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# Understanding the Role of Older Sibling Support in the Science Motivation of Latinx Adolescents

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**ABSTRACT**

Based on the expectancy-value theory, cultural microsystem model, and family systems theory, this study aimed to understand (a) the extent to which Latinx older siblings' support predicted the high school science motivational beliefs of their younger adolescent sibling, and (b) whether these relations varied based on older siblings' familism values and gender. This study included data on 104 Latinx adolescents in 9$^{th}$ grade and their older siblings. Quantitative regression analyses indicated that older siblings with high familism values were more likely to provide higher support. Older siblings' support did not predict science self-concept or task value for all youth; however, this relation was significant when the older sibling's familism values were high. Older sibling gender was unrelated to any indicators in this study. These findings suggest that familism values may play a significant positive role in Latinx sibling dyads, with older siblings who are more connected to their family serving as a significant resource to promote science motivation among their younger siblings.

**KEYWORDS**

familism, STEM, motivation, self-concept, task-value, science, Latinx, adolescents, sibling

# Understanding the Role of Older Sibling Support in the Science Motivation of Latinx Adolescents

Having a diverse STEM workforce is essential for the advancement of society in areas such as healthcare (Allen-Ramdial & Campbell, 2014). In addition, it is beneficial for all to expand their scientific understanding due to the many benefits it brings, such as being informed about environmental issues (Jones, 2018). However, certain groups are often marginalized and underrepresented in STEM; for example, Latinxs account for only 6% of the science and engineering workforce while accounting for 18% of the U.S. population (National Science Board, 2018). Latinx youth face several barriers and challenges when it comes to their STEM education. These challenges include taking less advanced math and science courses due to often being placed in remedial STEM and special education courses (Guiberson, 2009; Tyson, Lee, Borman, & Hanson, 2007), being stereotyped to be less competent in STEM, and facing discrimination and microaggressions (Andersen & Ward, 2014; Rosenbloom & Way, 2004).

Given the challenges that Latinx youth face in schools (Conchas, 2001), it is important to understand the individual and non-school contextual strengths that help support Latinx youth in science. Because having high STEM motivational beliefs has been suggested as one way to increase STEM persistence and achievement, the goal of this study is to test how adolescents' older siblings' support is associated with their science motivational beliefs (Andersen & Ward, 2014; Hazari, Sadler, & Sonnert, 2013; Kang et al., 2018). Older siblings are another family member who can be influential in adolescents' educational outcomes (Carolan-Silva & Reyes, 2013; Cox, 2010; Luna & Martinez, 2013), yet the majority of studies focus on parental support and on European-American students (Hill & Tyson, 2009; Simpkins, Price, & Garcia, 2015; Wigfield et al., 2015). The few studies on Latinx sibling dyads frequently highlight the role that older sibling gender and cultural values, such as the value placed on the family (i.e., familism), play in sibling relationship quality and support (Killoren et al., 2015; Killoren, Alfaro, & Kline, 2016; Streit et al., 2017). Hence, this study extends the literature by examining (a) the extent to which older sibling support is related to 9$^{th}$ grade Latinx students' science motivational beliefs, and (b) the extent to which older sibling support varies by older sibling gender and familism values.

## Sibling Support and STEM Motivation

The Eccles' expectancy-value theory of achievement motivation has often been used to examine what motivational factors predict students' STEM choices and achievement as well as contextual predictors of those motivational factors. It argues that an "individual's choice, persistence, and performance can be explained by their beliefs about how well they will do on the activity and the extent to which they value the activity" (Wigfield & Eccles, 2000, p. 68). Two core motivational beliefs associated with achievement motivation are ability self-concept, which relates to how the student views his/her competence within a certain task or activity, and subjective task value, which relates to the importance of the task, intrinsic value, and utility value (Wigfield & Eccles, 2000). Due to the importance of

these motivational beliefs for adolescents' academic achievement, choices, and overall engagement in science (Eccles & Wigfield, 2002; Guo et al., 2017), a main focus of the study was to examine predictors of these two motivational beliefs.

The expectancy-value theory also underscores family members as key socializers of students' motivational beliefs. Much of the existing empirical research on family support of students' STEM achievement motivation has primarily focused on parental support, including studies focused on Latinx families (Kang et al., 2018; Peralta, Caspary, & Boothe, 2013). The findings suggest that parental support usually positively predicts adolescents' math and science motivation (e.g., Bouchey & Harter, 2005; Simpkins, Fredricks, & Eccles, 2015). That said, preliminary work in the higher education literature suggests that although parent support remains important, siblings are a source of motivation and support for Latinx adolescents during this period (Carolan-Silva & Reyes, 2013; Hurtado-Ortiz & Gauvain, 2007; Luna & Martinez, 2013; Sánchez, Reyes, & Singh, 2006).

According to family systems theory, researchers need to examine the influence siblings have in order to fully understand how each component of the family system shapes adolescent development and behavior of adolescents, including their motivational beliefs (Cox, 2010; Cox & Pailey, 1997). Older siblings may play a larger role for their younger sibling if their parents were not able to graduate high school or are unfamiliar with the American educational system, which may be the case for many Latinx families with foreign-born parents (Flores, López, & Radford, 2017; Updegraff et al., 2010; Valenzuela, 1999). Aligned with family systems theory, most studies exploring the motivation of Latinx college students suggest that, aside from parents, siblings are a source of motivation as well as a source of support (Carolan-Silva & Reyes, 2013; Hurtado-Ortiz & Gauvain, 2007; Luna & Martinez, 2013; Sánchez, Reyes, & Singh, 2006).

A growing number of studies focus on Latinx sibling support and its relation to students' motivation during the adolescent period (Alfaro, Weimer, & Castillo, 2018; Luna & Martinez, 2013), with much of this research focusing on the quality of sibling relationships (Alfaro & Umaña-Taylor, 2010; Pomerantz, Moorman, & Litwack, 2007; Simpkins et al., 2006). Alfaro and Umaña-Taylor (2010), for example, found that sibling relationship quality significantly predicted greater sibling academic support and adolescent academic motivation. In general, researchers have highlighted how sibling support positively predicts academic achievement, including math grades and academic adjustment (Alfaro & Umaña-Taylor, 2010; Azmitia, Cooper, & Brown, 2009; Bouchey, Shoulberg, Jodl, & Eccles, 2010).

