by mentions of parents and siblings checking-in about the students' progress in their class and their grades. For example, Edward, a 15-year-old boy, mentioned the following about his sister: "She'll check up on my grades. She'll like print them out." Additionally, parents and siblings monitored adolescents' completion of their homework by reminding them to complete their homework, checking that their homework was completed, and enacting rules like having a designated time for completing homework. In the following excerpt, Daniela, a 15-year-old girl, talked about her parents ensuring that she completed her homework:

They just tell me like make sure you have your homework done, that's pretty much it. I know they just want me to get my work done and do well, so I just want to do it so I will be happy and they will be happy.

Although Daniela's parents did not necessarily provide direct support with her science homework, their monitoring motivated Daniela to complete her work. Daniela's account highlights the importance of monitoring in Latinx families and conveys the role that familism values, such as making one's parents proud, can have in the academic endeavors of Latinx adolescents (Azmitia et al. 1996; Ceballo et al. 2014; Mena 2011; Sanchez et al. 2006; Valenzuela and Dornbusch 1994).

3.1.2 Academic Socialization

The second theme that emerged from adolescents' responses reflects Hill and Tyson's (2009) conceptualization of academic socialization. Following previous work conducted on the academic socialization of Latinx families, the findings from this theme indicated the various ways in which Latinx parents and siblings emphasized the value of science education (Auerbach 2007; Carranza et al. 2009; Rivas-Drake and Marchand 2016). Particularly, the three categories of this theme were *encouragement*, *conversations about the future*, and *advice*. The category that adolescents mentioned the most within this theme was encouragement, which were messages that parents and siblings used to motivate adolescents to perform well in science. More adolescents talked about encouragement as a support from parents compared to siblings (see Table 2). Humberto, a 15-year-old boy, talked about encouragement from their parents in the following way: "[They] reward me for like how hard I work and like keep telling me positive things to keep me going." In another example, Elena, a 15-year-old girl, described how their older brother encouraged her in science:

He congratulates me on something well I did, or encourages me to do better because he says that I'm smart, so he tells me how to do good, you know? I'll make it through and what not.

Humberto's and Elena's accounts show how parents and siblings used encouraging messages, such as praise and positive messages, to motivate adolescents to work hard and put effort in their science work. Ultimately, through these encouraging messages parents and siblings emphasized the value of adolescents' science education (Auerbach 2006; Ceballo et al. 2004; Mena 2011).

For conversations about the future, parents and siblings talked with adolescents about their college and career aspirations. About the same number of adolescents mentioned conversations about the future with their parents and with their siblings (see Table 2). An example of this support can be seen through the following interview excerpt where Edward suggested that his interest in pursuing a science career arose from the conversations he had with their parents: "[My parents] talking to me about science jobs and what I want to do in college and that's pretty much set the path for me." In another example, Cristian, a 15-year-old boy, recounted conversations with his brother about his career prospects: "He tells me...I should probably do well in science in general and I will be able to have a good job if I don't make it as a singer." These examples demonstrate how parents and siblings used their conversations with adolescents about their college and career prospects to emphasize the value of pursuing a science career. Moreover, as seen through Edward's account, these conversations contributed to building an interest in science.

For the category of advice, parents and siblings talked with adolescents about strategies to perform well and succeed academically in science, such as paying attention, asking questions, and studying. Adolescents talked about receiving advice equally from parents and siblings (see Table 2). In the following excerpt, Cesar, a 16-year-old boy, described how his parents provided advice:

They always are telling me to study and work hard and understand my work and make sure I know what I am learning and learning what I am supposed to be learning and learn. Not just say 'oh' pretend I am learning but learning so that I can use it in my daily life and use to help others.

Siblings particularly provided advice based on their knowledge from their previous experience in the same high school that the adolescents were enrolled in. For example, Melanie, a 16-year-old girl mentioned the following about his sister's advice:

Since she went to the same school, she kind of knows the same criteria that I'm dealing with so she kind of just gives me like a heads up. So, like feedback and what I should do and what I should not do.

Similar to classwork help, older siblings' knowledge from their previous schooling experiences was instrumental in providing relevant specific advice to their younger siblings.

3.1.3 Providing Resources

For this theme, parents and siblings leveraged their own resources and social networks to provide adolescents with material and social resources. For material

resources, adolescents talked about their parents or siblings buying them supplies for science class, with more adolescents mentioning this support from parents than siblings (see Table 2). For example, Alex, a 16-year-old boy, explained that his mother helped him in the following way: “She gets me the supplies I need to be able to complete that work.” This category aligns with the definition of provision of materials outlined in the Eccles’ (1993) parent socialization model as well as previous literature on the educational resources Mexican American families provide their children (Altschul 2011; Delgado-Gaitan 1992). Additionally, adolescents mentioned the unique material resources that older siblings provided based on their previous schooling experiences. For example, adolescents, like Joseph, a 15-year-old boy, mentioned that his siblings provided notes from similar science classes they had taken: “She shows me like previous notes she took from stuff she took when she was taking the course I’m taking.” Joseph’s experience and that of other adolescents who mentioned getting notes from their siblings exemplifies the helpful resources that older siblings can provide to their younger sibling when having previously taken similar science classes.