**Older Sibling Familism, Gender, and Support**

Even though the expectancy-value theory and family systems theory state that culture is a critical factor in shaping family processes, these theories frame it as an external factor rather than as an inseparable and integral component of behavior and consequentially, development. Sociocultural perspectives, for example, define culture as "informed by racial and ethnic categories…[and] is produced in cultural settings between people" (Nasir & Hand, 2006, p. 458). In this study, we draw on

the cultural microsystem model, which is an adaptation from the bioecological theory (Bronfenbrenner & Morris, 1998) that is influenced by sociocultural theories (Vélez-Agosto et al., 2017). According to Vélez-Agosto and colleagues (2017), culture is present in the proximal and distal processes, including those of sibling interactions. Similar to family systems theory, the cultural microsystem views development as part of a *cultural* system, referring to the context that the developing person is in, but it places cultural processes at the forefront of everyday behaviors and interactions. In sum, the cultural microsystem model acknowledges how cultural characteristics, such as older siblings' familism values and gender, may impact the interactions between the developing child and others.

Among Mexican-origin and other Latinx groups, familism is a common set of values that is characterized by the importance of the family to one's identity and decisions (Knight et al., 2010; Stein et al., 2014) and includes giving and receiving family support (Azmitia, Cooper, & Brown, 2009). At times, familism has been subject to criticism since some suggest it is a deterrent for achieving educational goals (Desmond & Turley, 2009; Niemann, Romero, & Arbona, 2000). However, it has also been cited as a protective factor for a number of positive adolescent outcomes, such as closer family relationships, lower externalizing behaviors, and higher levels of academic achievement (Germán, Gonzales, & Dumka, 2009; Streit et al., 2017). Studies that focus on the role of familism values in sibling relationships highlight its association to stronger and closer sibling relationships as well as how these positive sibling relationships are related to better developmental outcomes (Calderón-Tena, Knight, & Carlo, 2011; Killoren, Alfaro, & Kline, 2016; Wheeler et al., 2017). Though this work demonstrates the direct positive effects of familism on adolescents' academic adjustment, we argue that it can also strengthen the potential impacts of sibling support on adolescents' adjustment. For example, parent support was a stronger predictor of adolescents' science motivational beliefs when adolescents held higher familism values and weaker when adolescents held lower familism values (Simpkins et al., 2018). One goal of this study is to extend the existing literature on familism to test if older siblings' familism values moderate (or alter) the association between older siblings' support and adolescents' science motivational beliefs.

Latinx sibling relationships are also influenced by culturally-grounded gender socialization and the gender roles that shape family life, which aligns with the cultural microsystem model's argument of how cultural values and norms shape not only the broader society but also shape the interactions within individuals. Older siblings in Latinx families are expected to help with the caregiving of younger siblings, which can include not only taking care of younger siblings but also helping in other tasks such as tutoring (Valenzuela, 1999). Although Valenzuela (1999) did not find a gender difference in terms of caring for younger siblings, there are other studies that emphasize the caregiving role assigned to girls among Latinx families (East & Hamill, 2013; Raffaeilli & Ontai, 2004). In relation to gender socialization, Killoren and colleagues (2015) note that having an older sister was related to having a closer sibling relationship, which was further associated with higher familism values. Others have also found that, generally, older sisters tend to give greater support compared to older brothers due to the closer relationships they

have with their younger siblings (Bouchey et al., 2010; Hollifield & Conger, 2015). Because of the prevalent finding of older sisters giving greater support, this study will also test the extent to which older sibling gender relates to how much support they give and ultimately how older sibling support and adolescents' science motivational beliefs may differ based on older sibling gender.

**Current Study**

Due to the many benefits associated with science involvement and the limited work on Latinx older sibling support in regard to academic outcomes, this study focuses on testing associations among older siblings' familism values, gender, and science support with adolescents' science motivational beliefs (i.e., ability self-concept and task-value). Prior literature suggests that higher familism values and having an older sister is associated with closer sibling relationships (Bouchey et al., 2010; Hollifield & Conger, 2015; Killoren, Alfaro & Kline, 2016). Thus, it is hypothesized that greater familism values and having an older sister will be positively related to older sibling support. Because parental support has been positively related to adolescents' STEM motivational beliefs and sibling support has been related to general adolescents' academic motivation and achievement (Azmitia, Cooper & Brown, 2009; Carolan-Silva & Reyes, 2013; Simpkins, Fredricks & Eccles, 2015), it is hypothesized that the support older siblings give will be positively related to their younger sibling's 9$^{th}$ grade science motivational beliefs. Lastly, it is hypothesized that the support of older sisters and older siblings with greater familism values will be more strongly associated with adolescents' science motivational beliefs as compared to older brothers and older siblings with weaker familism values.

## METHOD

**Participants**

The study drew upon data collected from three public high schools in a large southwestern metropolitan city in the U.S. The three schools (School A = 63 students; School B = 14 students; School C = 27 students) were selected because they served a significant number of Latinx students (22.79% - 48.40%), had different school ratings (School A and C letter grade = A; School B letter grade = C) and title status (School B = Title 1 status while Schools A and C did not qualify), as well as different science achievement levels (60% of students in Schools A and C and 29% in School B passed the state science exam).