For social resources, parents and siblings connected adolescents with other people, such as teachers, counselors, friends, or other family members, who could provide more direct science support. Like material resources, more adolescents mentioned this support from parents than siblings (see Table 2). In the following excerpt, Ana, a 16-year-old girl, talked about her parents’ suggestions to get help from other sources: “They tell me to ask my sisters for help. They just like tell me to go on the internet or ask someone else for help.” Another example of social resources can be seen through Michael’s experience, a 15-year-old boy whose older sibling arranged tutoring sessions with his friends:

He has a few friends that are really advanced in their classes, so if I am struggling a lot he’ll ask one of his friends maybe to tutor me after school or just help me out on a certain problem because he doesn’t take as advanced classes as them.

In this example, Michael’s brother did not necessarily provide direct science support, such as classwork help, but instead utilized his social network of friends who took advanced science classes to support Michael. Although social resources are not consistently included within traditional models of family influences on youth’s academic outcomes, a previous study conducted by Delgado-Gaitan (1992) found that Mexican American immigrant families relied on their social networks within their extended family and community to support their children’s education. Thus, as shown in our findings, leveraging of social resources can be especially valuable when families are not able to provide other types of more direct support, such as classwork help.

3.1.4 No Support

When asked about the two most important ways that their parents and siblings supported them in science, 25 out of the 90 adolescents (28%) mentioned that they did not receive support from their parents, sibling, or both. More adolescents talked

Table 4 Frequency of types of science support in full sample and parents' science education groups

	Full sample	High science classes	Some science classes	No science Classes
<i>Active engagement</i>				
Classwork help	68%	59%	74%	67%
Monitoring	47%	55%	35%	47%
<i>Academic socialization</i>				
Encouragement	22%	17%	32%	17%
Conversations about the Future	9%	17%	6%	3%
Advice	11%	14%	16%	17%
<i>Providing resources</i>				
Material resources	21%	10%	23%	33%
Social resources	12%	3%	16%	17%
No support	28%	21%	26%	30%
Total families (N)	90	29	31	30

about not getting support from siblings ($n=20$) than from parents ($n=13$), eight of which mentioned not receiving support from either. When talking about the reasons why they did not receive support in science from their parents and siblings, adolescents most commonly mentioned that their parents or siblings were not able support them. Specifically, adolescents talked about their parents not knowing the material or not remembering the material from when they went to high school. Additionally, when talking about their siblings not being able to support them, adolescents talked about their siblings taking different science classes. For example, Diego, a 15-year-old boy mentioned taking more advanced science classes than their sibling: "The science class I'm in, chemistry, she's not in, like, that advanced kind of science. She was in, like, earth science and biology." Other reasons that adolescents mentioned for their parents or siblings not supporting them in science were not needing help from them because of their ability to work independently or their parents and siblings not having time to help because of other responsibilities, such as work.

3.2 Science Support by Parents' Science Education

Findings from the first research question suggest that parents and siblings engaged in a variety of ways to support Latinx adolescents in science. For the second research question, we considered whether their science support varied based on parents' science education (see Tables 3 and 4). The *high science classes* group included families with parents who took three or four science classes in high school, whereas parents in the *some science classes* group, took one or two high school science classes. In the *no science classes* group, parents took no high school science classes. Below, we outline some of the main differences we found between the three parents' science education groups for each of the themes of science support we previously described.

3.2.1 Active Engagement

Across the three parent science education groups, classwork help was the most commonly reported category of science support (see Table 4). This support was mentioned the most in the *some science classes* group (74%) and then the *no science classes* groups (67%) and *high science classes* (59%) groups. Moreover, the percentage of families where only siblings provided classwork help varied across groups. Specifically, in the *high science classes* group, 38% of adolescents reported receiving classwork help from both parents and siblings and 10% from only their siblings, whereas 32% of adolescents in the *some science classes* and 37% in the *no science classes* groups mentioned classwork help only from their siblings. Monitoring was the second most commonly reported category of science support across the three parent science education groups. This support was mentioned the most in the *high science classes* group (55%) compared to the other two groups, with the difference being larger with the *some science classes* group (35%).

3.2.2 Academic Socialization

The percentage of adolescents in the *some science classes* group (32%) who mentioned encouragement was almost twice as much as the percentage who mentioned it in the *high science classes* and *no science classes* groups (both 17%; see Table 4). Additionally, conversations about the future were mentioned about three times as often for the adolescents in the *high science classes* group (17%) compared to adolescents in the *some science classes* (6%) and *no science classes* (3%) groups. Advice was mentioned by 14% of adolescents in the *high science classes* group, 16% in the *some science classes* group, and 17% in the *no science classes* group.

3.2.3 Providing Resources

Adolescents mentioned material resources about three times as often in the *no science classes* group (33%) compared to the *high science classes* group (10%; see Table 4). In the *some science classes* group, 23% of adolescents mentioned material resources. Additionally, the percentage of adolescents who mentioned social resources was almost five times as much in the *no science classes* (16%) and *some science classes* groups (17%) compared to the *high science classes* group (3%).

3.2.4 No Support

When comparing the adolescents who reported not receiving support from their parents or siblings across the parent science education groups, there are some noteworthy aspects to highlight. Adolescents in the *no science classes* group (23%) mentioned not receiving support from parents almost four times as much as the adolescents in the *high science classes* group (3%). In the *some science classes* group, 16% of adolescents mentioned not receiving support from parents. On the other hand, the percentage of adolescents not receiving support from siblings was similar across groups with eight adolescents mentioning it for the *low science classes* group

(27%) and seven adolescents mentioning this for the *some science classes* (23%) and *high science classes* (24%) groups. This similarity across groups of adolescents reporting not getting support from siblings may be due to our science education measure being based on parents' education and not on siblings' education.

4 Discussion

Framed by models on family involvement in youth's education (Epstein 2010), family influence on youth's achievement-related domains (Eccles 1993, 2005), and family systems theory (Cox and Paley 1997), this study aimed to fill the gap in the literature by exploring the role of parents' and older siblings' support for Latinx adolescents' science education. The goals for this study were to (a) identify what Latinx adolescents believe are the most important types of science support they received from their parents and siblings, and (b) explore how the family science support varied depending on parents' science education. Through the analysis of semi-structured qualitative interviews from the adolescents' perspective, we found that parents and siblings supported Latinx adolescents in science through a variety of ways: active engagement, academic socialization, and providing resources. We also found that some support from parents and siblings varied depending on parents' level of science education.

Two of the three central themes, namely active engagement and academic socialization, align with traditional models of family influences whereas the third theme of providing resources expands the traditional supports highlighted in these models. The two specific types of active engagement, namely classwork help and monitoring, align with the traditional conceptualization of home-based involvement and have been well-documented in theoretical frameworks and the existing literature on Latinx families' support of youth's overall academic success (Altschul 2011; Azmitia et al. 1996; Eccles 1993; Epstein 2010; Hill and Tyson 2009; Mena 2011). Additionally, our study reflects previous findings on the various academic socialization strategies, such as encouragement and conversations about the future, that Latinx parents use to emphasize the value of education (Carranza et al. 2009; Ceballo et al. 2014; Hill and Tyson 2009; Rivas-Drake and Marchand 2016). Our work suggests that parents and siblings utilize these strategies to support adolescents in science. The third theme, providing resources, involves Latinx parents and siblings using their social networks to support adolescents in science, which expands the traditional definitions of family influences which often do not highlight social resources such as networks. Leveraging social networks was particularly helpful when parents and siblings were not able to provide more traditional forms of support, such as classwork help. This finding highlights the importance of social networks for Latinx families in supporting their children's general educational needs (Delgado-Gaitan 1992; Soto-Lara and Simpkins 2020).

Following previous literature, we found some evidence in our study that Latinx parents' sociocultural knowledge and experiences informed the science support they provided for their children (Auerbach 2007; Delgado-Gaitan 1994; Flores 2017). For example, an adolescent talked about their parents providing classwork help based on

how they learned science in Mexico. This adolescent's experience reflects what Flores (2017) found in her study, where Mexican immigrant mothers showed their children to apply multiplication and long division based on what they learned in their home country. However, overall, adolescents only rarely mentioned their parents' or siblings' sociocultural knowledge and experiences when talking about the science support they received. Although this aspect of parent support was not highly prevalent in our study, this does not necessarily indicate that parents' cultural experiences and knowledge were not relevant for the families in our study. Our analysis was based on adolescents' perspectives on the most important ways they were supported in science and did not capture the perspective of the support providers. Future studies need to also consider the perspectives of parents and siblings to understand the reasons behind and the experiences that shape the support they provide.

Throughout the themes of science support, we found that Latinx adolescents highlighted the relevance of their older siblings having taken similar science classes. Based on adolescents' accounts, their older siblings used their knowledge and resources from the science classes they took to provide classwork help, advice, and material resources (e.g., sharing class notes). These findings extend the previous literature on the academic support of Latinx siblings to demonstrate how older siblings use the knowledge they acquired from their previous schooling experiences to provide their younger siblings with relevant class-specific support in their science classes (Carolan-Silva and Reyes 2013; Sanchez et al. 2006). In alignment with these findings, adolescents more commonly mentioned receiving classwork help from their older siblings compared to parents. Classwork help has been traditionally defined as a support from parents and some scholars suggest that the need for classwork help from parents decreases as youth reach adolescence (Hill and Tyson 2009; O'Sullivan et al. 2014). However, our findings suggest that Latinx adolescents continue to receive classwork help in science from both their parents and siblings, with siblings rather than parents being the likely source of this support. Thus, it may be that as youth reach high school, support for classwork help may be shifting to older siblings.