There were 104 9$^{th}$ grade Latinx students (40.38% female, *M* age = 14.54; *SD* = .52, see Table 1) that were recruited along with their older sibling or cousin (50% female, *M* age = 18.12; *SD* = 2.44) and parents. Among the sibling sample, 15 were older cousins and 89 were older siblings.[1] All except one older sibling had taken at least 1 year of science courses in high school. All 9$^{th}$ grade participants came from a Latinx background, with the majority being of Mexican-origin (~89%). The majority of the 9$^{th}$ grade (*n* = 89) and older sibling participants (*n* = 85) were U.S. born whereas 30-33% of the mothers and spouses were U.S. born (*n* = 60), with the majority of foreign-born being born in Mexico. The average parental income was between $30,000 and $49,000. The majority of 9$^{th}$ grade participants came from 2-parent households (60%) where parents had a high school degree or less (55% of mothers and 74% of spouses).

**Procedures**
Data came from a more complex longitudinal study, which included surveys, qualitative interviews, and video data on family interactions across three years. Participants included one parent, older sibling or cousin, and adolescent in each family. Due to the lengthy process and amount of data collected from participants, each participant was compensated with $50 each year. All procedures were IRB and school approved. Participants were assured that they would be compensated regardless of whether they finished study procedures during the individual consent and assent portions of the study. The data for the current study were primarily collected through individual surveys given to each high school adolescent, older sibling or cousin, and parent, which were all filled out in participants' homes. Surveys were provided in both English and Spanish and were collected when adolescents were in 9th grade during the 2012-2013 school year. All except for one 9th grade adolescent and three older siblings completed the survey in English. Spanish-fluent research assistants collected the data and translated the surveys with forward-translation and panel/group method approach (Knight et al., 2009).

**Measures**
All measures and scale items from the surveys are provided in the appendix.

*Older sibling characteristics.* Older siblings reported their gender with a dichotomous variable (1 = *Female*; 0 = *Male*). They also reported their familism values using a 15-item scale from Knight and colleagues (2010) that referred to placing the family first and having close family relationships (e.g., "Parents should teach their children that the family always comes first"; "Older kids should take care of and be role models for their younger brothers and sisters"; $\alpha$ = 0.90; 1 = *Not at all*, 5 = *Completely*).

*Older sibling support.* Older siblings reported the support they provided their younger sibling through a 25-item scale based on two prior measures and was adapted to focus on science (Bouchey & Harter, 2005; Simpkins et al., 2015). The scale included items that measured different types of support, such as conversations in science (e.g., "How often do you talk to [adolescent] about how things are going in [his/her] science classes") and encouragement (e.g., "How often do you praise [adolescent] for his/her school work in science"). All items were averaged to create a composite score representing overall sibling support ($\alpha$ = 0.93; 1 = *Never*, 5 = *Always*). Simpkins and colleagues (2015) have previously utilized this same scale to measure parent support and suggested using the overall scale rather than utilizing multiple highly correlated subscales in order to prevent multicollinearity issues during analyses. The scale is also further validated due to its strong measurement invariance across 9th grade Latinx and European-American students (Simpkins et al., 2015).

*Adolescent science motivational beliefs.* Adolescents reported on their science ability self-concept and task value (Eccles et al., 1993; Jacobs et al., 2002). Four ability self-concept items were asked for biology, chemistry, and physics creating a total of 12 items that were averaged to create an overall science ability self-concept score ($\alpha$ = 0.93; ;1 = *Not at all good*, 7 = *Very good*). For task-value, there were 5

items for each science subject, creating a total of 15 items that were averaged to create an overall science task value score ($\alpha$ = 0.94; 1 = *Not at all good*, 7 = *Very good*). These scales have demonstrated strong measurement invariance across Latinx and European-American students (Simpkins et al., 2015) and have also shown excellent validity (Jacobs et al., 2002; Simpkins et al., 2018; Simpkins et al., 2015).

*Covariates.* The covariates included parent education and adolescent gender due to their relations with the focal indicators (Funk & Parker, 2018; Hazari, Sadler, & Sonnert, 2013; Simpkins et al., 2015). Parent education was parent-reported and measured the highest level of education completed among parents (1 = *Less than a high school degree*; 6 = *More than a college degree*). Adolescent gender was reported by the adolescent (1 = *Female*; 0 = *Male*). Additionally, we controlled for schools B and C while school A remained as the reference group.

**Data Analysis Plan**

In order to address the research aims, multiple linear regressions with school fixed effects were conducted in Stata 14.2. Experts have demonstrated that fixed effects models are reliable when researchers have nested data (e.g., students nested within schools) with less than 20 or 30 clusters (i.e., schools) (McNeish & Stapleton, 2016). Moreover, fixed effects models are useful when researchers' hypotheses are focused at the individual level (i.e., level 1) and not at the school level (i.e., level 2), which is the case in the current study. School fixed effects models are a suitable method to account for potential biased findings and account for between-school variation with nested data (O'Dwyer & Parker, 2014). We estimated school fixed effects models by controlling for each school by including the two school dummy-coded variables (McNeish & Stapleton, 2016; O'Dwyer & Parker, 2014). The following covariates were controlled for in all of the regression analyses: highest level of parental education, schools B and C, and adolescent gender. Because only one person had missing data on the motivational belief outcomes, they were dropped from the analyses, creating a total sample of 103 adolescents and their siblings.

Under our first hypothesis, we expected older siblings' familism values and being female to positively predict the support they provided their younger sibling in science. To test this, we estimated two stepwise regressions with fixed effects, one for each predictor of interest. The first regression model included only the control variables. The second regression model included both the control variables as well as the main predictor (i.e., older sibling familism values or older sibling gender).

Our second hypothesis was that older sibling support would predict adolescents' science ability self-concept and task value. This hypothesis was tested by a stepwise regression with fixed effects. The first regression model included the control variables. The second regression model included the control variables and older sibling support. In addition to this main effect, we also expected that the positive relation between sibling support and adolescents' science motivational beliefs would be stronger when older siblings had higher familism values and were sisters. Thus, the third and fourth regression models included the control variables,

the main effect of older sibling support, either the main effect of older sibling familism or gender, and the interaction between support and older sibling familism or gender. Predictors in the regression analyses were mean centered before testing the interaction. For significant interactions, simple slope analyses were conducted (Dearing & Hamilton, 2006).