For our second research question, we found that parents' and siblings' science support for Latinx adolescents varied depending on parents' high school science coursework. Particularly, the findings suggest that Latinx adolescents relied more on classwork help from only their siblings in families where parents took less than three high school science classes, whereas adolescents tended to receive classwork help from both their parents and siblings in families where parents took more science classes. These findings align with family systems theory and extend from the literature on Latinx family influences by indicating that older siblings' support with science classwork may be especially relevant for families in which parents have more limited science education (Azmitia et al. 1996; Cox and Paley 1997; Sanchez et al. 2006). Thus, older siblings' knowledge and experience from their science classes may play a more prominent role in families where parents did not acquire such science resources through their own educational experiences.

Another difference between the science education groups is that conversations about the future were more prominent in families where parents had a higher level of high school science education. Parents with advanced courses, college degrees, or

occupations in science can draw on the range of their own science resources, including their knowledge, familiarity, and experiences, to advise their children about possible science majors, careers, and pathways (Archer et al. 2012; Dabney et al. 2013; Eccles 2005). In other words, parents can leverage their own science resources to promote their children's science beliefs, resources, and pathways, particularly their value of science and knowledge about science qualifications. Such patterns are likely to emerge in other areas, such as the humanities, and among other groups, such as other racial/ethnic groups. As such, it might be worthwhile to consider how schools or communities can capitalize on parents' varied funds of knowledge to support adolescents' varied educational pursuits.

Although conversations about the future were not prevalent for families where parents did not take any high school science classes, adolescents in these families mentioned often receiving several other types of science support, including monitoring, classwork help, encouragement, and material and social resources. In fact, adolescents in families where parents had limited high school science education were more likely to mention parents and siblings providing material and social resources than in families where parents had more advanced science education. Specifically, parents and siblings leveraged their social network to support adolescents when they were not able to provide other forms of support that were directly related to the science class content. Leveraging social networks may be especially helpful for families where parents have more limited high school science coursework. Overall, our findings suggest that Latinx families are resourceful and actively find ways to support adolescents, even when they were not able to directly provide support themselves.

It is also important to note that almost one third of the adolescents mentioned not receiving science support from their parents, siblings, or both. Some adolescents mentioned that they wanted help or support but due to various challenges, such as their parents' or siblings' working hours, were not able to receive it. Thus, these adolescents may seek science support from other social agents in their school or community networks, such as teachers and peers (Simpkins et al. 2019). Another reason that adolescents mentioned for not receiving support was that they felt they did not need help and preferred working by themselves, which may reflect adolescents' increasing autonomy. As suggested in previous literature, as youth reach adolescence, they may seek independence from their parents in their schoolwork (Hill and Tyson 2009).

4.1 Limitations and Future Directions

Though we found several noteworthy findings in our study, our results are not necessarily representative of the diversity of experiences within the Latinx community. For example, although the families in our study and the families who opted out were indistinguishable on nearly all the characteristics we tested, we cannot rule out that the latter families may have had different experiences than the perspectives reflected in our study. Moreover, the sample in our study was overwhelmingly of Mexican-origin and of low-income background, which may not represent the experiences of

Latinx families from other nationalities and socioeconomic backgrounds. Future studies should examine parent and sibling science support in a larger and more heterogeneous sample of Latinx families.

Another limitation of this study is that we did not consider the role of relevant sociocultural factors, such as generational immigrant status and gender. Previous literature suggests there are differences in the experiences of first-generation immigrant students, including those who are Latinx, within the American education system compared to that of second and third generation students, with first-generation students performing better academically (Portes and Rumbaut 2014; Suarez-Orozco et al. 2009; Valenzuela 1999). Therefore, future studies should consider how family science support may depend on the immigrant experience of Latinx adolescents and their families. Furthermore, given that Latinas are overwhelmingly more underrepresented in STEM fields than Latinos and that there is evidence indicating that parents socialize Latina girls in general academics differently than how they do so with Latino boys, gender is another relevant sociocultural factor to consider for future studies (Lopez 2003; National Science Foundation 2019; Valenzuela 1999).

4.2 Conclusion

The current study contributes to the growing literature simultaneously considering the academic support from parents and siblings and highlights the complementary support from siblings in Latinx families where parents had more limited high school science courses. Findings from this study can inform scholars, school administrators and teachers on the various ways that families support Latinx adolescents in science. Moreover, this study provides insight into the valuable role that Latinx older siblings can play in the science education of their younger siblings. In order to strengthen school and community partnerships with Latinx families, it will be important to acknowledge and value the various ways they are currently supporting their adolescents, including those that fall outside the traditional forms of academic support. To encourage the science participation of Latinx youth, school and community organizations can organize events, such as family science nights, that support the participation of both parents and siblings and are welcoming to the unique cultural insight of Latinx families. Lastly, schools may consider designing and implementing curriculum that can leverage students' assets at home and facilitate their social interactions with family members, including siblings.

Funding This research was supported by the National Science Foundation (NSF), through grants awarded to Simpkins, S. D. (DRL-1054798 & DRL-1560889) and Simpkins, S. D. (principal investigator) & Eccles, J. (DRL-1760757).

Declarations

Conflict of interest All authors report there are no conflicts of interests.

Availability of data and material Data was collected through grants awarded to Dr. Simpkins, who is the second author of this manuscript, and is not currently publicly available.

Code availability Not applicable.

References

- Alfaro, E. C., & Umaña-Taylor, A. J. (2010). Latino adolescents' academic motivation: The role of siblings. *Hispanic Journal of Behavioral Sciences*, 32(4), 549–570. <https://doi.org/10.1177/0739986310383165>
- Allen-Ramdial, S. A. A., & Campbell, A. G. (2014). Reimagining the pipeline: Advancing STEM diversity, persistence, and success. *BioScience*, 64(7), 612–618. <https://doi.org/10.1093/biosci/biu076>
- Altschul, I. (2011). Parental involvement and the academic achievement of Mexican American youths: what kinds of involvement in youths' education matter most? *Social Work Research*, 35(3), 159–170. <https://doi.org/10.1093/swr/35.3.159>
- Archer, L., DeWitt, J., Osborne, J., Dillon, J., Willis, B., & Wong, B. (2012). Science aspirations, capital, and family habitus: How families shape children's engagement and identification with science. *American Educational Research Journal*, 49(5), 881–908. <https://doi.org/10.3102/0002831211433290>
- Auerbach, S. (2006). "If the student is good, let him fly": Moral support for college among Latino immigrant parents. *Journal of Latinos and Education*, 5(4), 275–292. https://doi.org/10.1207/s1532771xjle0504_4
- Auerbach, S. (2007). From moral supporters to struggling advocates: Reconceptualizing parent roles in education through the experience of working-class families of color. *Urban Education*, 42(3), 250–283. <https://doi.org/10.1177/0042085907300433>
- Azmitia, M., Cooper, C. R., García, E. E., & Dunbar, N. D. (1996). The ecology of family guidance in low-income Mexican-American and European-American families. *Social Development*, 5, 1–23. <https://doi.org/10.1111/j.1467-9507.1996.tb00069.x>
- Azmitia, M., Cooper, C. R., & Brown, J. R. (2009). Support and guidance from families, friends, and teachers in Latino early adolescents' math pathways. *The Journal of Early Adolescence*, 29(1), 142–169. <https://doi.org/10.1177/0272431608324476>
- Carolan-Silva, A., & Reyes, J. R. (2013). Navigating the path to college: Latino students' social networks and access to college. *Educational Studies*, 49(4), 334–359. <https://doi.org/10.1080/00131946.2013.808199>
- Carranza, F. D., You, S., Chhuon, V., & Hudley, C. (2009). Mexican American adolescents academic achievement and aspirations: The role of perceived parental educational involvement and acculturation, and self-esteem. *Adolescence*, 44(174), 313–333.
- Ceballos, R. (2004). From barrios to Yale: The role of parenting strategies in Latino families. *Hispanic Journal of Behavioral Sciences*, 26(2), 171–186. <https://doi.org/10.1177/0739986304264572>
- Ceballos, R., Maurizi, L. K., Suarez, G. A., & Aretakis, M. T. (2014). Gift and sacrifice: Parental involvement in Latino adolescents' education. *Cultural Diversity and Ethnic Minority Psychology*, 20, 116. <https://doi.org/10.1037/a0033472>
- Chakraverty, D., & Tai, R. H. (2013). Parental occupation inspiring science interest: Perspectives from physical scientists. *Bulletin of Science, Technology & Society*, 33(1–2), 44–52. <https://doi.org/10.1177/0270467613509367>
- Civil, M. (1998). Parents as Resources for Mathematical Instruction. *Proceedings ALM*, 216, 222. <https://www.alm-online.net/images/ALM/conferences/ALM05/proceedings/ALM05-proceedings-p216-222.pdf>
- Civil, M., & Bernier, E. (2006). Exploring images of parental participation in mathematics education: Challenges and possibilities. *Mathematical Thinking and Learning*, 8(3), 309–330. https://doi.org/10.1207/s15327833mtl0803_6
- Conchas, G. (2001). Structuring failure and success: Understanding the variability in Latino school engagement. *Harvard Educational Review*, 71 (3), 475–505. <https://doi.org/10.17763/haer.71.3.280w814v1603473k>
- Cox, M. J. (2010). Family systems and sibling relationships. *Child Development Perspectives*, 4(2), 95–96. <https://doi.org/10.1111/j.1750-8606.2010.00124.x>
- Cox, M. J., & Paley, B. (1997). Families as systems. *Annual Review of Psychology*, 48(1), 243–267. <https://doi.org/10.1146/annurev.psych.48.1.243>