## RESULTS

### Descriptive Statistics

Descriptive statistics for the study variables can be found in Table 1. Older siblings on average "sometimes" gave their younger siblings science support, reflecting average levels of sibling support in science ($M$ = 2.42, $SD$ = .73 on a 1 to 5 scale). However, the average levels of familism values among older siblings were high ($M$ = 4.18, $SD$ = .55 on a 1 to 5 scale). Adolescents, on average, rated themselves as having slightly higher levels of science self-concept ($M$ = 4.29, $SD$ = .92 on a 1 to 7 scale) and task-value beliefs ($M$ = 4.72, $SD$ = .98 on a 1 to 7 scale). Sibling support and familism values were positively correlated ($r$ = .35, $p$ < .001) as was adolescents' science ability self-concept and task-value ($r$ = .58, $p$ < .001).

Table 1
*Descriptive Statistics and Bivariate Correlations of Study Variables*

| | Variable | 1. | 2. | 3. | 4. | 5. | 6. | 7. |
|---|---|---|---|---|---|---|---|---|
| 1. | Sibling support | 1 | | | | | | |
| 2. | Sibling familism | .35*** | 1 | | | | | |
| 3. | Sibling female | .16 | -.02 | 1 | | | | |
| 4. | Adolescent female | .03 | .06 | .12 | 1 | | | |
| 5. | Adolescent science task-value | .17+ | -.11 | .06 | -.10 | 1 | | |
| 6. | Adolescent science self-concept | .13 | -.02 | -.01 | -.03 | .58*** | 1 | |
| 7. | Parental education [a] | -.12 | -.11 | .05 | -.18+ | -.16 | .05 | 1 |
| | *M* / % | 2.42 | 4.18 | 50% | 40% | 4.72 | 4.29 | 3.16 |
| | *SD* | 0.73 | 0.55 | 0.50 | 0.49 | 0.98 | 0.92 | 1.58 |
| | Min | 1.09 | 2.67 | 0.00 | 0.00 | 1.73 | 1.75 | 1.00 |
| | Max | 4.48 | 5.00 | 1.00 | 1.00 | 6.73 | 6.50 | 6.00 |
| | Skewness | 0.52 | -0.43 | 0.00 | 0.39 | -0.39 | -0.33 | 0.04 |
| | Kurtosis | 2.93 | 2.66 | 1.00 | 1.15 | 3.23 | 3.40 | 1.92 |
| | % Missing | 0 | 0 | 0 | 0 | 0.96% | 0.96% | 0 |

*Note:* [a]Parental education was measured on a 1 to 6 scale, with a 1 indicating less than a high school degree and a 6 indicating more than a college degree. Because parent reports also included the spouses' level of education, parental education was determined by the highest level of education completed among the parents.
* $p<0.05$. ** $p<0.01$. *** $p<0.001$. $^{+}p<0.10$.

**Older Siblings' Familism Values, Gender, and Support in Science**

The first research aim was to understand whether older siblings' familism values and gender predicted the support they gave their younger sibling in science (see Table 2). Stepwise regressions suggest that older siblings who endorsed higher levels of familism values were more likely to give greater support to their younger sibling in science (ß = .33, *SE* = .09, $p < .01$). In contrast, sibling gender was not significantly related to how much support they gave their younger sibling (ß = .37, *SE* = .20, $p = .06$) though there was a trend suggesting older sisters gave greater support compared to older brothers.

Table 2
*Stepwise Regression Analyses of Sibling Familism Values and Sibling Gender and its Relation to Sibling Support*

| Predictor | Model 1 β (SE) | Model 2 β (SE) | Model 3 β (SE) |
|---|---|---|---|
| Constant | .00 | -.01 | -.15 |
| | (.14) | (.13) | (.16) |
| Parental education | -.08 | -.05 | -.09 |
| | (.11) | (.10) | (.10) |
| Adolescent female | .05 | -.00 | .02 |
| | (.21) | (.20) | (.21) |
| School B (Coronado) | .36 | .39 | .32 |
| | (.30) | (.28) | (.20) |
| School C (MPHS) | -.28 | -.19 | -.32 |
| | (.24) | (.23) | (.24) |
| Sibling familism | | .33** | |
| | | (.09) | |
| Sibling female | | | .37+ |
| | | | (.20) |
| $R^2$ | .05 | .16 | .09 |
| Adjusted $R^2$ | .01 | .11 | .04 |
| Observations | 103 | 103 | 103 |

*Note:* Standard errors in parentheses. Beta coefficients are standardized.
* $p<0.05$. ** $p<0.01$. *** $p<0.001$. + $p<0.10$.

**Older Siblings' Support and Adolescents' Science Motivational Beliefs**

The second research aim of the study was to understand the extent to which older sibling support was related to adolescent science motivation (see Table 3). The regression results indicated that there was no main effect for older sibling support on either ability self-concept (ß = .19, *SE* = .10, $p = .06$) or task-value (ß = .19, *SE* = .10, $p = .06$). However, both of these main effects exhibited a positive trend where greater sibling support was positively related to adolescent science motivational beliefs.

Table 3
*Stepwise Regression Analyses of Predictors on 9th Grade Science Motivational Beliefs*

| | Self-Concept | | | | Task Value | | | |
|---|---|---|---|---|---|---|---|---|
| | Model 1 | Model 2 | Model 3 | Model 4 | Model 1 | Model 2 | Model 3 | Model 4 |
| Predictor | β (SE) | β (SE) | β (SE) | β (SE) | β (SE) | β (SE) | β (SE) | β (SE) |
| Constant | -.09 | -.10 | -.11 | -.04 | .04 | .04 | .03 | .00 |
| | (.14) | (.14) | (.14) | (.16) | (.14) | (.14) | (.13) | (.16) |
| Parental education | -.04 | -.02 | -.02 | -.02 | -.25* | -.23* | -.24* | -.24* |
| | (.10) | (.10) | (.10) | (.10) | (.10) | (.10) | (.10) | (.10) |
| Adolescent female | -.16 | -.17 | -.08 | -.16 | -.35 | -.36+ | -.23 | -.37+ |
| | (.21) | (.21) | (.21) | (.21) | (.21) | (.20) | (.20) | (.21) |
| School B | -.02 | -.08 | -.13 | -.07 | -.07 | -.14 | -.23 | -.15 |
| | (.30) | (.29) | (.29) | (.30) | (.29) | (.29) | (.28) | (.30) |
| School C | .61 | .66** | .59* | .68** | .43+ | .49* | .38 | .48+ |
| | (.24) | (.24) | (.24) | (.24) | (.24) | (.24) | (.23) | (.24) |
| Sibling support | | .19+ | .17 | .21 | | .19+ | .21+ | .19 |
| | | (.10) | (.11) | (.15) | | (.10) | (.10) | (.15) |
| Sibling familism | | | -.03 | | | | -.16 | |
| | | | (.10) | | | | (.10) | |
| Sibling familism x sibling support | | | .19+ (.10) | | | | .22* (.10) | |
| Sibling gender | | | | -.13 | | | | .08 |
| | | | | (.20) | | | | (.20) |
| Sibling gender x sibling support | | | | -.01 (.20) | | | | -.02 (.20) |
| $R^2$ | .07 | .10 | .14 | .11 | .08 | .11 | .19 | .12 |
| Adjusted $R^2$ | .03 | .05 | .07 | .04 | .04 | .07 | .13 | .05 |
| Observations | 103 | 103 | 103 | 103 | 103 | 103 | 103 | 103 |

*Note:* Standard errors in parentheses. Beta coefficients are standardized.
* $p<0.05$. ** $p<0.01$. *** $p<0.001$. + $p<0.10$.

**Older Siblings' Familism Values and Gender as Moderators**

The last research aim was to understand the extent to which older sibling gender and familism values moderated the association between sibling support and adolescent science motivational beliefs (see Table 3). Testing older sibling gender and familism values as moderators allowed us to examine for whom older sibling support predicts adolescent science motivational beliefs. Contrary to our research hypotheses, older sibling gender did not moderate or alter the relations between sibling support and motivational beliefs (self-concept: ß =-.01, *SE* = .20, *p* = .95; task-value: ß = -.02, *SE* = .20, *p* = .93). In other words, the relation between older sibling support and adolescent motivational beliefs was similar for adolescents with older sisters and older brothers.

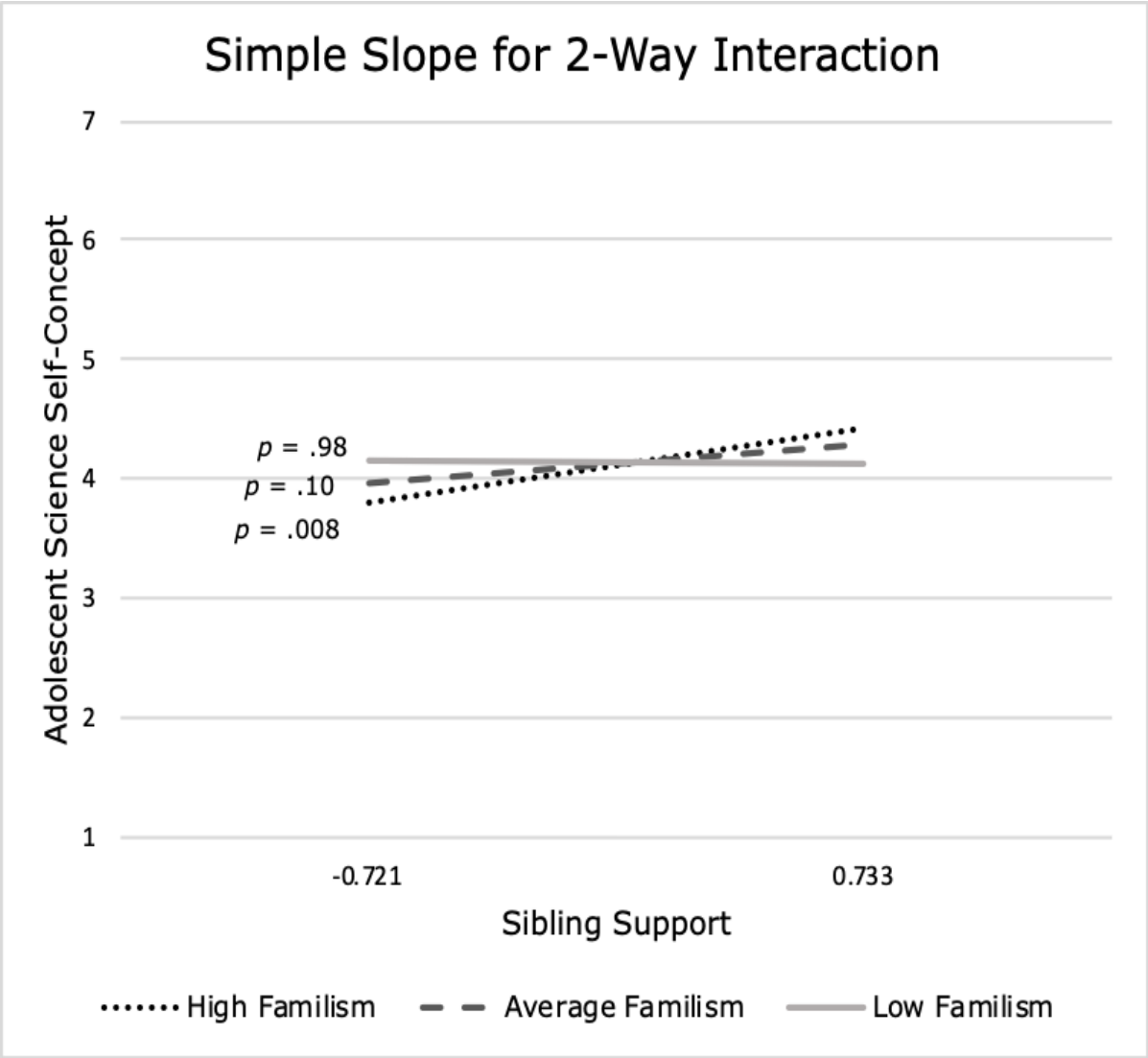


*Figure 1.* Simple slope analysis for the 2-way interaction between sibling support and sibling familism values on adolescent science self-concept.