- Cox, M. J., & Paley, B. (2003). Understanding families as systems. *Current Directions in Psychological Science*, 12(5), 193–196. <https://doi.org/10.1111/1467-8721.01259>
- Dabney, K. P., Chakraverty, D., & Tai, R. H. (2013). The association of family influence and initial interest in science. *Science Education*, 97(3), 395–409. <https://doi.org/10.1002/sce.21060>
- Dabney, K. P., Tai, R. H., & Scott, M. R. (2016). Informal science: family education, experiences, and initial interest in science. *International Journal of Science Education, Part B*, 6(3), 263–282. <https://doi.org/10.1080/21548455.2015.1058990>
- DeGarmo, D. S., & Martinez, C. R., Jr. (2006). A culturally informed model of academic well-being for Latino youth: The importance of discriminatory experiences and social support. *Family Relations*, 55(3), 267–278. <https://doi.org/10.1111/j.1741-3729.2006.00401.x>
- Delgado-Gaitan, C. (1992). School matters in the Mexican-American home: Socializing children to education. *American Educational Research Journal*, 29(3), 495–513. <https://doi.org/10.3102/00028312029003495>
- Delgado-Gaitan, C. (1994). Consejos: The power of cultural narratives. *Anthropology and Education Quarterly*, 25(3), 298–316. <https://doi.org/10.1525/aeq.1994.25.3.04x0146p>
- DeWitt, J., Archer, L., & Mau, A. (2016). Dimensions of science capital: exploring its potential for understanding students' science participation. *International Journal of Science Education*, 38(16), 2431–2449. <https://doi.org/10.1080/09500693.2016.1248520>
- Eccles, J. S. (1993). School and family effects of the ontogeny of children's interests, self-perceptions, and activity choice. In J. Jacobs (Ed.), *Nebraska Symposium on Motivation, 1992: Developmental perspectives on motivation* (pp. 145–208). University of Nebraska Press.
- Eccles, J. S., & Harold, R. D. (1996). Family involvement in children's and adolescents' schooling. In A. Booth & J. F. Dunn (Eds.), *Family-school links: How do they affect educational outcomes?* (pp. 3–34). Lawrence Erlbaum Associates Inc.
- Eccles, J. S. (2005). Influences of parents' education on their children's educational attainments: The role of parent and child perceptions. *London Review of Education*, 3, 191–204. <https://doi.org/10.1080/14748460500372309>
- Epstein, J. L. (2010). School/family/community partnerships: Caring for the children we share. *Phi Delta Kappan*, 92(3), 81–96. <https://doi.org/10.1177/003172171009200326>
- Flores, G. M. (2011). Latino/as in the hard sciences: Increasing Latina/o participation in science, technology, engineering and math (STEM) related fields. *Latino Studies*, 9(2), 327–335. <https://doi.org/10.1057/lst.2011.36>
- Flores, G. M. (2017). *Latina teachers: Creating careers and guarding culture*. NYU Press.
- Gandara, P. (2006). Strengthening the academic pipeline leading to careers in math, science, and technology for Latino students. *Journal of Hispanic Higher Education*, 5(3), 222–237. <https://doi.org/10.1177/1538192706288820>
- Goldberg, A. E., & Allen, K. R. (2015). Communicating qualitative research: Some practical guideposts for scholars. *Journal of Marriage and Family*, 77(1), 3–22. <https://doi.org/10.1111/jomf.12153>
- Goldsmith, J. S., & Kurpius, S. E. R. (2018). Fostering the academic success of their children: Voices of Mexican immigrant parents. *The Journal of Educational Research*, 111(5), 564–573. <https://doi.org/10.1080/00220671.2017.1323717>
- Hill, C. E., Knox, S., Thompson, B. J., Williams, E. N., Hess, S. A., & Ladany, N. (2005). Consensual qualitative research: An update. *Journal of Counseling Psychology*, 52(2), 196. <https://doi.org/10.1037/0022-0167.52.2.196>
- Hill, N. E., & Tyson, D. F. (2009). Parental involvement in middle school: A meta-analytic assessment of the strategies that promote achievement. *Developmental Psychology*, 45(3), 740. <https://doi.org/10.1037/a0015362>
- Hsieh, T. Y., Liu, Y., & Simpkins, S. D. (2019). Changes in United States Latino/a high school students' science motivational beliefs: within group differences across science subjects, gender, immigrant status, and perceived support. *Frontiers in Psychology*, 10, 380. <https://doi.org/10.3389/fpsyg.2019.00380>
- Hurtado-Ortiz, M. T., & Gauvain, M. (2007). Postsecondary education among Mexican American youth: Contributions of parents, siblings, acculturation, and generational status. *Hispanic Journal of Behavioral Sciences*, 29(2), 181–191. <https://doi.org/10.1177/0739986307299584>
- Jiang, S., Simpkins, S. D., & Eccles, J. S. (2020). Individuals' math and science motivation and their subsequent STEM choices and achievement in high school and college: A longitudinal study of gender and college generation status differences. *Developmental Psychology*, 56(11), 2137–2151. <https://doi.org/10.1037/dev0001110>