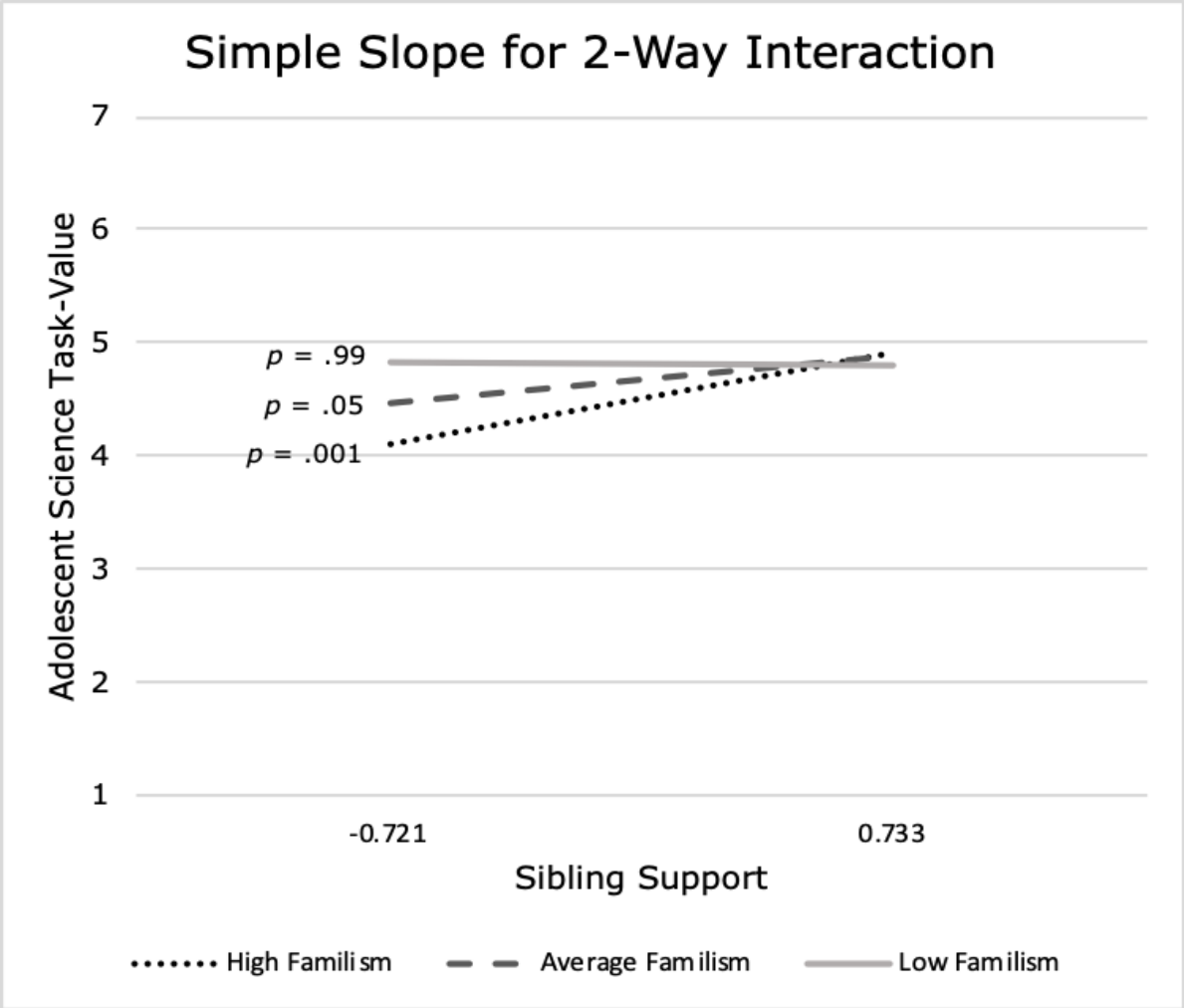


*Figure 2.* Simple slope analysis for the 2-way interaction between sibling support and sibling familism values on adolescent science task-value.

Consistent with our hypothesis, older sibling familism values did moderate the relations between sibling support and certain motivational beliefs. The interaction between older sibling support and familism values was significant at the trend level when predicting adolescent science ability self-concept (ß = .19, *SE* = .10, *p* = .07) and significant at the *p* < .05 level when predicting adolescent science task value (ß = .22, *SE* = .10, *p* < .05). The significant interactions mean that the relation between older sibling support and adolescent motivational beliefs changed depending on the older sibling familism values. The simple slope analysis was used to test if the relations between older sibling support and adolescent motivational beliefs were significant when the older sibling held low, average, and high levels of familism values. The findings shown in Figure 1 revealed that older sibling support positively predicted adolescent science self-concept when the older sibling held high familism values (ß = .43, *SE* = .16, *t* = 2.73, *p* = .008), but not when the older sibling held average (ß = .21, *SE* = .13, *t* = 1.64, *p* = .10) or low familism values (ß = -.01, *SE* = .19, *t* = -.03, *p* = .98). Similarly, the findings shown in Figure 2 revealed that older sibling support positively predicted adolescent task values when

the older sibling held high familism values (ß = .56, *SE* = .17, *t* = 3.38, *p* = .001) and a positive trend when the older sibling held average familism values (ß = .28, *SE* = .14, *t* = 2.00, *p* = .05), but not when the older sibling held low familism values (ß = -.00, *SE* = .20, *t* = -.01, *p* = .99). In sum, the significant interactions between older sibling familism values and older sibling support indicate that the association between older sibling support and adolescent science motivational beliefs was stronger when older siblings endorsed higher levels of familism values.

## DISCUSSION

Whether or not individuals pursue a science career or continue to be involved in science is highly influenced by how they view their abilities in science and how much they value science (Wigfield & Eccles, 2000). For Latinx students, these motivational beliefs and their predictors are key for finding ways to increase their representation in the science field and/or keep them involved in science. Even if they do not pursue science careers, having access to science knowledge and engaging in science will benefit both Latinx youth and society. Based on the Eccles' expectancy-value theory, this study tested the extent to which the support Latinx older siblings provided was related to the motivational beliefs of their younger sibling in high school. We also analyzed whether older siblings' familism values and gender would predict older sibling support and also strengthen the association between older sibling support and adolescent science motivational beliefs. The key findings were: (1) older siblings who had greater levels of familism values reported giving greater support in science to their younger sibling; (2) older sibling support was a stronger predicter of adolescent science motivational beliefs when older siblings had high familism values; and (3) older sibling gender was not strongly associated with the indicators at hand.

Our findings support past research indicating the importance of sibling support for the academic motivation of Latinx adolescents (Alfaro, Weimer & Castillo, 2018; Alfaro & Umaña-Taylor, 2010; Luna & Martinez, 2013). However, this association was only significant when older siblings had higher familism values, suggesting that this process was evident under a certain family context. This patterned emerged for adolescents' ability self-concept and task value, though the overall interaction was just at the trend level for ability self-concept and should be interpreted with caution. These positive findings for familism values contrast studies arguing familism values as a possible hindrance to educational goals (Desmond & Turley, 2009; Niemann, Romero, & Arbona, 2000). Our findings extend the sibling literature by focusing on science specifically rather than general academic outcomes (Alfaro & Umaña-Taylor, 2010; Luna & Martinez, 2013).These findings also expand the work on parent support based on the expectancy-value theory, which argues that key family socializers, including siblings, can be related to adolescents' ability self-concept and task value (Simpkins, Fredricks & Eccles, 2015; Wigfield & Eccles, 2000). The current findings also underscore the importance of the cultural milieu in these motivational beliefs as outlined by the expectancy-value theory (Wigfield & Eccles, 2000) and also emphasizes the presence of culture in proximal processes as outlined by the cultural microsystem model (Vélez-Agosto et al., 2017).

Why might older sibling support be predictive of motivational beliefs when they have high familism values? Familism could be a marker of relationship quality as Latinxs with higher familism values report closer and positive sibling relationships (Killoren, Alfaro, & Kline, 2016; Wheeler et al., 2017), which aligns with parenting research suggesting that the impact of specific supportive behaviors varies considerably depending on the quality of the overall relationship (Alfaro & Umaña-Taylor, 2010; Pomerantz, Moorman, & Litwack, 2007; Simpkins et al., 2006). Older siblings who endorse greater familism values may have closer relationships that then strengthen the association between their support and their siblings' science motivational beliefs. A closer sibling relationship may also allow adolescents to feel comfortable reaching out to their older siblings for academic support. Finally, these closer relationships may involve positive interactions and conversations between the siblings that then encourage the younger sibling to have a better view of their science abilities and to value science. Such processes have been found among parent-child relationships, where parents who had more conversations with their child about STEM predicted greater number of STEM courses taken in high school due to increases in utility value (Harackiewicz et al., 2012). Moreover, studies on Latinx adolescents in college highlight the phenomenon of *ganas*, where Latinx siblings are motivated to achieve higher education in order to give back to their parents (Easley, Bianco, & Leech, 2012). This could be considered an aspect of familism as it aligns with the family's influence on Latinx youth's identity and informs their goals. Older siblings with high familism values may be further endorsing *ganas*, which may motivate them to support their younger sibling and also emphasize the utility of science as a way to give back to their family.

Contrary to some of the literature, our results indicated that older sibling support and its relation to adolescent motivational beliefs did not vary by older sibling gender. A large portion of the literature on sibling relationships notes closer relationships and greater familism values among older sisters as compared to older brothers due to the caregiving role assigned to females in Latinx families (Bouchey et al., 2010; East & Hamill, 2013; Hollifield & Conger, 2015). However, our findings did not support our hypothesis that older sisters would provide more support and that their support would be more strongly related to adolescents' motivational beliefs compared to older brothers. This may be in part because of the gender notions surrounding science where, depending on the subject, are often stereotyped as more "masculine" (Frome, Alfeld, Eccles, & Barber, 2006; Schoon & Eccles, 2014) as well as the low representation of Latinxs in science. Thus, older siblings, regardless of gender, may support a younger sibling who wants to pursue science. Another reason why older sibling gender may not have moderated the association is due to the moderation of high familism values. Among Mexican immigrant households with high familism values, Valenzuela (1999) highlights how older siblings, regardless of gender, were involved in the caretaking of younger siblings, including serving as tutors and educational guides. Additionally, if older siblings have high or moderate familism values, they may be more prone to supporting their younger sibling in science compared to older siblings with low familism values.

**Limitations and Future Studies**

A main limitation of the study was the small sample size as well as the cross-sectional nature of the study. To our knowledge, there have been few studies, if any, that have focused on Latinx older sibling support and Latinx adolescent science motivational beliefs. The current findings of this study provide some key evidence that should be further examined with larger sample sizes and increased power. Having a larger sample size both in terms of the number of students and the number of schools would also afford more opportunities to study within-group differences more extensively, such as differences across immigrant generations, different Latinx ethnic groups, or differences across different school settings (e.g., ethnic composition of the school, school science resources, etc.).