- Kang, H., Calabrese Barton, A., Tan, E. D., Simpkins, S., & RheeTurner, H. Y. C. (2019). How do middle school girls of color develop STEM identities? Middle school girls' participation in science activities and identification with STEM careers. *Science Education*, 103(2), 418–439. <https://doi.org/10.1002/sce.21492>
- LeFevre, A. L., & Shaw, T. V. (2012). Latino parent involvement and school success: Longitudinal effects of formal and informal support. *Education and Urban Society*, 44(6), 707–723. <https://doi.org/10.1177/0013124511406719>
- Lopez, N. (2003). *Hopeful girls, troubled boys: Race and gender disparity in urban education*. Routledge.
- Maltese, A. V., & Tai, R. H. (2011). Pipeline persistence: Examining the association of educational experiences with earned degrees in STEM among U.S. students. *Science Education*, 95 (5), 877–907. <https://doi.org/10.1002/sce.20441>
- McGuire, S., & Shanahan, L. (2010). Sibling experiences in diverse family contexts. *Child Development Perspectives*, 4(2), 72–79. <https://doi.org/10.1111/j.1750-8606.2010.00121.x>
- McHale, S. M., Updegraff, K. A., & Whiteman, S. D. (2012). Sibling relationships and influences in childhood and adolescence. *Journal of Marriage and Family*, 74(5), 913–930. <https://doi.org/10.1111/j.1741-3737.2012.01011.x>
- Mena, J. A. (2011). Latino parent home-based practices that bolster student academic persistence. *Hispanic Journal of Behavioral Sciences*, 33(4), 490–506. <https://doi.org/10.1177/0739986311422897>
- National Science Foundation, National Center for Science and Engineering Statistics (2019). *Women, Minorities and Persons with Disabilities in Science and Engineering*. Special report NSF 19–304. Alexandria, VA. <https://www.nsf.gov/statistics/wmpd>
- Navarro, R. L., Flores, L. Y., & Worthington, R. L. (2007). Mexican American middle school students' goal intentions in mathematics and science: A test of social cognitive career theory. *Journal of Counseling Psychology*, 54(3), 320. <https://doi.org/10.1037/0022-0167.54.3.320>
- O'Sullivan, R. H., Chen, Y. C., Fish, M. C. (2014). Parental mathematics homework involvement of low-income families with middle school students. *School Community Journal*, 24(2), 165–188. <https://eric.ed.gov/?id=EJ1048611>
- Portes, A., & Rumbaut, R. G. (2014). *Immigrant America: A portrait* (4th ed.). University of California Press.
- 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. <http://genderandset.open.ac.uk/index.php/genderandset/article/view/661/1094>
- Rivas-Drake, D., & Marchand, A. (2016). Academic socialization among Latino families: Exploring the compensatory role of cultural processes. *Research in Human Development*, 13(3), 225–240. <https://doi.org/10.1080/15427609.2016.1194708>
- Robinson, M. (2003). Student enrollment in high school AP science and calculus: How does it correlate with STEM careers? *Bulletin of Science, Technology and Society*, 23(4), 265–273. <https://doi.org/10.1177/0270467603256090>
- Saldaña, J. (2016). *The coding manual for qualitative researchers*. SAGE Publications.
- Sánchez, B., Reyes, O., & Singh, J. (2006). Making it in college: The value of significant individuals in the lives of Mexican American adolescents. *Journal of Hispanic Higher Education*, 5(1), 48–67. <https://doi.org/10.1177/1538192705282570>
- Simpkins, S. D., Vest, A. E., & Price, C. D. (2011). Intergenerational continuity and discontinuity in Mexican-origin youths' participation in organized activities: Insights from mixed-methods. *Journal of Family Psychology*, 25(6), 814–824. <https://doi.org/10.1037/a0025853>
- Simpkins, S. D., Fredericks, J., & Eccles, J. S. (2015a). The role of parents in the ontogeny of achievement-related motivation and behavioral choices. *Monographs of the Society for Research in Child Development*, 80(2), 119–137. <https://doi.org/10.1111/mono.12157>
- Simpkins, S. D., Price, C. D., & Garcia, K. (2015b). Parental support and high school students' motivation in biology, chemistry, and physics: Understanding differences among Latino and Caucasian boys and girls. *Journal of Research in Science Teaching*, 52(10), 1386–1407. <https://doi.org/10.1002/tea.21246>
- Simpkins, S., Estrella, G., Gaskin, E., & Kloberdanz, E. (2018). Latino parents' science beliefs and support of high school students' motivational beliefs: Do the relations vary across gender and familism values? *Social Psychology of Education*, 21(5), 1203–1224. <https://doi.org/10.1007/s11218-018-9459-5>
- Simpkins, S. D., Liu, Y., Hsieh, T. Y., & Estrella, G. (2019). Supporting Latino high school students' science motivational beliefs and engagement: Examining the unique and collective contributions