It would also be beneficial to understand when and what type of sibling support is most helpful. For example, an older sibling may be a particularly important protective factor when adolescents face challenges, such as microaggressions, which are common experiences for Latinx youth in school (Andersen & Ward, 2014; Conchas, 2001; Rosenbloom & Way, 2004). Additionally, most studies on sibling support among Latinx families focus on the college transition and college years (Carolan-Silva & Reyes, 2013; Luna & Martinez, 2013; Sánchez, Reyes, & Singh, 2006). However, the common types of support and which type of support may differ by the developmental period and may be based on the needs of the developing individual (Eccles et al., 1993). For example, how does older siblings' support differ when their younger sibling is in elementary school compared to college? Exploring sibling support at different ages would further extend the literature on family systems theory and the cultural microsystem model as this would look into the function of the chronosystem and the effect of the chronosystem on the family system (Bronfenbrenner & Morris, 1998).

Although sibling support typically has positive effects on younger siblings, it could also have negative effects. For example, sometimes de-identification processes, which refer to the formation of separate identities, emerge among siblings when siblings aim to differentiate from each other in aspects such as careers and extracurricular activities (Bouchey et al., 2010). If the younger sibling aims to de-identify from the older sibling's pursuit of science, older sibling science support could lead to academic maladjustment (Bouchey et al., 2010; McHale, Updegraff, & Whiteman, 2012). Future studies should examine when older sibling support has a positive influence and when it also has a negative influence in order to further understand the role of older siblings in their younger siblings' science motivation.

**Conclusion**

In addition to extending the literature on Latinx older sibling support and adolescent science motivation, the findings of this study highlight the need to consider cultural values and family strengths when promoting the science motivation of Latinx adolescents. In order to increase Latinx representation in science fields, it is essential to understand all sources of support within the family, including parents and siblings. Focusing on just parents and their support neglects a key socializer among Latinx families. Because familism values are related to sibling support, researchers and educators interested in interventions should consider how

they can make their interventions culturally responsive by including these cultural strengths of Latinx families.

## ENDNOTES

1. We examined differences between older siblings and older cousins. Older siblings and cousins did not differ in the support they gave the younger adolescent, $d$ = -.11, or their familism values, $d$ = .06. There were also no mean-level differences in terms of the levels of the younger adolescent's science self-concept, $d$ = -.19, and task-value, $d$ = -.19. In terms of backgrounds, older siblings and cousins did not significantly differ in their age, whether they worked, years of science classes taken, interest in science, nor in their confidence in the different science subjects, $d$ = -.52 - .26.

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## APPENDIX

### Sibling Familism Scale

1. Parents should teach their children that the family always comes first.
2. Children should be taught that it is their duty to care for their parents when their parents get old.
3. Children should always do things to make their parents happy.
4. Family provides a sense of security because they will always be there for you.
5. If a relative is having a hard time financially, one should help them out if possible.
6. When it comes to important decisions, the family should ask for advice from close relatives.
7. It is always important to be united as a family.
8. A person should share their home with relatives if they need a place to stay.
9. It is important to have close relationships with aunts/uncles, grandparents, and cousins.
10. Older kids should take care of and be role models for their younger brothers and sisters.
11. Children should be taught to always be good because they represent the family.
12. Holidays and celebrations are important because the whole family comes together.
13. Parents should be willing to make great sacrifices to make sure their children have a better life.
14. A person should always think about their family when making important decisions.
15. It is important to work hard and do one's best because this work reflects on the family.

### Sibling Support Scale

1. How often do you buy science supplies, like equipment, books, games, or things to help study?
2. How often do you help enroll [TEENAGER] in science lessons, workshops, or tutoring programs outside of class?
3. How often do you tell [TEENAGER] that (he/she) is good at science?
4. How often do you talk to [TEENAGER] about how things are going in (his/her) science classes?
5. How often do you give [TEENAGER] rewards for good performance in science?
6. How often do you make sure [TEENAGER] has a space or time to work on science homework?
7. How often do you pressure [TEENAGER] to do well in science?
8. How often do you encourage [TEENAGER] to work with friends or family members who are good at science?
9. How often do you talk about college majors and careers in science?
10. How often do you tell [TEENAGER] how important doing well in science will be for (his/her) future?

11. How often do you check or ask if [TEENAGER]'s science homework is complete?
12. How often do you help [TEENAGER] do (his/her) science work?
13. How often do you take [TEENAGER] to a science museum, zoo, or event?
14. How often do you watch science television shows with [TEENAGER]?
15. If yes, please specify.
16. How often do you look at science websites with [TEENAGER]?
17. If yes, please specify.
18. How often do you talk about news or current events related to science?
19. How often do you praise [TEENAGER] for (his/her) school work in science?
20. How often do you help [TEENAGER] feel better when science is hard?
21. How often do you like how [TEENAGER] does things in science?
22. How often do you say nice things about [TEENAGER]'s grades in science?
23. How often do you like [TEENAGER]'s study habits in science?
24. How often do you teach [TEENAGER] about things (he/she) needs to know?
25. How often do you teach [TEENAGER] about things (he/she) wants to know in science?

**Adolescent Science Motivational Beliefs Scales**
Each item was repeated for each science subject.

***Self-concept:***

1. How good at biology are you? (1= Not at all good, 2=2,3=3, 4= Somewhat good, 5=5,6=6, 7= Very good)
2. How good would you be at learning something new in biology? (1=Not very good, 4= Somewhat good, 7= Very good)
3. Compared to other 9th grade students, how good are you at biology? (1= A lot worse, 4= About the same, 7= A lot better)
4. If you were to list all of the 9th grade students from best to worst in biology, where are you? (1= One of the worst, 4= In the middle, 7= One of the best)

***Task-value:***

5. I find doing biology: (1= Very boring, 4= Neither boring nor interesting, 7= Very interesting)
6. How much do you like biology? (1= A little, 4= Somewhat, 7= A lot)
7. For me, being good in biology is: (1= Not at all important, 4= Somewhat important, 7= Very important)
8. Compared to other subjects, how important is it to be good at biology? (1= Not at all important, 4= Somewhat important, 7= Very important)
9. How useful is what you learn in biology? (1= Not at all useful, 2=2,3=3,4=4,5=5,6=6, 7= Very useful)