- of family, teachers, and friends. *Educational Psychology*, 1-21. <https://doi.org/10.1080/01443410.2019.1661974>
- Šimunović, M., & Babarović, T. (2020). The role of parents' beliefs in students' motivation, achievement, and choices in the STEM domain: A review and directions for future research. *Social Psychology of Education*, 23(3), 701–719. <https://doi.org/10.1007/s11218-020-09555-1>
- Solorzano, D. G., & Ornelas, A. (2004). A critical race analysis of Latina/o and African American advanced placement enrollment in public high schools. *The High School Journal*, 87(3), 15–26. <https://doi.org/10.1353/hsj.2004.0003>
- Soto-Lara, S., & Simpkins, S. D. (2020). Parent support of Mexican-descent high school adolescents' science education: A culturally grounded framework. *Journal of Adolescent Research*. <https://doi.org/10.1177/0743558420942478>
- Stanton-Salazar, R. D. (2001). *Manufacturing hope and despair: The school and kin support networks of US-Mexican youth*. Teachers College Press.
- Suarez-Orozco, C., Rhodes, J., & Milburn, M. (2009). Unraveling the immigrant paradox: Academic engagement and disengagement among recently arrived immigrant youth. *Youth and Society*, 41(2), 151–185. <https://doi.org/10.1177/0044118X09333647>
- Taningco, M. T. V., Mathew, A. B., & Pachon, H. P. (2008). STEM Professions: Opportunities and challenges for Latinos in science, technology, engineering, and mathematics: A review of literature. *Tomas Rivera Policy Institute*. <https://eric.ed.gov/?id=ED502063>
- Turiman, P., Omar, J., Daud, A. M., & Osman, K. (2012). Fostering the 21st century skills through scientific literacy and science process skills. *Procedia-Social and Behavioral Sciences*, 59, 110–116. <https://doi.org/10.1016/j.sbspro.2012.09.253>
- Updegraff, K. A., McHale, S. M., Whiteman, S. D., Thayer, S. M., & Delgado, M. Y. (2005). Adolescent sibling relationships in Mexican American families: Exploring the role of familism. *Journal of Family Psychology*, 19(4), 512. <https://doi.org/10.1037/0893-3200.19.4.512>
- Updegraff, K. A., McHale, S. M., Whiteman, S. D., Thayer, S. M., & Crouter, A. C. (2006). The nature and correlates of Mexican-American adolescents' time with parents and peers. *Child Development*, 77(5), 1470–1486. <https://doi.org/10.1111/j.1467-8624.2006.00948.x>
- Updegraff, K. A., McHale, S. M., Killoren, S. E., & Rodríguez, S. A. (2010). *Cultural variations in sibling relationships* (pp. 83–105). Implications for Mental Health Practitioners.
- Updegraff, K. A., & Umaña-Taylor, A. J. (2015). What can we learn from the study of Mexican-origin families in the United States? *Family Process*, 54(2), 205–216. <https://doi.org/10.1111/famp.12135>
- Valenzuela, A., & Dornbusch, S. M. (1994). Familism and social capital in the academic achievement of Mexican origin and Anglo. *Social Science Quarterly*, 75(1): 18–36. <https://www.jstor.org/stable/42863288>
- Valenzuela, A. (1999). *Subtractive schooling: Issues of caring in education of US-Mexican youth*. State University of New York Press.
- Zarate, M.E. (2007). Understanding Latino parental involvement in education: Perceptions, expectations and recommendations. *Tomas Rivera Policy Institute*. <https://eric.ed.gov/?id=ED502065>

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Perla Ramos Carranza is a doctoral student from the School of Education at the University of California, Irvine. Her research focuses on the influence of family involvement and organized activities on the educational trajectories of youth from underserved communities, particularly Latinx youth. Her research also seeks to explore the role of culture, immigrant experiences, intersectional identities, and sense of belonging in shaping youth's development.

Sandra D. Simpkins Ph.D. in developmental psychology, is a Professor at the University of California, Irvine School of Education. Her research addresses positive youth developmental processes, the influence of families and organized activities on those processes, and how these processes vary by social position factors (such as, ethnicity and gender). Her current projects focus on how youth's organized after-school activities support their positive adjustment into adulthood and how families help support adolescents' STEM motivation, activities, and choices.